

This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

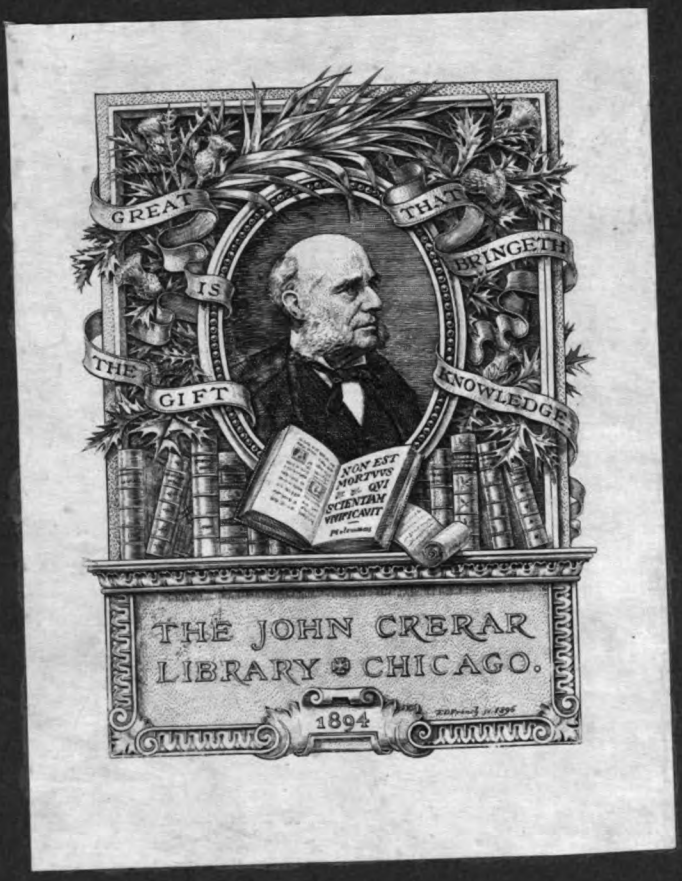
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`



Digitized by Google

Digitized by Google

Digitized by Google

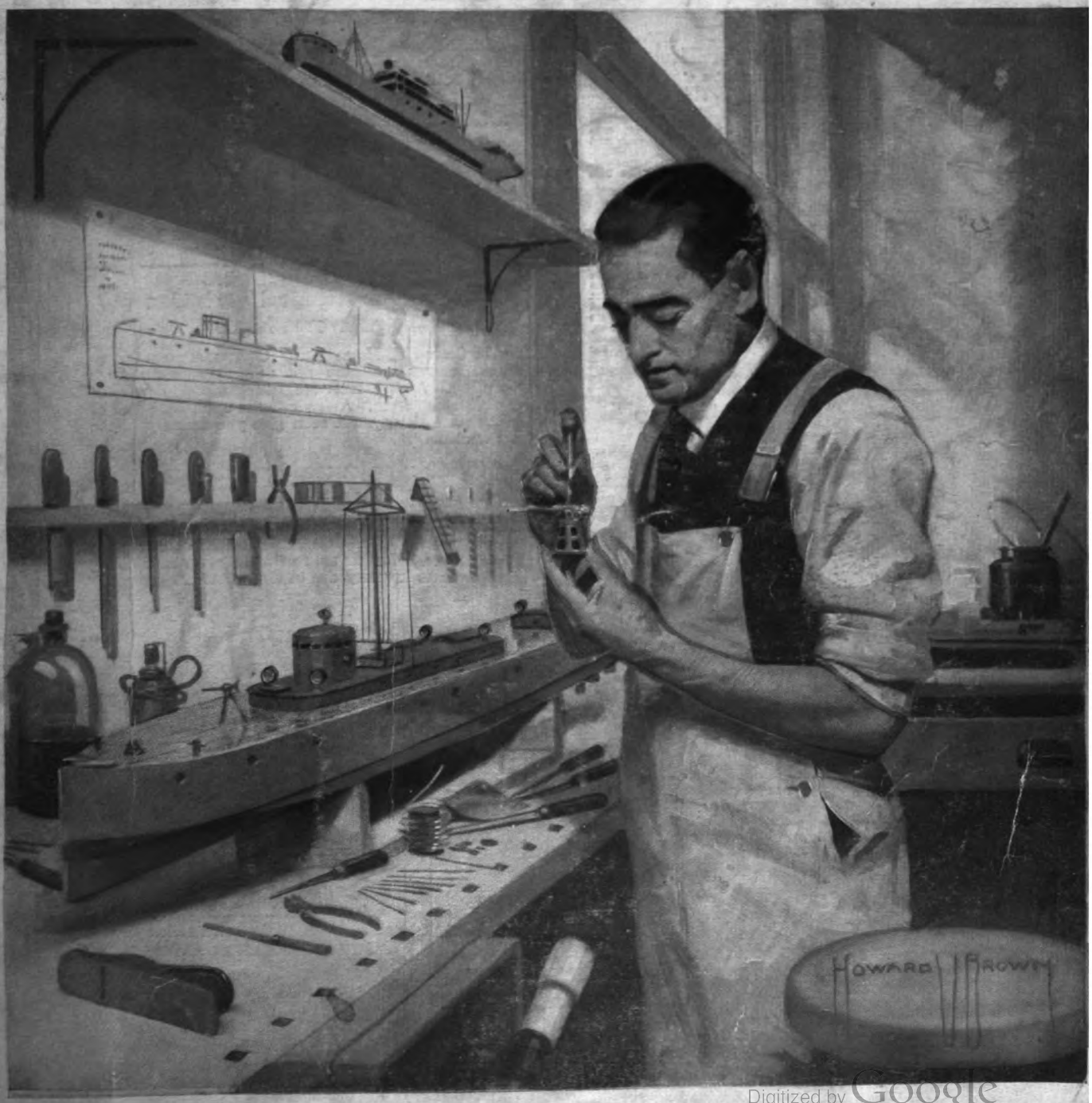
Digitized by Google

Digitized by Google

EVERYDAY ENGINEERING MAGAZINE

October, 1919
Vol. 8 No. 1

Fifteen Cents
a Copy



Digitized by Google

A $500 raise in salary



Power Plant Library

Power plant practice complete, including mathematics, boilers, engines electricity, turbines and refrigeration. Now the most used engineers' library in existence. Has enabled thousands of men to pass the most rigid examinations. 2,500 pages. 1,500 illustrations. Eight handsome volumes, bound in the tough T pattern of cloth, as durable as leather. **Price $12, payable $1.00 per month.**

Factory Management

A set of books written by leading authorities, to help men fit themselves to take complete charge of the shop or factory. Covers industrial organization, administration, purchasing, manufacturing costs and accounts, engineering of shops, factories and power plants. 6 volumes, 2,300 pages, fully illustrated. Bound in semi-flexible karatol. **Price $20, payable $2 in ten days and $3 per month.**

Croft Library of Practical Electricity

Without question of more practical value than anything of the kind ever attempted in the world of electricity. Enables you to know electricity as experts know it. Mathematics, practical electricity, electrical machinery, central stations, wiring for light and power, wiring of finished buildings, illumination. 8 flexible volumes, pocket size, 3,000 pages. **Price $16, payable $2 per month.**

Iron and Steel Library

The high positions in the great iron and steel world are now attainable through this library, which is written by authorities actually engaged in this work. Metallurgy, foundry work, blast furnaces construction, operation and products, refractories. A complete iron and steel library. Seven volumes, over 3,000 pages. Fully illustrated. **Price complete $24, payable $3 per month.**



Machine Shop Library

Machine shop practice complete. Written by eight practical men, well known in the machine shop world. Now the standard in America. No other set of books on the subject ever equalled it in popularity. Mathematics, drawing and design, composition and heat treatment of steel, gears, tool work, grinding, jigs and fixtures, screw machines, dies, etc. 9 volumes, 3,000 pages. **Price $16, payable $2 per month.**

Metal Mining Library

Herein is brought together in nine flexibly-bound volumes the very meat of metal mining practice in America. Examinations, principles of mining, timbering, thousands of working details, ore dressing, surveying, accounting, costs. All the information you need to reach the high positions in the mining world. The most intricate problems solved by plain words and illustrations. **Price $24, payable $3 per month.**

Coal Mining Library

Coal mining and colliery practice complete, including outside and inside work—both mechanics and engineering. Of assistance to every man in the business, from the lowest paid man to the operator. It is now looked upon as a necessity, and as containing the secrets of success in coal mining. 8 volumes. 3,000 pages. 1,700 illustrations. **Price $16, payable $2 per month.**

McGraw-Hill Book Co., Inc.,
New York, N. Y.

Gentlemen:—I wish to say that my salary has been raised $500 since I got one of the McGraw-Hill Home Study Courses, and I figure on getting $300 more very soon. I thank you very much.

Yours truly,
E. O. Hentz, Clinton, S. C.

What would a $500 or an $800 raise in salary mean to you? We have thousands of letters from men in every walk of life who have bettered themselves through the aid of a McGraw-Hill Home Study Course.

Right at this stage of your life an investment of only $12 to $24 might mean your turning point. You can spend ten times this sum without gaining a better or more accurate technical education than is afforded by a McGraw-Hill Home Study Course.

Your last chance to purchase

McGraw-Hill Home Study Courses

At the old prices

Prices of the McGraw-Hill Home Study Courses will have to be advanced very soon. Great increases in all costs of manufacture make this absolutely necessary. You have but a limited time to order at the old prices mentioned in the coupon below.

A complete technical education in your own home

The McGraw-Hill Home Study Courses are not correspondence courses, and are not sold at correspondence course prices. All the facts are laid bare before you, in easily understood form. A few minutes spent with one of these courses each day will soon give you mastery of the subject treated.

65,000 men succeeding through these courses

Over 65,000 men in the industrial world are using the McGraw-Hill Home Study Courses as a means of reaching the high positions. Letters are received in every mail telling of large advances in salary due to these Courses.

Ten days' free trial—merely return coupon

Fill out the coupon below and return to us before prices advance. We will ship prepaid the library you select for ten days' free inspection. If not satisfactory return at our expense. If wanted, send the small monthly payments called for.

Free Examination Coupon

McGraw-Hill Book Co., Inc., 239 W. 39th St., N. Y.
Gentlemen: Send for ten days' free inspection the Library I have checked below:

[ ] **Croft's Electricity,** $16—payable $2 per month.
[ ] **Machine Shop Library,** $16—payable $2 per month.
[ ] **Iron and Steel Library,** $24—payable $3 per month.
[ ] **Mining Library** $17—payable $3 per month.
[ ] **Coal Mining Library,** $16—payable $2 per month.
[ ] **Power Plant Library,** $12—payable $1 per month.
[ ] **Factory Management,** $20—payable $3 per month.

If satisfactory I will send first payment in ten days and the same amount each month until paid. If not wanted I will return the books at your expense.

Signature .....
Residence Address .....
City and State .....
Your employer .....
His address .....
Your occupation .....ED 10-19

Digitized by Google

CONTENTS

VOL. 8 OCTOBER, 1919 NO. 1

THE PATROL BOAT LUCIFER..... 7
By Martyn Baker

AIRPLANE MODELS AND WIND TUNNEL TESTS 10
By Victor W. Pagé, M. S. A. E.

OPTICAL AND MECHANICAL PYROMETERS..... 13
By Joseph Stanley

NOTES ON MODEL AIRPLANE CONSTRUCTION.. 15
By H. C. Ellis

A SAWING ATTACHMENT FOR A BENCH LATHE 17
By Joseph Dante, Jr.

FITTING GAS ENGINE PISTON RINGS..... 19
By Victor W. Pagé, M. S. A. E.

HOW TO MAKE FORMING DIES..... 22
By George F. Kuhne

THE AMERICAN SOCIETY OF EXPERIMENTAL ENGINEERS 23

MAKING GAS ENGINE PACKINGS..... 24
By Arthur Alfred Alexander

POWER TAKE-OFF FOR LIGHT AUTOMOBILE.... 25

BUILDING A TWO-PASSENGER SEAPLANE..... 27
By Charles E. Muller

HOW TO MAKE A SIMPLE STEAM TURBINE.... 29

A TALK WITH RADIO BEGINNERS..... 30

A THREE-FOOT FLYING MODEL NIEUPORT SPEED SCOUT 31
By Elmer Ross

METALLURGY FOR BEGINNERS..... 34
By E. Hurley

CONSTRUCTION OF APPARATUS ON STANDARDIZED PANELS 36
By M. B. Sleeper

THE RADIO DEPARTMENT..... 39

AUDION CRYSTAL RECENIUM FOR DESTROYERS.. 40

HIGH-FREQUENCY RESISTANCE..... 44

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

Editor RAYMOND F. YATES
Managing Editor VICTOR W. PAGÉ
Radio Editor M. B. SLEEPER

Contributing Editor
PROF. T. O'CONNOR SLOANE

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Offices
E. M. CLEMENT, 320 Wayne Avenue, East Oakland, Calif.
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Southern Representative
H. W. ENGLISH, P. O. Box 339, Birmingham, Ala.

Published Monthly by
EVERYDAY MECHANICS COMPANY, Inc.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $1.50 a year in the United States and possessions. Canada, $1.75; Foreign, $2.00 a year.

Copyright, 1919, by Everyday Mechanics Co., Inc.

Mind, Matter and Energy

WHAT is the relation between mind, matter and energy? No question of science is shrouded in more mystery than this.

WE recognize the brain as a bit of gray matter resting between our ears that is the seat of—what? Intelligence? Life? Energy? The actual brain we know has for its constituents the same elements that are in the remainder of the human body. The real question is: What is the connection between the brain cells and that "intelligence" that directs and controls that potential force that animates our bodies?

THE body is possessed of what our learned physiologists are pleased to call "muscular energy." In a normal state of mind, we are able to control this muscular energy intelligently. If we are injured on the head, many times we lose "intelligent" control of our bodily forces, proving more or less conclusively that the brain is extremely sensitive to physical disturbances.

THE distinction between mind and matter is just as vague as the relation of matter to energy in the human system. We can easily understand the body as a seat of potential force, but understanding the "intelligence" of this force is quite another problem.

WHEN life becomes extinct, what becomes of the energy that it possessed at the last heart beat? What becomes of that vitalizing force that gives warmth to our bodies; that causes us to breath, move and think? As men of science, we cannot believe that this energy is destroyed—the laws of the conservation of energy would make such a conclusion quite impossible. But the question still remains: What becomes of it? Probably the energy is still there, but has merely lost its "intelligence"—its mastering influence. Galvani's experiment with the frog leg would tend to prove that muscular energy is present in a dead organism, but merely lacks direction.

THERE will probably come a day when these problems will be more clear to us. Many explanations have been offered, but how scientific are they? The man of science is not satisfied with vague theories. Proof must come by direct conduct by investigators that are satisfied with nothing but the cold facts, bare of doubt and superstition.

RAYMOND FRANCIS YATES,
Editor.

434101

L62.51
F92

Digitized by Google



ELECTRICITY

Taught By A Practical Man

And In Your Own Home

Put Part of Your Spare Time To a Good Purpose

A HOME STUDY COURSE FOR AMBITIOUS MEN

MY course of instruction is vastly different from the general run of correspondence work, as it is actually an extension of a consulting engineering experience, which gives my students the opportunity of becoming familiar with electricity as applied to everyday work, and as applied to their particular needs.

My Real Purpose

My real purpse is to reach those who have not a lot of time and money to devote to an electrical education, and to give them what they need. By working in various branches of the electrical industry, I learned that there were many men who had an earnest desire to get into the electrical field, but could not do so because they did not have the time and money to go to a school teaching this work. I also learned that a large proportion of men engaged in electrical work, could not make the progress they desired, because they lacked the technical details which are necessary to the man who reaches the top. It is these men I want, and it is these men who need me. Hundreds of such men have come to realize that my instruction and advice has been of untold value to them, and that my institution is run on a sound basis and with a view of giving them what they want.

Not a Cut and Dried Book Plan

In addition to my practical and consulting experience, I have designed instruction courses for various educational institutions, which has given me an unusual opportunity to study the teaching business from a practical standpoint. I have carefully noted what men wanted and what they needed, in order to make good, and I have designed and written my instructions with a view of meeting these conditions. Letters from my students are sufficient proof that I have succeeded and the results they are getting through my instruction and help is very gratifying to me.

Beginners and Experienced Men

My course of study and service suit both beginners and experienced men, but I cannot do it all alone, nor do I wish to give this impression. My students must be earnest, and be willing to do their share of the work in order to make a success of it Where I find students who are not willing to do their work as I suggest, I return their money and ask them to discontinue, as I stated above, this course is for ambitious men, not triflers. Among my students are beginners, electricians, foremen, maintainers, repair men, armature winders, power-house helpers, power-house foremen, Navy electricians, Chief Navy electricians, chief electricians, Chief City Electricians and Contractors. These men are taking my course and find my instruction and my help of value to them. Not only are they satisfied, but they are sending me more students. In several places I have nearly all the men in the plant taking my work together.

What I Can Do

What I can do and will do is to help you whenever the opportunity offers. This statement is broad but I make good on it in every particular. A student never asks a question, or asks for help of any kind, but that every effort is made to see that he gets what he wants. I do not say that I shall fit you to qualify as an electrical engineer in a couple of months, as it cannot be done. Neither do I say that you will earn fifty or one hundred dollars a week when you complete this work with me, because they are things over which I have no control. As a matter of fact, there are men I have taught who are electrical engineers today, and others are earning very large salaries, but what you become, or how much you may eventually earn, is mainly UP TO YOU. I do my part, and if you do yours by following my instructions and advice, you will have the same opportunities as others to make good.

Results of My Efforts

These three facts stand out to show how my work is accepted.

Practical men recommend my course to others.

Over 65 per cent. of my students are engaged in the electrical business.

Over 11 per cent. of my enrollment was obtained through satisfied students.

Fifty-Fifty

My business is run on an absolutely 50-50 basis with my students. By that I mean I am just as much concerned with his welfare and progress as I am with the money he sends me, and that I meet him at least half-way on any proposition. I am paid the comparatively low price I ask, and I give the instruction and other help as detailed in my catalog. I offer nothing free, give nothing free, and do not expect anything unless I return its full value. No student is permitted to pay for his course in full on starting, the payments being made in monthly installments. Also, students have the privilege of discontinuing the course if they find it is not just what they are after, and their payments stop at the same time, as I do not expect and I do not wish money from men whom I am not helping.

Apparatus, Instruments, Material, Etc.

Certain electrical apparatus, instruments, material, charts, drafting implements, etc., as detailed in the catalog, are included in the course and are a part of the regular instruction for which there is no extra charge as it is covered by the regular monthly payments.

Fill Out Coupon or

Write me and I shall promptly send you one of my catalogs which contains full information regarding my course and the service I offer.

BURGESS ELECTRICAL SCHOOL
751 E. 42nd St., Chicago, Ill.

YORKE BURGESS,
BURGESS ELECTRICAL SCHOOL,
751 East 42nd Street, Chicago, Illinois.

Gentlemen:—

Send me catalog describing your course in Electricity.

NAME.....

ADDRESS.....

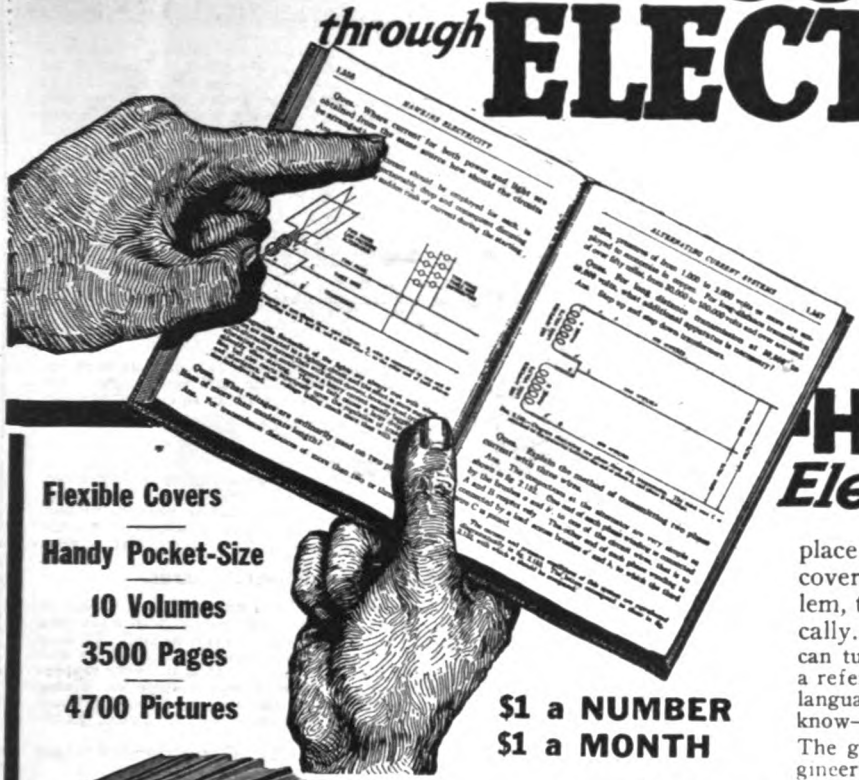
CITY.....

STATE.....

Digitized by Google

Get Bigger Pay through ELECTRICITY

by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.



HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 317 pages, 379 illustrations Alternating current, wiring power stations—turbines: management, selection, location erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro-therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides There are over 13,500 cross references. You find what you want to know **instantly.**

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....
Occupation .....
Employed by .....
Residence .....
Reference .....

E. E. Oct. '09

SEND NO MONEY - USE THE COUPON

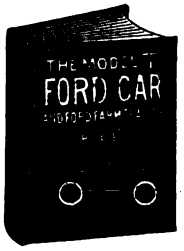
Digitized by Google

BEST PRACTICAL BOOKS

The Modern Gasoline Automobile, Its Design, Construction, Operation.

By Victor W. Pagé, M.S.A.E. This is the most complete, practical and up-to-date treatise on gasoline automobiles and their component parts ever published. In the new revised and enlarged 1919 edition, all phases of automobile construction, operation and maintenance are fully and completely described and in language anyone can understand. 1000 pages. 1000 illustrations.

Price, $2.50



The Model T Ford Car, Its Construction, Operation and Repair, Including the Ford Farm Tractor.

By Victor W. Pagé. This is the most complete and practical instruction book ever published on the Ford car. A high grade, cloth bound book, printed on the best paper, illustrated by specially made drawings and photographs. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and operating principle made clear to everyone. 310 pages, 106 illustrations. Price, $1.00

How to Run an Automobile.

By Victor W. Pagé. This treatise gives concise instructions for starting and running all makes of gasoline automobiles, how to care for them, and give distinctive features of control. Describes every step for shifting gears, controlling engines. 178 pages. 72 illustrations.

Price, $1.00

Automobile Welding with the Oxy-Acetylene Flame.

By M. Keith Dunham. Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone. 167 pages, fully illustrated.

Price, $1.25

Dies; Their Construction and Use for the Modern Working of Sheet Metals.

By J. V. Woodworth. A new book by a practical man, for those who wish to know the latest practice in the working of sheet metals. It shows how dies are designed, made and used, and those who are engaged in this line of work can secure many valuable suggestions. Sixth revised edition. 525 illustrations, 394 pages. Cloth.

Price, $3.50

Automobile Repairing Made Easy.



By Victor W. Pagé. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism. Written in a thorough but non-technical manner. This book also contains Special Instructions on Electric Starting, Lighting and Ignition Systems, Tire Repairing and Rebuilding. Autogenous Welding, Brazing and Soldering, Heat Treatment of Steel, Latest Timing Practice, Eight and Twelve-Cylinder Motors, etc., etc. You will never "Get Stuck" on a job if you own this book. 1,000 specially made engravings on 500 plates. 1,056 pages (5½ x 8). 11 folding plates. Price, $3.50

Machine Shop Arithmetic.

By Colvin-Cheney. Most popular book for shop men. Shows how all shop problems are worked out and "why." Includes change gears for cutting any threads; drills, taps, shrink and force fits; metric system of measurements and threads. Used by all classes of mechanics and for instruction in Y. M. C. A. and other schools. Seventh edition. 131 pages. Price, 60c.

Standard Practical Plumbing.

By R. M. Starbuck. This is a complete treatise and covers the subject of modern plumbing in all its branches. It treats exhaustively on the skilled work of the plumber and the theory underlying plumbing devices and operations, and commends itself at once to anyone working in any branch of the plumbing trade. A large amount of space is devoted to a very complete and practical treatment of the subjects of hot water supply, circulation and range boiler work. Another valuable feature is the special chapter on drawing for plumbers. The illustrations, of which there are three hundred and forty-seven, one hundred being full-page plates, were drawn expressly for this book and show the most modern and best American practice in plumbing construction. 6½ x 9¼. Cloth, 406 pages, 347 illustrations. Price, $3.50

American Stationary Engineering.

By W. E. Crane. A new book by a well-known author. Begins at the boiler room and takes in the whole power plant. Contains the result of years of practical experience in all sorts of engine rooms and gives exact information that cannot be found elsewhere. It's plain enough for practical men and yet of value to those high in the profession. Has a complete examination for a license. Third edition revised and enlarged. 345 pages. 131 illustrations. Cloth.

Price, $2.50

Brazing and Soldering.

By James F. Hobart. The only book that shows you just how to handle any job of brazing or soldering that comes along; it tells you what mixture to use, how to make a furnace if you need one. Full of valuable kinks. The fifth edition of this book has just been published, and to it much new matter and a large number of tested formulas for all kinds of solders and fluxes have been added.

Price, 35c

Drafting of Cams.

By Louis Rouillion. The laying out of cams is a serious problem unless you know how to go at it right. This puts you on the right road for practically any kind of cam you are likely to run up against. Third edition. 35 cents

House Wiring.

By Thomas W. Poppe. Describing and illustrating up-to-date methods of installing electric light wiring. Intended for the electrician, helper and apprentice. Contains just the information needed for successful wiring of a building. 125 pages, fully illustrated, flexible cloth. Price, 60c.

Electric Wiring, Diagrams and Switchboards.

By Newton Harrison, with additions by Thomas Poppe. This is the only complete work issued showing and telling you what you should know about direct and alternating current wiring. It is a ready reference. The work is free from advanced technicalities and mathematics, arithmetic being used throughout. It is in every respect a handy, well-written, instructive, comprehensive volume on wiring for the wire-man, foreman, contractor or electrician. Second revised edition. 303 pages, 130 illustrations. Cloth. Price, $2.00

High Frequency Apparatus, Its Construction and Practical Application.

By Thomas Stanley Curtis. The most comprehensive and thorough work on this interesting subject ever produced. The book is essentially practical in its treatment and it constitutes an accurate record of the researches of its author over a period of several years, during which time dozens of coils were built and experimented with. 248 pages. Fully illustrated. Price, $2.50

The Lathe—Its Design, Construction and Operation, With Practical Examples of Lathe Work.

By Oscar E. Perrigo. A new revised edition, and the only complete American work on the subject, written by a man who knows not only how work ought to be done, but who also knows how to do it, and how to convey this knowledge to others. It is strictly up-to-date in its descriptions and illustrations. A number of difficult machining operations are described at length and illustrated. The new edition has nearly 500 pages and 350 illustrations. Price, $3.00

Henley's Twentieth Century Book of Recipes, Formulas and Processes.

Edited by Gardner D. Hiscox. The most valuable techno-chemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work. New edition. Cloth binding, $3.00. Half Morocco binding, Price, $4.00

Starting, Lighting, and Ignition Systems.



By Victor W. Pagé. A practical treatise on modern starting and ignition system practice. This practical volume has been written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. It can be understood by anyone even without electrical knowledge. Nearly 500 pages. 297 specially made engravings. New edition.

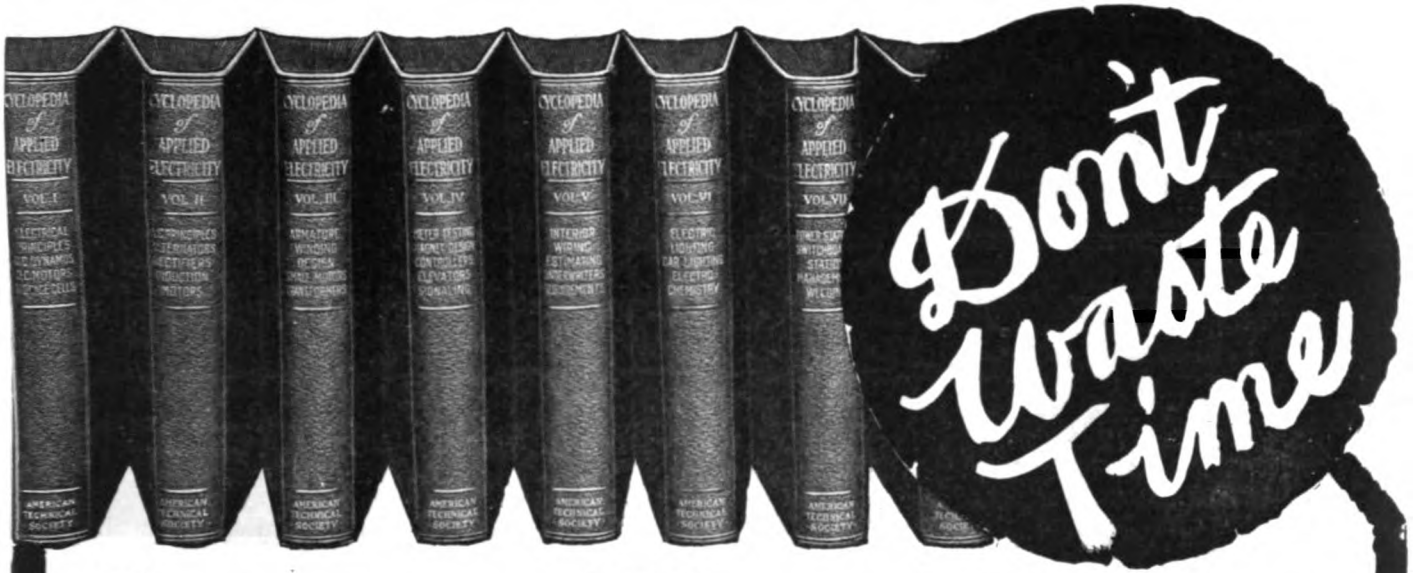
Price, $2.00

☞ Any of these books sent prepaid on receipt of price. FREE—Our new Catalog of Practical Books sent free on request.

THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. 2 West 45th Street, New York

Digitized by Google



Don't Waste Time

Learn Electricity —the New Way

IT'S no longer necessary to go to school or serve an apprenticeship to learn electricity. With this new library of APPLIED PRACTICAL ELECTRICITY you learn right at home—in your spare time without interfering with your present work.

Any big job that you want in the electrical field is yours if you will train yourself to fill it. It only takes an hour or two a day with these books.

This is the 1920 edition—new from cover to cover—chuck full of the latest methods and most recent discoveries in this fascinating field. Everything is written in plain, good old U. S. language by 27 of the greatest experts in the business. The eight volumes with 3800 pages make up a complete course in electrical engineering. It's a home study course for the beginner and a handy reference guide for the expert combined.

Big Pay for Trained Men Jobs paying $1500.00 to $5000.00 a year are waiting for men who can qualify as Electrical Engineers—Substation Operators—Troublemen—Switchboard Operators—Dynamo Tenders—Electricians. Electricity is the greatest force in the world and it is growing bigger and bigger every day. More and more men are needed all the time. Why don't you get into this big paying field now?

Good Jobs Are Waiting If you are trained in some branch of electricity you will never have to look for a job. The job and the big pay will be looking for you. You can't dodge a good job if you have the "know how" under your hat. Let these 27 great engineers help you to the best kind of job with their books.

Send the coupon below and get them for FREE examination. See our free offer below.

What the Books Teach Elements of Electricity—Electrical Measurements—Electric Wiring—Underwriter's Electrical Requirements—Theory, Calculation, Design and Construction of Direct Current Generators and Motors—Types of Generators and Motors—Management of Electrical Machinery—Electric Lighting—Alternating Current Machinery—Power Transmission—Electric Railways—Self-Propelled Railway Cars—Trackless Trolley—Power Stations—Switchboards and Switching—Storage Batteries—Applied Electro-chemistry—Electric Elevators—Electric Welding and Heating—Wireless Telegraphy and Telephony—Land and Submarine Telegraphy.

The World's Greatest Electrical Books LOANED to YOU FREE

We will lend you this wonderful library to use in your own home or shop a whole week FREE. It won't cost you one cent. DON'T SEND ANY MONEY. Just fill out and mail the coupon today and the set of eight volumes will come to you by express collect. You be the judge and find out for yourself what the books will do for you. Use them as you please. Show them to your friends and get their opinion. Then if you have any doubt as to their value send them back at our expense and you won't owe us anything.

Free Service With every set of these great electrical books we give a one year membership in this society. This entitles you to consult our engineers and experts on any electrical problem. Write as often as you like. Ask as many question as you like for one year.

Only 7 Cents a Day

If you like the books after a week's examination you pay us only $2.00 and the same amount each month until $24.80 is paid. This is only 50 cents a week—7 cents a day. You can't afford to pass up a better job on these easy terms. MAIL THE COUPON NOW.

American Technical Society
Dept. E-357, CHICAGO

Coupon is All You Need— Send it Now

American Technical Society
Dept. E-357
Chicago, U. S. A.

Please send me the 8-volume set of Electrical Engineering for 7 days' examination, shipping charges collect. If I decide to buy I will send $2.00 within 7 days and balance at the rate of $2.00 a month until $24.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will return them, after 7 days, at your expense.

Name .....

Address .....

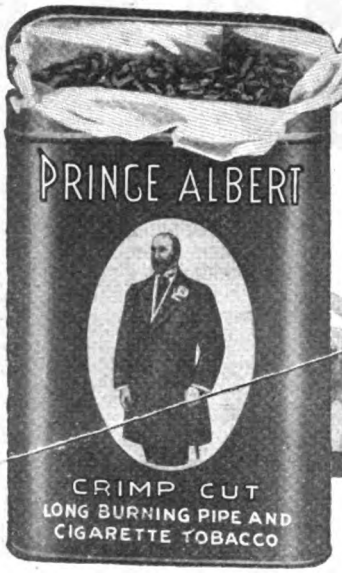
Reference .....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PRINCE ALBERT

the national joy smoke



Copyright 1919 by
R. J. Reynolds Tobacco Co.

TOPPY red bags, tidy red tins, handsome pound and half-pound tin humidors—and—that classy, practical pound crystal glass humidor with sponge moistener top that keeps the tobacco in such perfect condition.

R. J. Reynolds Tobacco Co.
Winston-Salem, N. C.

NO use arguing about it, or making chin music in a minor key! If you've got the jimmy-pipe-notion or cigarette rolling 'em idea cornered in your smokeappetite, slip in a few liberal loads of Prince Albert! *And,* you'll sign the longest lease you can hook up to on about the cheerfulest brand of in-and-out-door sport that ever did ramble up Broadway or down Lost Creek trail!

Boiled down to regular old between-us-man-talk, *Prince Albert kicks the "pip" right out of a pipe!* Puts pipe pleasure into the 24-hours-a-day joy'us class! Gives smokers more fun to the square inch than they, *or you,* ever dug out of a pipe before! Prince Albert makes a pipe or cigarette a peace party at both ends and the middle! Just hums and hums the soothingest symphony of smoke content that ever sifted its happy way into a man's system! P. A. is so fragrant, so fascinating in flavor, so refreshing!

And, you run plumb-fair against the astounding fact that Prince Albert can't bite your tongue or parch your throat! Because, our exclusive patented process cuts out bite and parch! Why, you can't get orders in fast enough to try to buy up the supply for a long, long spell!

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

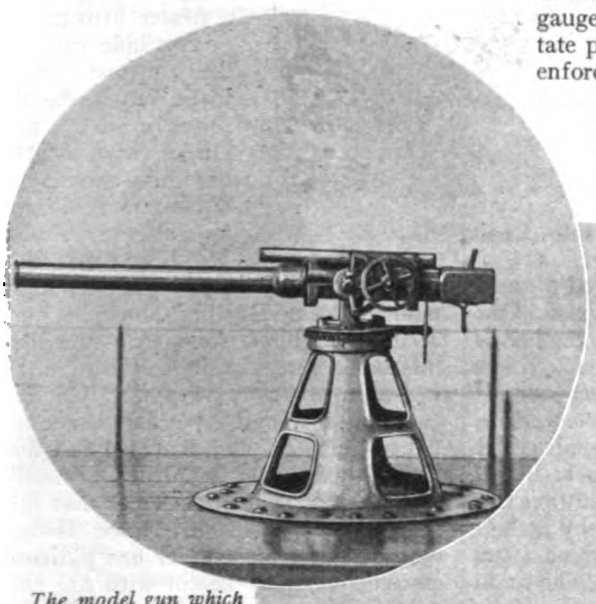
IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 8 OCTOBER, 1919 NUMBER 1

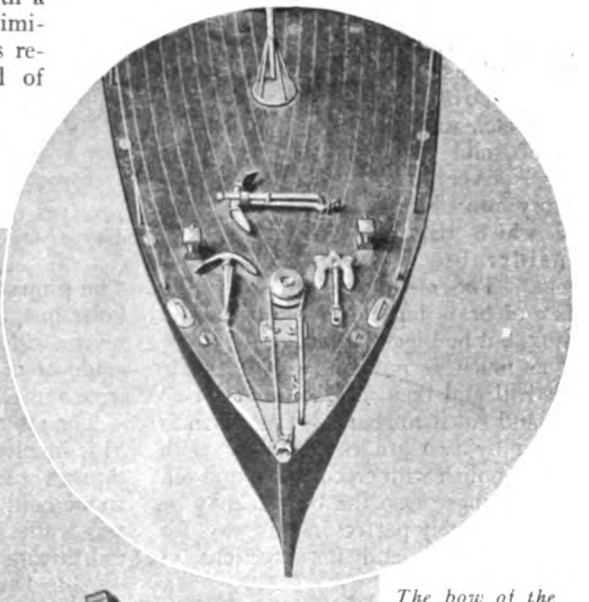
The Patrol Boat "Lucifer"

By Martyn Baker

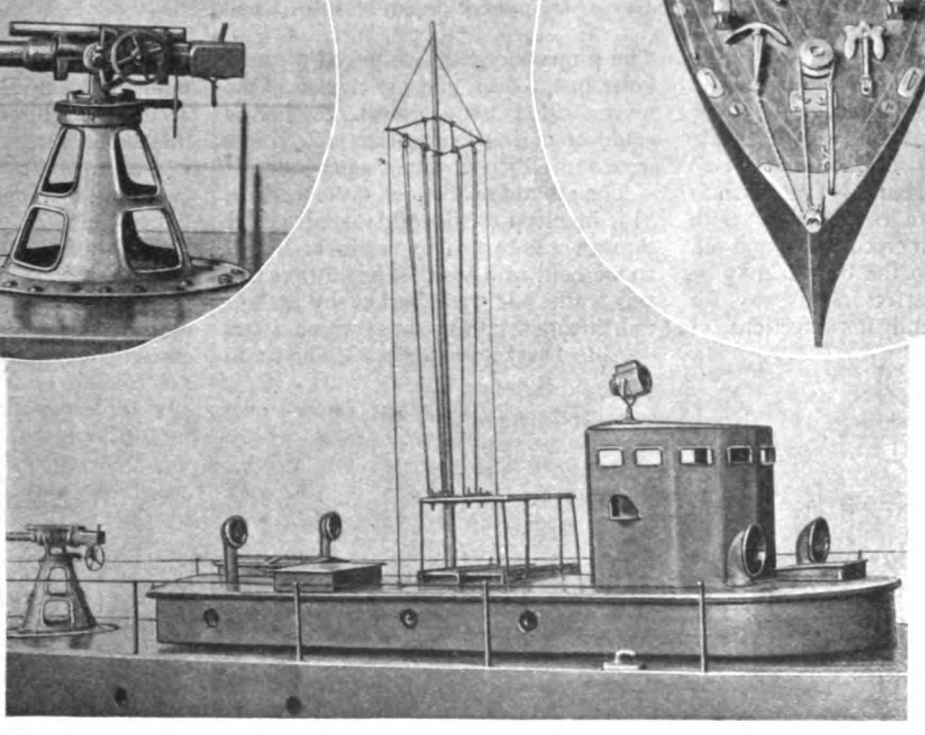
THE boat, *Lucifer*, is a scale model of the sixty-foot craft built in the early part of the war by the Greenport Basin and Construction Company for the Russian Government. Some of these boats were refused by Russia for financial reasons and were sold in this country.



The model gun which is mounted between the cabins



The bow of the boat showing fittings



A close view of the cabin showing the details of the deck fittings

The dimensions of the model are roughly as follows: Length, 36 inches; beam, 6 inches; draft of hull, 1½ inches. Other dimensions may be taken from the drawings. With the exception of the heavy work of digging out the hull, *Lucifer* was built entirely in a study with the necessary tools kept in a desk drawer.

The hull was gouged out of a solid piece of sugar pine in the conventional way, using templates to insure the two sides being the same. By cutting out the stern and putting in a transom piece afterward, much labor is saved in hollowing out the hull. It was made so thin that a seventy-five watt nitrogen bulb just showed light through the sides. The deck is an eight-inch piece of mahogany lined with a gauge and pencil to imitate planking. It was reenforced at each end of the openings for the deck houses by pieces of soft wood glued and screwed on athwart ship. A short section in the stern is easily removable to give access to the steering gear. The two deck houses are made of mahogany. The rounding front to the forward house was jig-sawed out of a two-ply piece and finished with file and sandpaper.

To the average model maker, the hull and upperworks so far explained present no unusual difficulties, but the question of presentable fittings is indeed a perplexing one to those who have not access to the little castings and stampings from which professional model fittings are made.

It is here that the experince gained in making *Lucifer* may be of help to many, for, with one exception, all the fittings were made from stock easily obtainable at the corner hardware store.

The instruments used were the ordinary assortment of light metal working tools, and included in particular a set of the little assorted shapes of files knows as "Swiss" files, a good alcohol blow torch, and several small sharp punches and cold chisels. The stock comprised sheet brass in three thicknesses, a little heavier plate brass, a half dozen sizes of brass wire with drills

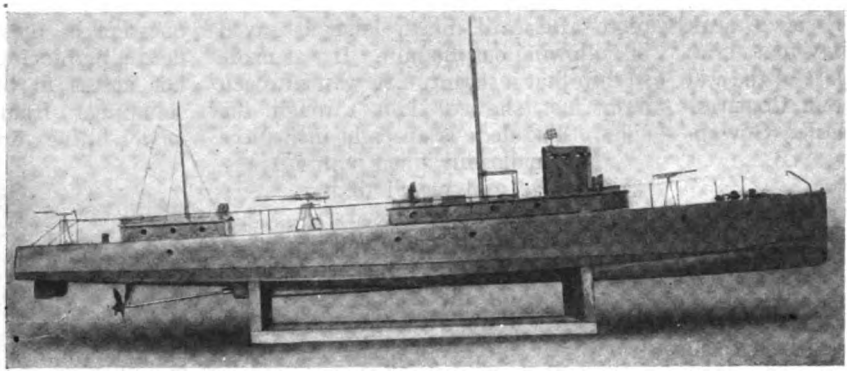
Digitized by Google

to fit each size, and brass rod and tubing bought as needed. In addition to this, was some assorted pieces of sawed brass in several thicknesses and widths. This was used only in making the little fittings that were cut from the solid.

For soldering, the combined solder and flux in paste form known as "Nokorode" was found very convenient; in fact, some of the more delicate jobs would have been impossible without it. For holding work together, fine black iron wire was used as solder does not stick to it readily. In complicated places, wet rags kept one part of the work from unsoldering while the rest was being done. A surprisingly small quantity of solder is needed—the less used the better, for it only makes a messy job. These few hints contain the meat of a long and varied experience in building up fittings with solder.

Many smaller parts, such as cleats, chocks, hoisting hooks, etc., were cut out of solid metal. This is a very satisfactory process, but one which requires considerable patience. The method is to saw off a block of brass big enough to make the fitting, but no bigger, to rough the thing out as much as possible with hacksaw and drill and then to take the "Swiss" files and cut it to shape. The finish is put on by two grades of emery cloth and the polish with crocus cloth and oil. Little fittings, even the tiniest, may be made absolutely perfect in this way, for the blow holes and imperfections of castings are absent.

Starting from the bow of *Lucifer* and working aft, the fittings were made as follows: The bow plate and chain lead were made of sheet brass cut and bent to shape and soldered. The anchor davit was heavy wire with the end flattened to allow the tackle hook to pass through. The cleat was made of wire soldered into holes in the davit. In passing, I may say the spring wire is the kind to use, for its strength is sometimes needed and it may be easily annealed by heating it red hot and plunging it into cold water. The little eyebolt in the deck under the davit as well as the others holding the rigging were made of a loop of wire soldered into two holes in a tiny square of brass.

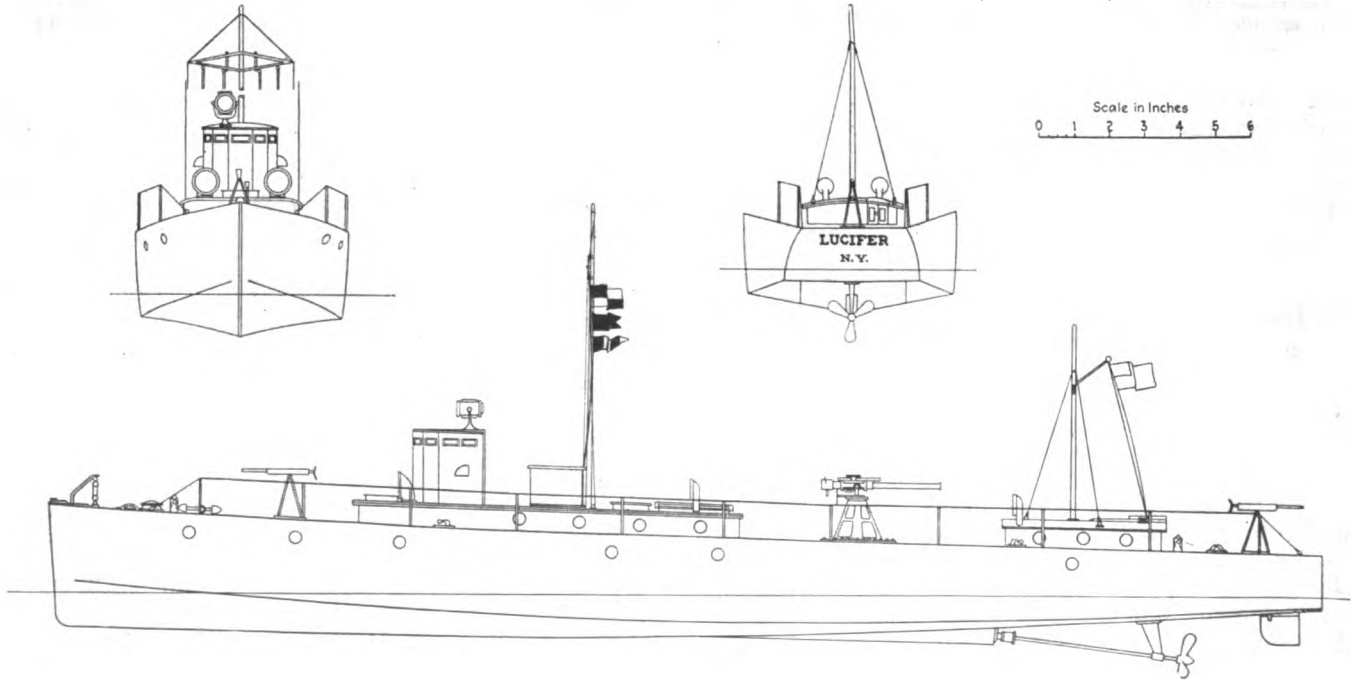


A view of the finished boat resting in its cradle

The projecting ends are poked through holes in the deck and clinched. If the reverse side is not accessible, the bolt is made of a ring in the end of a single wire and is driven into a snug hole.

The ground tackle took quite a while, as it involved considerable detail. The capstan was turned by means of a drill frame held in a vise. The cutting tool was a file. It was chucked by a short rod threaded into the base which afterward fastened it to the deck. The chain plate was cut from sheet with little semi-circles of wire soldered around the forward side of the openings and filed smooth. The anchors themselves were made from castings and were the one fitting mentioned above not made from ordinary stock. However, the writer has since made several anchors from solid metal which were the equal in every way of those on *Lucifer*. The cross cars were made of wire with little wire rings soldered on and filed to shape for the balls. The shackles were made of fine wire. The chain cable was originally a piece of eyeglass chain which is obtainable in several sizes. The dead-men or snubbing posts were made of mahogany with brass pins, but could be easily made of square rod and polished. The shore line leads were made of sheet and wire, but cutting from solid would produce a neater fitting.

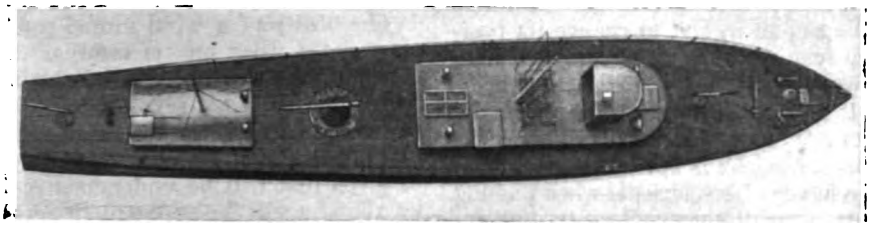
Port hole rims are best turned on a lathe, but in the absence of such a machine, short sections of brass tubing cut square and allowed to project very slightly from the side make excellent rims. The inside is painted black. Railing stanchions were a stumbling block for a long time, but the problem was finally solved by making them of heavy wire with just the end annealed and squeezed somewhat flat in the vise. The flattened end was then drilled with a fine drill and neatly rounded off. The slight taper that full size stanchions usually have is not missed, but if the builder has patience enough, they may be cut with file and



Digitized by Google

emery before the flattening process. The rail is unannealed wire stretched as tight as it could be pulled with pliers. Soft wire was first used, but it stretched so after being put on as to hang in loops between the stanchions.

The two machine guns fore and aft were made of wire and sheet soldered. The after one also controls the twin rudders by a simple system of arms and connecting rods. This does away with any fitting for steering that was not on the prototype. The hatches to the crew's quarters and to the engine room were made of sheet brass, the four sides in one piece and the top another. They are held on by pinning through the sides to a block of soft wood screwed to the deck.



This view shows the deck plans of the Lucifer

The conning tower was made of fairly heavy sheet cut and bent to shape. Before bending, the ports were cut by drilling around them and then using a cold chisel and finishing with a file. The roof is soldered to the under side of the angle formed by bending over the top of the sides. A beading of wire was soldered to the after edge of the sides, and a rim of fine wire soldered around each port. This was a lengthy process, but well worth the trouble, for it gave a finished appearance that was otherwise lacking. The tower was pushed up through an opening in the deck house cut the exact shape and held by a flange on the under side. The searchlight was made from a 32 caliber pistol shell with the ventilation boxes, etc., soldered on. The base was made, after much deliberation, from an old collar button which had the proper shape.

The signal bridge was made almost entirely of wire soldered together. The three strips of sheet through which the grating bars run must be identical, and to secure this they were cut longer than necessary and the ends temporarily soldered together so that it was only necessary to file and drill one piece of metal instead of three. When they were ready for the bars, the surplus ends were cut off and the three pieces were absolutely alike. In soldering the bars, as little solder as possible was put on the under side, and the heat applied to a different bar and strip each time so as to avoid melting out the rest. The railing is obviously of wire.

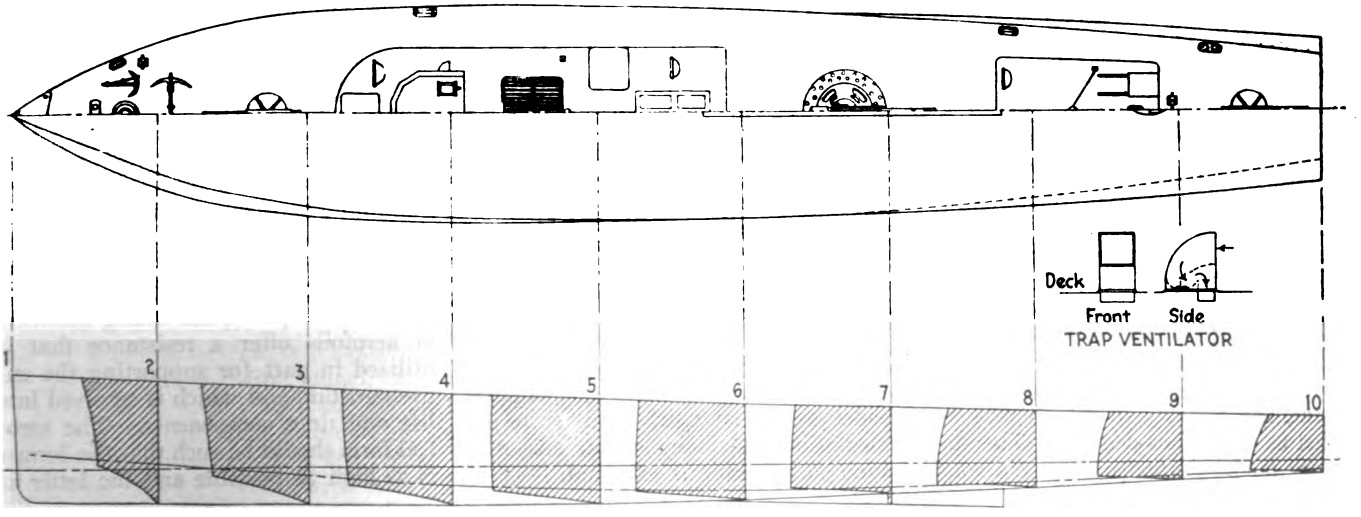
The mast is hard wood carefully tapered and smoothed. The tendency of most amateurs is to get all spars too thick, and the boat's appearance is thus greatly marred. The diamond yard arm was easily made of wire and fastened on by bindings of very fine wire.

The skylight over the engine room was made similar to the hatches, with the openings cut in by the cold chisel and file process. Celluloid makes excellent glass. The companionway slide on the after house was also made much the same way. It was first laid out flat on paper, then the brass was cut and bent to shape and ends soldered in.

The three-pounder mounted amidships took time and patience, but the result was altogether satisfactory. The conical mount was made of sheet with the openings cut out and a fine wire rim soldered around each. Here again the time expended in this fussy job is amply repaid. It was topped by the little drum which contains the spring in a well known cheap watch. This drum has teeth in its periphery, and forms part of the pointing mechanism. The barrel was made of two sizes of tubing with a wire soldered around the muzzle to give the bell shape. The square breech was made of sheet and soldered on. The barrel is held in a carriage made of a large piece of tubing cut away except for a ring at each end, a lengthwise strip down each side and a half ring underneath where the trunnions come. The recoil cylinders were pieces of rod soldered to the top of this carriage. The carriage swung in a fork made of heavy sheet soldered to a disc which in turn is free to revolve on top of the conical mount. A pair of arms soldered on form the bearings of the worm gear which was made by soldering a few turns of fine wire properly spaced on a heavier wire and filing it to shape. The hand wheel was a gear from the same watch as the top of the cone, the teeth being removed. The elevating mechanism consists of a sector of another gear soldered to one arm of the fork and a gear with pinion combined engaging this, and turning in the carriage. The pointing and training action is rather delicate and will not stand rough handling.

The strut for the propeller shaft was cut out of solid metal, but could be easily built up from a short piece of tube and some heavy sheet. The stuffing box was made on a lathe at a later time, but a good one can be made from a piece of tubing larger than the shaft with a plug in each end drilled to fit the shaft. This is filled with grease. The propeller is best made as described in a recent issue of EVERYDAY ENGINEERING, by the built-up process.

I have left the description of the ventilators till the last, for they are perhaps the most perplexing problem of all parts. The smaller ones were cast of a zinc-tin alloy in a plaster of paris mold, and the two larger ones in front beaten from very soft thin copper over an iron form, but both these methods have their disadvantages for the amateur.



Digitized by Google

Airplane Models and Wind Tunnel Tests

By Victor W. Pagé, M. S. A. E.

THERE seems to be an impression on the part of many uninformed people that model making is not serious work and that it is chiefly a hobby or pastime indulged in by men seeking mechanical recreation. In many lines of mechanical endeavor model making has an unquestioned practical value and is the means of carrying on experiments with new inventions at much less cost and with greater ease than would be possible if the experimental work was done with full-sized mechanism. Model making is serious work that calls for a high degree of mechanical skill when it is used as an adjunct to either scientific or mechanical development.

Scale Models Valuable

This is especially true of the small airplanes that are used in wind tunnel tests. It has been known for some time that experiments on scale models of both ships and aircraft afforded a means of obtaining valuable information on which the action of full size vessels and airplanes could be based. The problems studied with models relate chiefly to the performance of a movable body in a fluid, as in naval architecture where a small hull is towed at various speeds in a special tank of water, known as a "towing basin" or in the field of aeronautical engineering where a fixed model is tested in a moving air stream, the velocity of which may be varied as conditions demand. The stationary model method used in the wind tunnel offers the important advantage that it is easier to measure the forces acting upon it, and to change its position relative to the air stream flow lines at will.

It is not always easy to apply results obtained with models to full size machines, as there is apt to be an error in the change of co-efficients when passing from a small to a full scale, but experience is of value in this connection as in many others, and in the majority of cases the corrections necessary in applying with tunnel data are known with considerable accuracy.

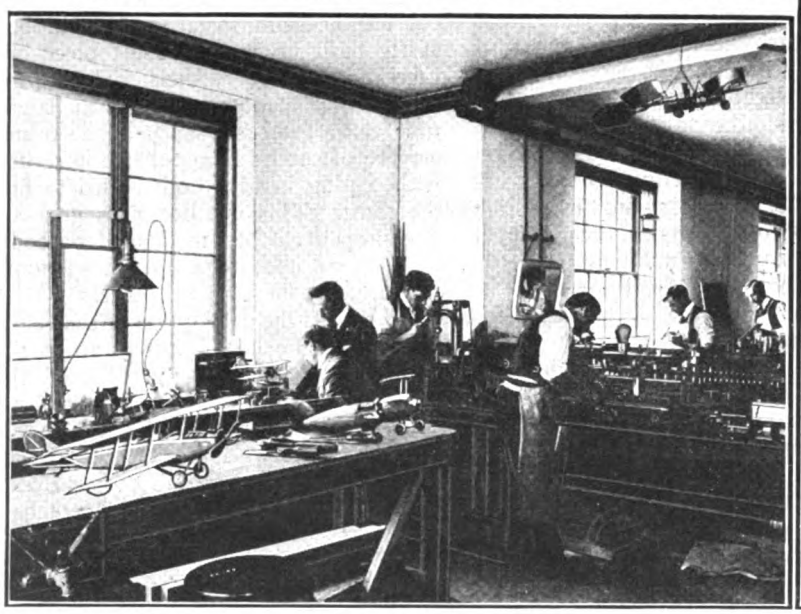
Models Must Be Accurate

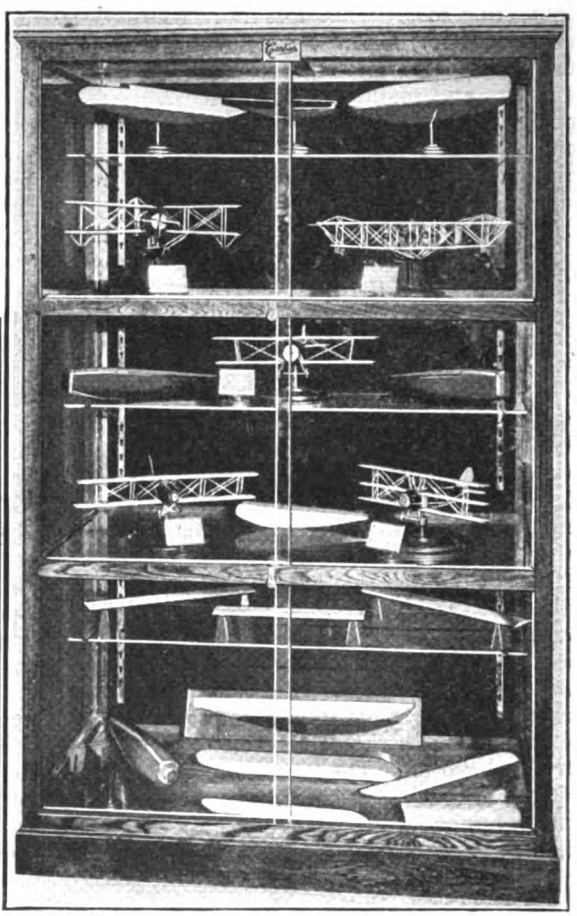
The models used must be made with great precision and of materials that are not apt to change their shape appreciably. For this reason, models of aerofoils are usually made of brass and machined with micrometrical exactness, most experiments being made with 18″ by 3″ wings. Seaplane hulls, fuselage shapes and other members of that class are made of wood, highly polished and as exactly as skilled workmen can produce them. A complete airplane for tests calls for extremely accurate location and assembly of the various parts, as well as precise reproduction of the members comprising the assembly. An error on a 1/12th scale model would be much greater in the calculations involving a full size machine so accuracy is essential.

Utility of Wind Tunnel

The utility of a wind tunnel can be appreciated when one is familiar with the mass of data that can be obtained by its use. It is not possible to go into this subject to any extent in an article of limited scope, but an example can be given that will be understood easily by all. As will be apparent in accompanying line drawing, an airplane may be divided into two main assemblies, one comprising the lifting surfaces; the other, the parts needed to carry the motor and passengers and to which the wings are attached. Obviously, each of these assemblies offers a definite resistance to forward movement of the plane through the air.

The non-lifting parts offer a parasitic resistance that should be reduced to the lowest point, the lifting members or aerofoils offer a resistance that is utilized in part for supporting the entire structure and which is resolved into lift and drag components. The aerofoil form should be such that the former is as high as possible and the latter as





View of the model making department of a prominent aircraft manufacturer shows the importance attached to production of accurate scale models of airplanes and their components for wind tunnel tests. Some of the Curtiss airplane and seaplane models produced and various parts used in trials are shown in cabinet at the right

Digitized by Google

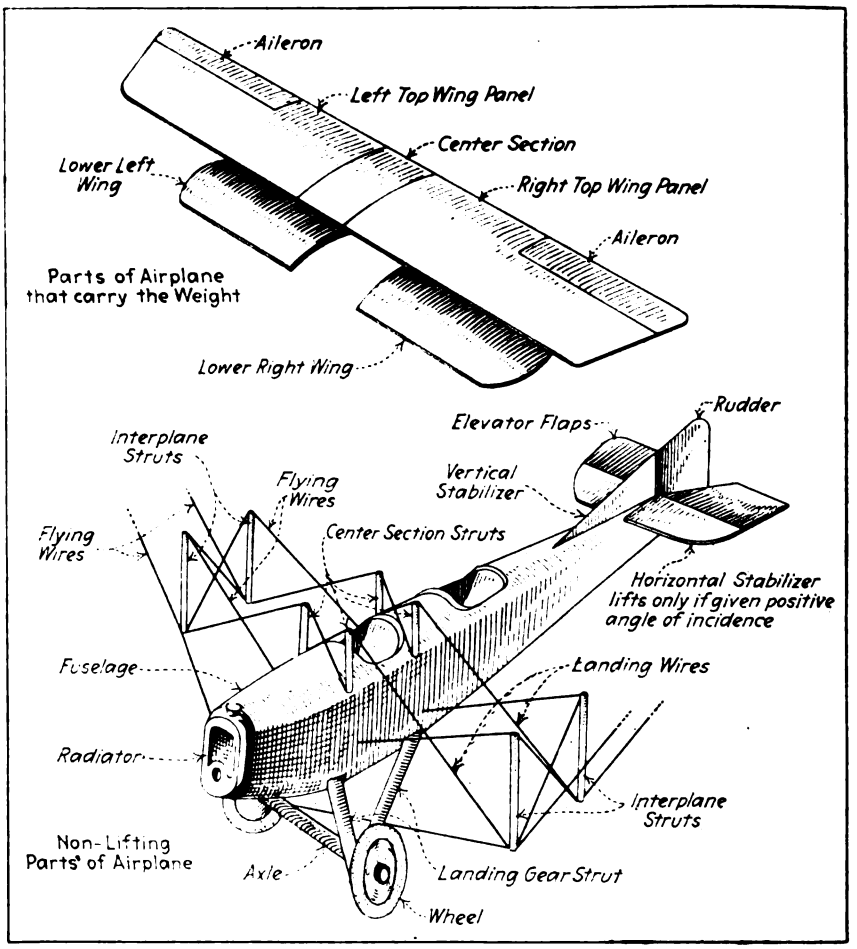
low as can be obtained. The resistance of an airplane varies with the design. The proportionate parasitic resistance is about as follows: Fuselage and wings 62 per cent., landing gear 16 per cent., tail plane, fin, rudder and elevator 7 per cent., and wires struts and fittings of the wing structure 15 per cent. The reduction of any of these items will increase the efficiency of the airplane, i. e., it will fly faster with less power without decreasing the weight carried.



Expert model maker at work on miniature reproduction of nine cylinder rotary airplane motor mounted at front end of nacelle for twin-motored biplane

By the aid of the wind tunnel weighing mechanism these percentages can be determined in pounds or fractions thereof, this enabling the designer to figure the horsepower required to attain a certain speed and numerous other points in design. The complete airplane may be tested and its resistance measured or any of the parts may be tried out distinct from the assembly and the influence of change of form, location or size determined. Loening states that 10 pounds of air resistance saved by the better shaping of a part or placing it so it will present its best angle to the air will result in a saving in power that will permit of carrying 70 or 80 pounds more weight on the machine. Air resistances are measured by supporting the body in the air stream and weighing its reaction to the moving air, the velocity of the air being changed to simulate high and low speed flight conditions.

As an example of the development work possible with the wind tunnel, the first trials of a model seaplane hull showed that it would offer considerable resistance without contributing any useful lift in the air. Its shape was changed several times and finally a form was evolved that not only had less resistance but that contributed a certain direct lift to help carry its weight while it was in flight. The form that had the least air resistance was also found to be the most efficient when planing on the water in starting a flight and more effective in landing.



The modern airplane consists of two main assemblies as depicted below and resistance of each must be known in computing characteristics of the design and power needed for flight

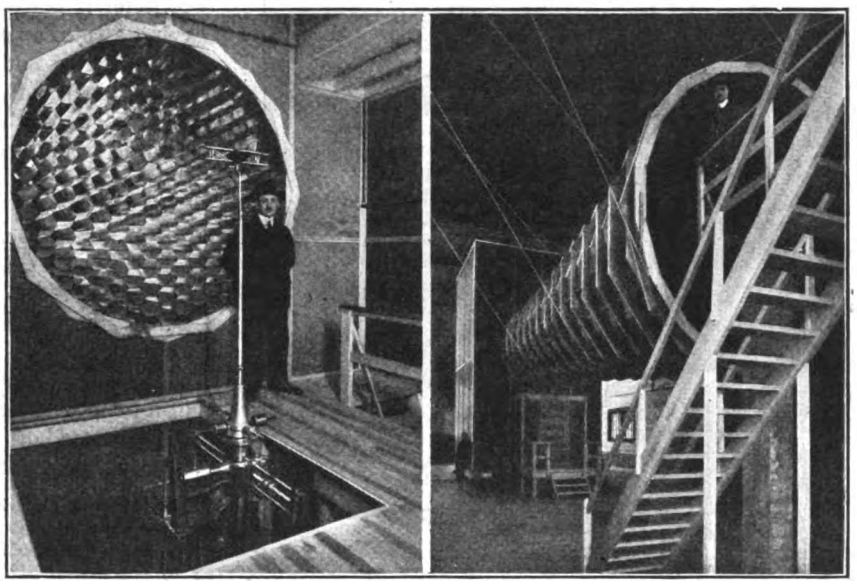
Typical Wind Tunnel

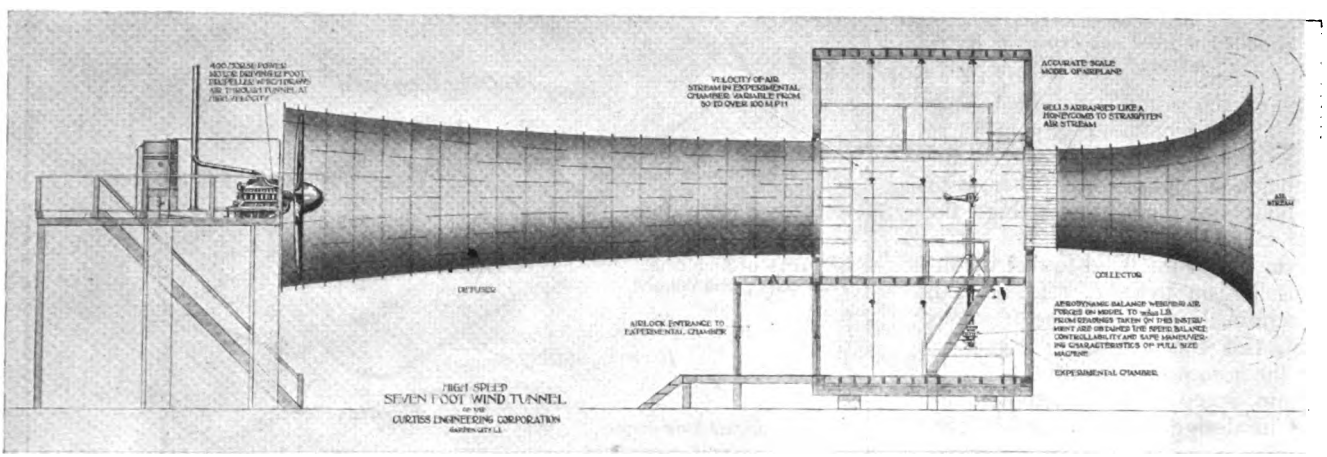
The sectional view of the wind tunnel installed in the laboratory of the Curtiss Engineering Corporation at Garden City, L. I., outlines a typical apparatus of this nature. It consists of three main parts, the central one of two rooms incorporating the two experimental chambers. The model is placed in the upper one through which the air stream passes, the measurements are recorded in the lower one which is below the air current. A large horn-shaped collector is placed at one side, this carrying a cellular or honeycomb partition to straighten out the air stream before it passes around the model. The diffuser is a long discharge conduit extending from the experimental chamber. The air flow is induced by an aerial propeller 12 feet in diameter, driven by a 400 horsepower Curtiss airplane engine. The speed of the air stream may be varied from 50 to over 100 miles per hour. The aerodynamic balance is so sensitive that it will measure forces acting on the model to 1/10,000 part of a pound. The collector and diffuser conduits are built of wood with external framing, the experimental chamber follows the usual light wood building construction. The size of the tunnel can be readily estimated from the illustrations.

Digitized by Google

Mounting Models for Test

There is no more difficult part of an investigation into the forces acting on a model than the increase of resistance due to the supports. The difficulty depends on the kind of model tested. If the resistance of a sphere, or a square plate in normal presentation, was being investigated, it is unlikely that any appreciable error would be introduced by the assumption that the correction to be applied is a given measurement of the resistance of the supports in the absence of the model. In the measurement of the resistance of a "streamline" body, however, an entirely different state of affairs exists. The resistance of an airship model 6 ft. long and 0.5 ft. in diameter is in some cases only about 1/100th of that of a square plate whose area is equal to that of the maximum cross-section of the airship model. Even though such a model is supported on a spindle about 0.3 in. in diameter, an error amounting in some cases to as much as 20 per cent. of the model resistance would be introduced if this method of measuring spindle resistance were adopted. In the test of some models, several alternative methods of test are available. Thus in experiments with aerofoils the method which is sometimes adopted is to mount the model with its span vertical on a spindle screwed into its end.





The wind tunnel of the Curtiss Engineering Corporation is a good example of this important apparatus for studying aerodynamics in the laboratory. The views at the top show how the model is supported by the weighing mechanism in front of the honeycomb arrangement used to straighten out the air stream. The other view gives a good idea of the size of the discharge opening of the diffuser

Weighing Mechanism

The weighing mechanism is very substantial in construction and on first thought would appear too heavy to permit accurate measurements, but it is extremely sensitive. The balance consists of two main parts, the lower of which carries the weighing arms and moment apparatus, and the upper which projects upward through the floor of the experimental chamber and carries the model under test. The upper part of the balance can be turned upon the lower one, and the model thus rotated through any desired angle about the vertical axis from outside the channel, and without stopping the wind.

The balance is supported on a single point resting in a hollow cone. This cone is rigidly fixed to a heavy casting, which is firmly bolted to a bed and is perfectly free from contact with the channel itself. The support is at the intersection of the center lines of the two weighing arms, which are set along and normal to the wind direction. The balance has three degrees of freedom, and is arranged in such a manner that moments can be measured about the center line of each arm and about the vertical axis of the balance. A jockey weight is provided on each beam for the adjustment, and the weighing arms are accurately counterbalanced to secure maximum sensitiveness of measurements.

The wind tunnel is not only valuable in measuring resistance to flight but it also gives valuable information relative to balance and stability, location and angle of incidence of aerofoils, streamline fuselage forms and effect of controls. Much of the development noted in modern aeronautical engineering can be attributed to wind tunnel experimentation.

By testing models, the great expense entailed in constructing full size machines that might not be successful after completion and the waste of time incidental to this method is eliminated. The expense involved is but a fraction of that called for by the old "rule of thumb" system and lives of valuable test pilots are saved.

A curious application of the Wheatstone bridge to giving the depth of water or fuel in airplane tanks has been proposed. Two wires are inclosed in a tube immersed in the tank. The liquid in the tank has access to one of them only. Each wire is in circuit in its own arm of the bridge. The liquid operates to cool the wire to which it has access, thus keeping down its resistance, and as this cooling action is greater or less as the wire is more or less immersed in the liquid the galvanometer and connections are calibrated to give the depth of fluid in the tank. The higher the level of the liquid the greater will the cooling effect be and lower the resistance.

Digitized by Google

Mechanical and Optical Pyrometers

By Joseph Stanley

PYROMETERS used for measuring temperatures up to 1,500 deg. F. may be of the expanding element type, the actuating or heat-recording element being a rod of graphite or copper contained in a steel tube. The lower end of this member is securely held while the upper end can move as the rod lengthens out under the influence of the heat. The degree of expansion varies directly as the increase in temperature and the greater the heat the more the rod lengthens out. This movement is transmitted to a pointer by suitable mechanism and the scale calibrated in degrees centigrade or Fahrenheit or both, as desired.

While both the metal case and copper rod expand from the heat, the copper has a much greater co-efficient of expansion than the case so its lengthening will produce a movement of the needle through suitable multiplying gear, as shown in accompanying illustration. Other types depend upon the expansion of mercury, still others on the principle of the Bourdon spring tube used in measuring air, steam and other fluid pressures.

Expanding Rod Type

If one refers to the illustration, Fig. 1, the interior construction of an expanding rod type will be easily understood. The relatively slight movement of the rod will be multiplied by the segment and pinion gearing actuating the pointer shaft. The end of the expanding copper rod is cupped out and a short toggle rod pointed at both ends is used to join the cupped lever on the toothed segment to the rod end. The parts are held in contact by a coil spring so there will be no lost motion and all rod movement, either on expansion or contraction will be transmitted to the segment, from there to the pinion and then to the pointer. The gearing is such that the oscillating motion of the segment imparts almost a complete rotation to the pointer shaft.

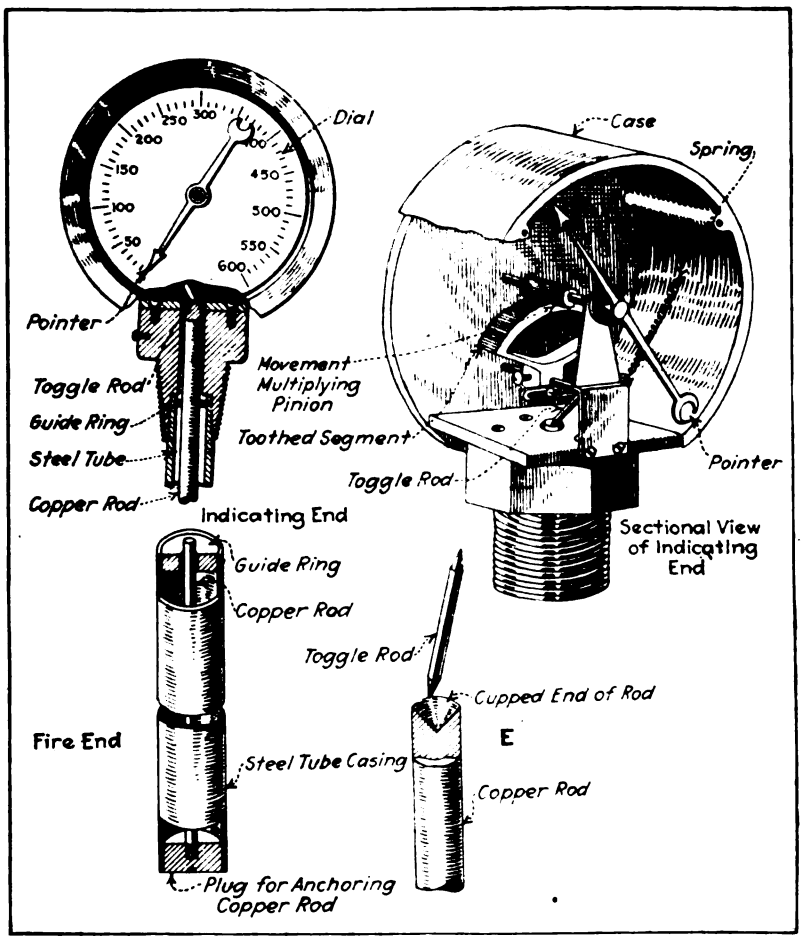


Fig. 1—Diagrams showing details of mechanical pyrometer outlines important parts and their relation to each other

The Pyroscope and Its Use

Certain drawbacks had been enough to prevent the optical pyrometer from coming into practical use until the pyroscope was introduced in 1910. This instrument does not employ prisms made of rare and costly minerals, or electric apparatus of great delicacy. A plain oil lamp is used, which gives the desired constancy in a much better way. The optical arrangement shown at Fig. 3 is of admirable simplicity and so designed as to endure rough usage under the conditions which these instruments have to be applied, as in foundries, steel mills, forge shops and heat-treating departments specially in the presence of corrosive atmosphere.

The personal element often thought to be a serious objection in the use of optical pyrometers, is of little or no importance. The principle used is one to compare light intensities. Although in the type A pyroscope the natural heat colors are shown, which is an advantage in general practice, the color is not a factor upon which successful reading depends. A color-blind person, therefore, can read temperatures as well as one having normal eyesight, likewise if a green or blue glass be interposed between the eye, the pyroscope and the heated metal, faithful temperature readings can still be obtained. This is because, as before stated, readings ultimately depend upon comparison of light intensity.

The use of such an instrument is a great advantage and its low price makes it possible for small shops that could not profitably install an electric pyrometer outfit to carry on heat-treatments with much greater accuracy than possible when colors are gauged with the unaided eye. Two scales are provided, one reading from 1,200 deg. F. to 2,100 degrees, the other reading from 2,000 deg. F. to 3,000 degrees.

Optical Pyrometer Easily Read

The method of operation is very simple and easily grasped by the practical mechanic. Ordinary kerosene oil is put in the container of the lamp. Open glass door B, Fig. 2, and light the wick as in any ordinary lamp and adjust flame to normal height (about ¼ inch) by the knob K. Have flame low until wick is warmed up, then set as above. The variations of the flame cannot affect the readings unless entirely too low to cover reflector R or high enough to smoke. The instrument is now ready for work. By looking at the hot metals, etc., through eye-piece C, one will clearly see the object the same as through a telescope.

Focus by turning knurled ring E. Next turn knob F, which works the colored diaphragm and controls the light intensity of the comparison reflector R until practically no difference can be seen between redness of said reflector and the work. You can best tell this by going a shade higher or lower until balanced. Now look at indicator H on graduated drum G and take the tem-

Digitized by Google

perature reading. If it is desired to set the instrument at a given temperature, figure so that the work can be all heated up to a certain degree, then lock by the set screw M.

The telescope can be used in any desired position on its pivot. All fine lenses are protected by glass shields, which, when broken, can be replaced at trifling cost. To clean the glass facing the lamp, which through carelessness may take on dust or soot, release set screw I, and pull out by drum G, and wipe with a clean rag or chamois skin. Any soot accumulating in chimney can be removed by turning cap J and at the same time pulling up and removing it.

Locotractors in South Africa

A CONTEMPORARY states that owing to the high cost of operating the usual forms of motor truck in South Africa, a modification of the truck tractor is being used in a way that promises both cheap and efficient transport. Roads are very poor and during the rainy season are often impassable. The light railway is advocated as the solution and suitable motive power is believed to have been definitely discovered in a gasoline locotractor, a special form of machine intended to take the place of the locomotive on pioneer light railways. When the usual railroad system is followed, a ballasted bed and heavy rails are needed to carry a locomotive of usual construction and the railroad cost per mile is very high. The locotraction system uses load-carrying cars running wholly upon rails. The guiding portion of the locotractor also runs on the rails, but the driving wheels, shod with solid rubber tires, run on prepared strips of road metal on each side of the railway track and have greater traction, thus for a given horsepower and weight the hauling power is stated to be four times as great as with ordinary locomotives having driving wheels running on tracks.

High Candlepower Projectors

PREVIOUS attempts to improve the efficiency of projectors have been in the direction of optical effect. A German experimenter has augmented the specific surface luminosity of the searchlight arc-lamp and has been able to attain a searchlight efficiency of five times that formerly obtained with the same current consumption and optical arrangements.

Instead of using the ordinary 38-mm. diameter pure carbons, he employed high-efficiency carbons 16 mm. in diameter. The negative carbon is placed obliquely upward opposite the horizontal positive, which is 11 mm. in diameter. The carbon ends are played upon by a flat spirit flame which cools the incandescent ends of the carbon, as the passage of the current is no longer limited to the ends but reaches the inner parts of the carbons. This causes a considerable increase in the temperature of the carbon crater, and the latter burns very deeply into the thin carbon rod, giving a small, round, and intensely bright crater opening which, when projected, appears as a circular luminous disk and has a much higher specific luminous intensity than the usual large but flat crater in the ordinary type of searchlight.

The energy consumption is much better, as the voltage with a current of 150 amp. is not 60 volts as ordinarily but reaches 75 to 80 volts. The carbons are kept in constant rotation by a small electric motor to ensure even burning. To keep the crater of the positive carbon in the focus of the parabolic mirror the carbon is displaced by an electromagnetic device with the aid of a selenium cell. Experiments show the light intensity of such searchlights to attain 500,000,000 candlepower. The new system makes it possible to construct very compact projectors of high power.

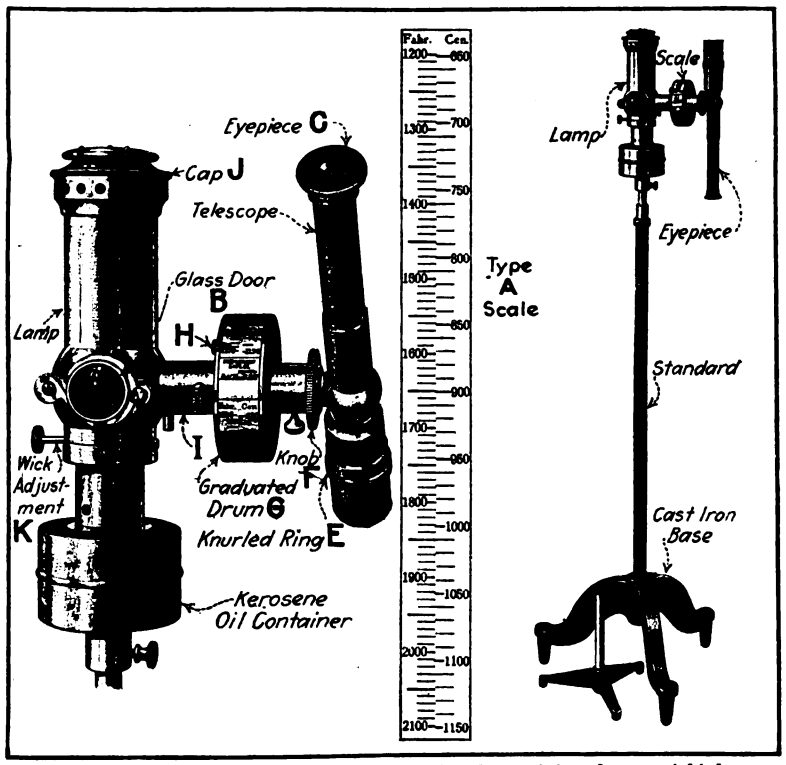


Fig. 2—The Shore pyroscope, an instrument for determining degree of high temperatures by optical means

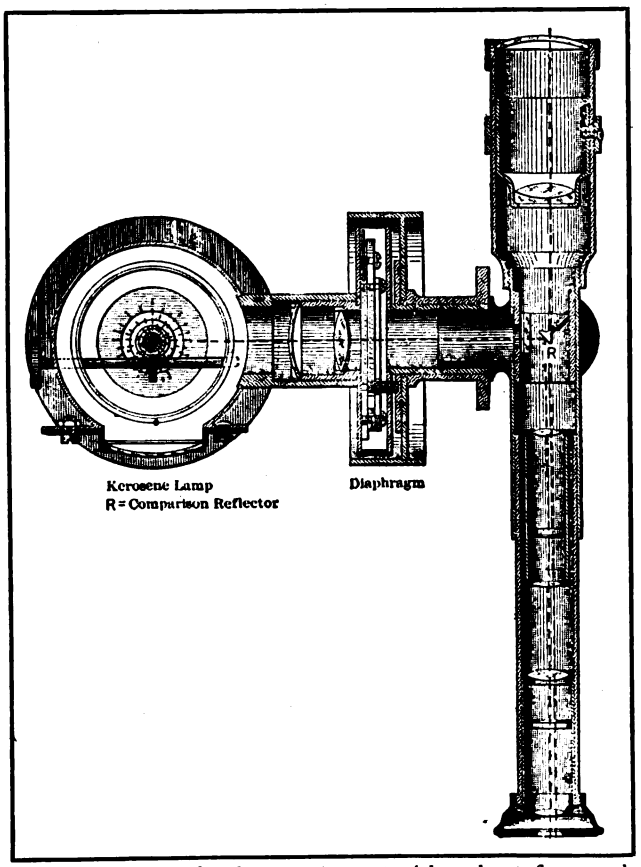


Fig. 3—Diagram showing arrangement of lens, lamp flame and comparison reflector in Shore pyroscope

SHEET COPPER was first made in America at Canton, Mass., in 1801, by Colonel Revere. The first founder who worked in brass in America was Joseph Jenks, who made brass and iron at Lynn, Mass., in 1646. In 1653 silver coins were cast in Massachusetts.

Digitized by Google

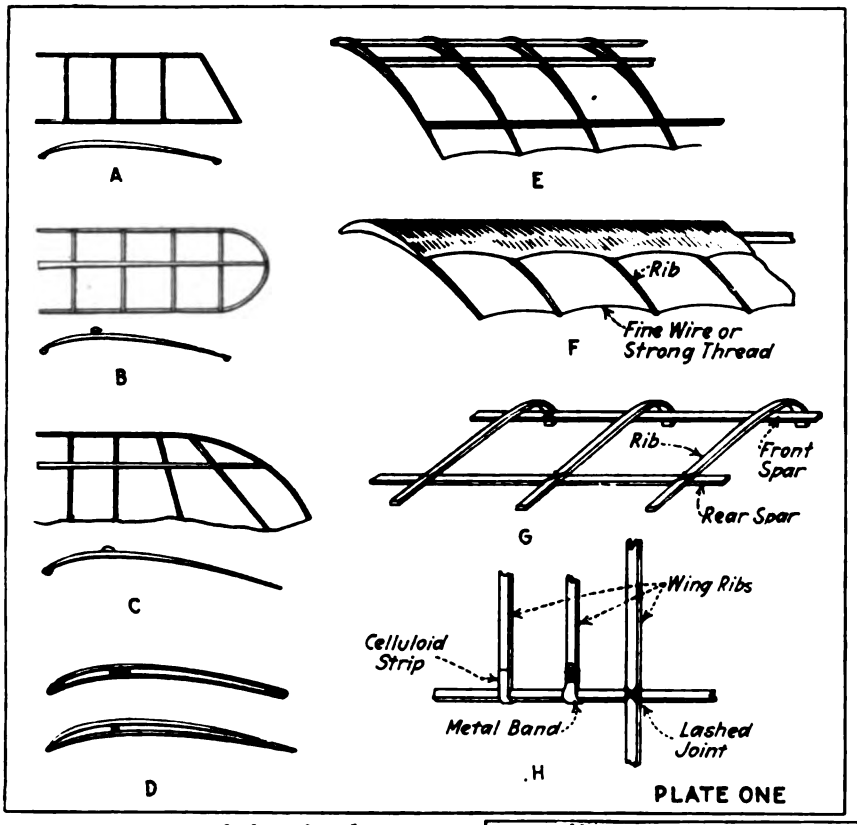


PLATE ONE

Notes on Model Airplane Construction

By H. C. Ellis

THE flying qualities of any model, particularly a racer, depend on the methods and thoroughness in design and construction as well as the workmanship. The model must be able to withstand very hard knocks and yet be light. The only way such a model can be turned out is by a good knowledge of the materials used and how to fasten them strongly together.

All wood must be straight grained and light, the frames, fuselages and spars being of spruce or cypress. All parts possible should be made from split bamboo, which is the best material for ribs, skids, braces, etc. It is easily split with a knife and should always be joined together by binding with strong fine linen thread and covering with glue. Nails should never be used on bamboo. Bending is always accomplished by steaming the material while working it. Reed and rattan are worked the same as bamboo and used for skids, planes, rudders, etc.

All metal parts should be small and light as possible, yet strong. Steel is considered the best and strongest by many for any metal part of a model, but brass and aluminum have their respective uses also. Small flat or round nose pliers are very useful in handling sheet metal and wires. In joining parts of the same material, the metals must be soldered wherever possible. When joined to wood or bamboo, strong thread and glue are the proper materials to use to make a satisfactory joint.

In covering a plane or tail the quickest and best way in my experience is to glue the cloth or bamboo fibre paper to the frame and allow to dry. Then give the covering one or two coats of Aero Varnish or "dope," which strengthens the surface and makes it taut and smooth. The fuselages, elevators, rudders, etc., are covered in the same manner. The dope is easily applied in thin coats with an ordinary brush.

The propellers in all cases must be as near perfect as possible as regards balance, and should turn in their bearings with minimum friction. Bearings must be accurately made, strong and light, also well oiled when model is in use. Wherever possible the propellers are protected by skids, which also enable the model to raise from the ground when wheels are attached.

Various Methods of Wing Construction

Plate One shows construction of bamboo and wood planes, both single

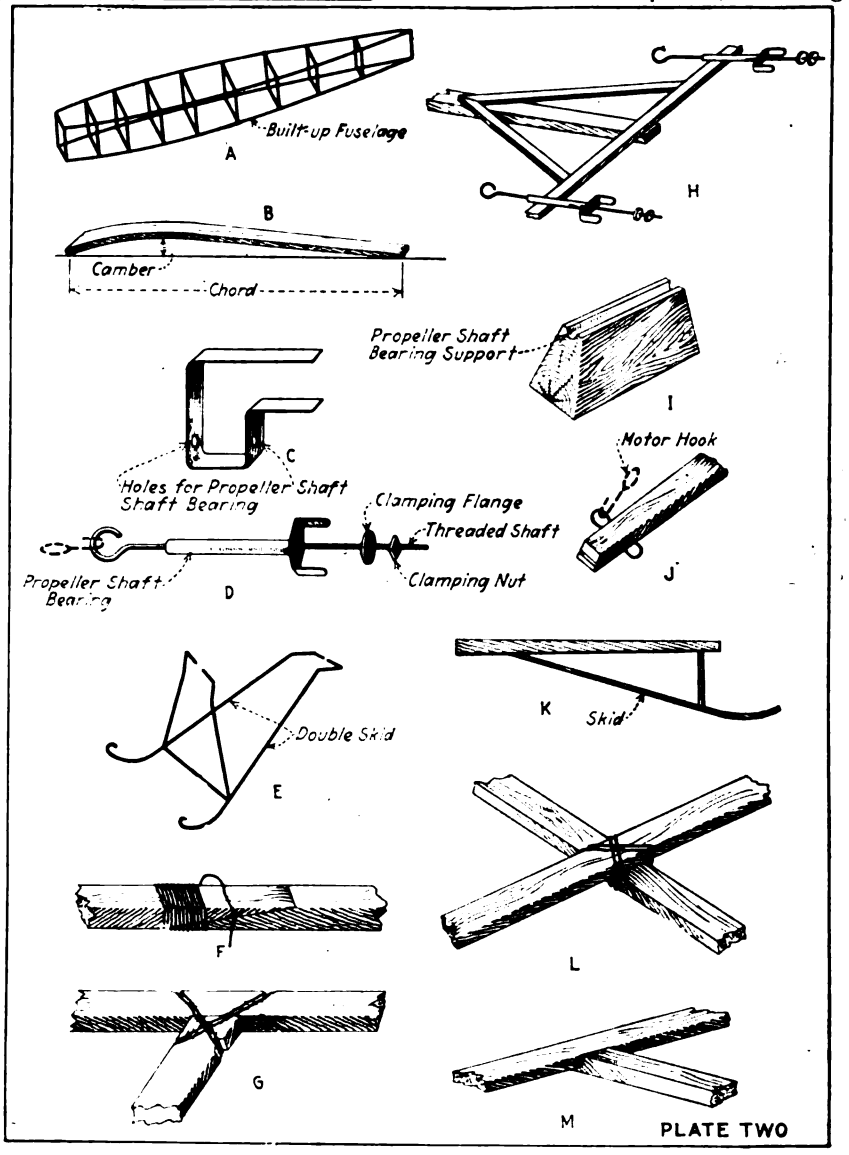
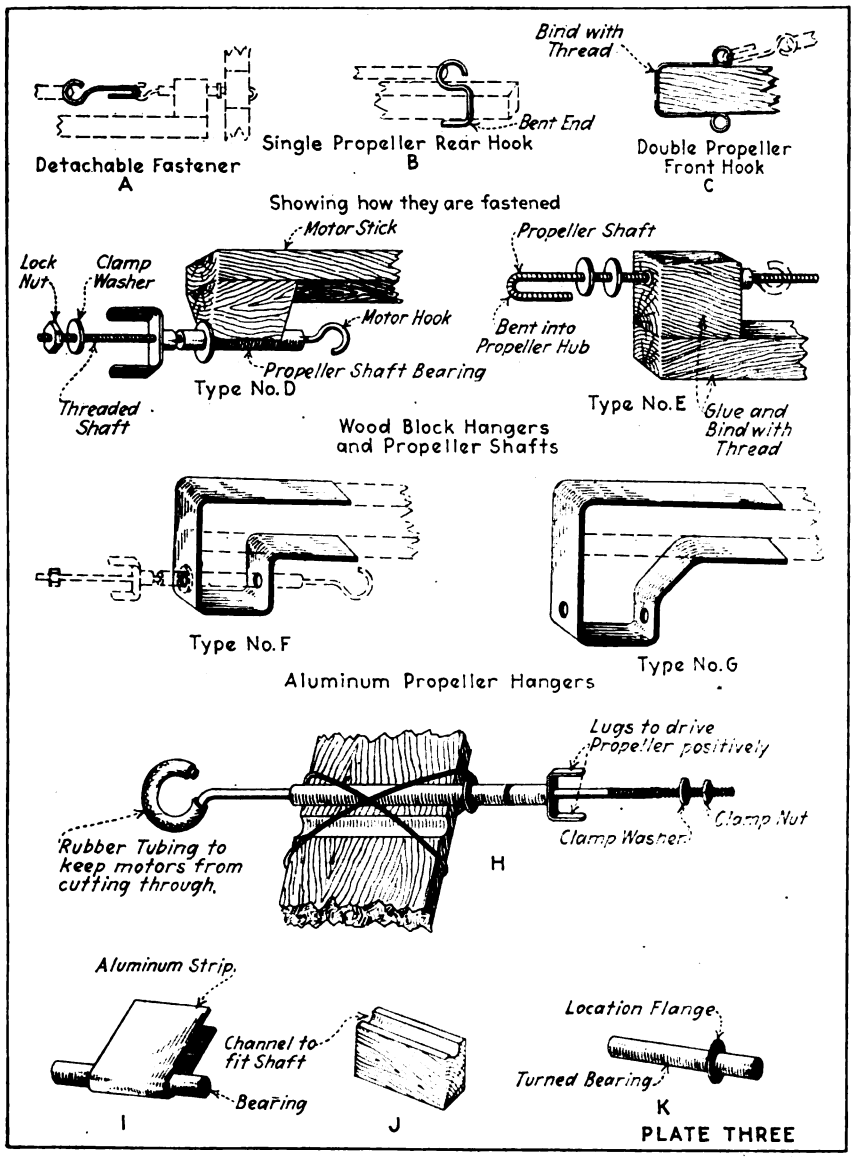


PLATE TWO

Digitized by Google

and double surfaced, showing methods of joining parts. The single surfaced wings, being lighter and much easier to assemble than other kinds, have found favor almost universally with the aero-



plane flyers. The simplest type of plane is shown at A; this consists of two strips of equal size for the edges of the frame, joined by the required number of ribs, usually equal distances apart. B illustrates a single-surfaced plane. The spar, as will be noticed, is placed above the ribs, the entering and trailing edge strips below. C gives a good idea of trailing knife edges which are always more or less flexible.

At D, the correct method of construction to secure light and strong double surface frames is compared with the old, heavy style which, generally speaking, caused that class of supporting surface to be labeled "too weighty." A two spar, double surfaced wing with a trailing knife edge as at E is the most satisfactory wing as regards efficiency. An alternative method of wing building is given at F, which is the semi-double surfaced plane.

The illustration at Fig. G, Plate One, shows method of joining ribs to entering and trailing edge strips, and is self-explanatory. Many different shapes and sizes of fittings, cut from the sheet aluminum or brass are used to a certain extent, being bound to the wood members and then glued as in H.

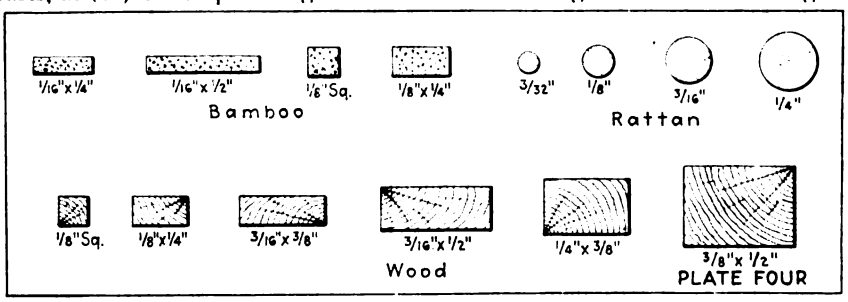
Plate Two clearly shows a variety of parts, at (A) built-up fuselage for scale model, (B) rib, (C) propeller hanger, (D) shaft and bearing, (E) wire skid for front of machine, (F) splice, (G) butt joint, lashed, (H) bearing spar and bearings attached in place on frame, (I) bearing block, (J) double frame hook, (K) bamboo skid for rear, (L) cross joint, (M) butt joint of frame and propeller spar. All these details can be easily understood by the reader interested in such matters.

Plate Three, Figs. A, B and C, show different types of motor hooks and how they are fastened to the motor stick. Sketches at D and E show types of wood block propeller shaft bearing hangers and propeller shafts. Figs. F and G show two types of aluminum propeller hangers, the forms being simple, light and practical and capable of easy duplication by the model maker. There is perhaps no other part that is so necessary to secure good success with a model as the bearings and shafts. All the strain or pull of the twisted strands of the rubber motor comes directly on the bearings, and they must be made strong and assembled to turn with as little friction as possible. Small ball-bearing shafts have been found of little value for flying models. The best all-round shaft and bearing is shown in Plate Three, Fig. H. The diagram at Fig. I shows bearing used for light racing models. That at Fig. J shows a wooden bearing block as used in the assembly at A. Fig. K shows a solid turned bearing that is used in type E propeller.

Plate Four shows sections that give sizes of wood, bamboo and rattan which have been found most satisfactory in the construction of model aeroplanes.

Making Granulated Brazing Spelter

—There are two common methods of preparing brazing "spelter", one by pouring the molten alloy into a tank of water and the other by breaking up heated bars in a mortar. In either case the alloy is carefully made in graphite crucibles, there being no difference in this part of the work, while the dross is very carefully skimmed off the metal surface before pouring. In the "wet" process the molten metal is poured through a sieve of suitable mesh into a tank and when enough has been poured, the water is drained off and the metal dried and graded for size through wire sieves. In the dry process, the metal is formed into bars which are heated to the granulating temperature and then smashed up in an iron mortar with a heavy pestle of the same material, reheating being done as necessary. Grading is the same as in the first process.



Digitized by Google

A Sawing Attachment for a Bench Lathe

By Joseph Dante, Jr.

Member A. S. E. E.

THERE are many model makers who are making boats, railway cars, wooden models, etc., that have a bench lathe and use it for wood turning also. Herewith is a description of a small scroll saw which is intended for fine wood work and which will make a handy addition to the model engineer's shop. The design is simple and requires but a few patterns. The attachment is run from the spindle of a lathe using a plate to drive the machine, or, if the builder wishes, he can construct a small side bracket and make a pulley for the same. This will make the machine a unit by itself. Note that the assembled drawing has all the parts marked with letters. The same also applies to the details. Following is a description of the parts:

Part A. The base is cast iron. The first operation is to surface the bottom as per drawing. After this is done, drill a 5/8 in. hole, drill set screw hole and tap 3/8 in. A slot is then cut for the clamp bolt.

Parts B and C. The upper and lower brackets are cast iron. These two blocks should be drilled in pairs so as to insure perfect aligning of holes. In part B, drill a hole and tap 1/4 in. The set screw for this hole should have a tit on one end 3/16 in. in diameter so as to fit in the spline in the spindle rod and keep same in position. The set screw should have a very tight fit so that it will not work loose while running.

Part D. The driving block is cast iron. Mill 5/16 in. The slot is 5/16 in. deep. If a milling machine is not at hand, a 5/16 in. hole can be drilled and then broken open on the side. An operation of this kind may be recalled in an article published in this paper on Speedy, Jr. steam engine. Drill a 1/2 in. hole and tap 1/4 in. for set screw.

Part E. This is the driving plate and is cast in iron. A 3/4 in. hole is drilled in the center and at a 3/4 in. radius from the center plate. Another hole is drilled to accommodate a 5/16 in. pin. When the stud is put in place a 1/16 in. hole is drilled through the periphery of the disc through the stud. Into this 1/16 in. hole a pin is placed. The driving plate is 2 in. in diameter as noted on the drawing and it should also be case hardened to prevent wear. In the 3/4 in. center hole a No. 1 Morse taper shank is driven.

Part F. This is the table bracket and it should be cast in iron like the rest of the parts. A 5/8 in. hole is drilled in its center. A 1/4 in. hole is drilled into this and tapped to receive a set screw. Four holes are then drilled as shown at a 13/16 in. radius to receive wood screws. These four holes are countersunk.

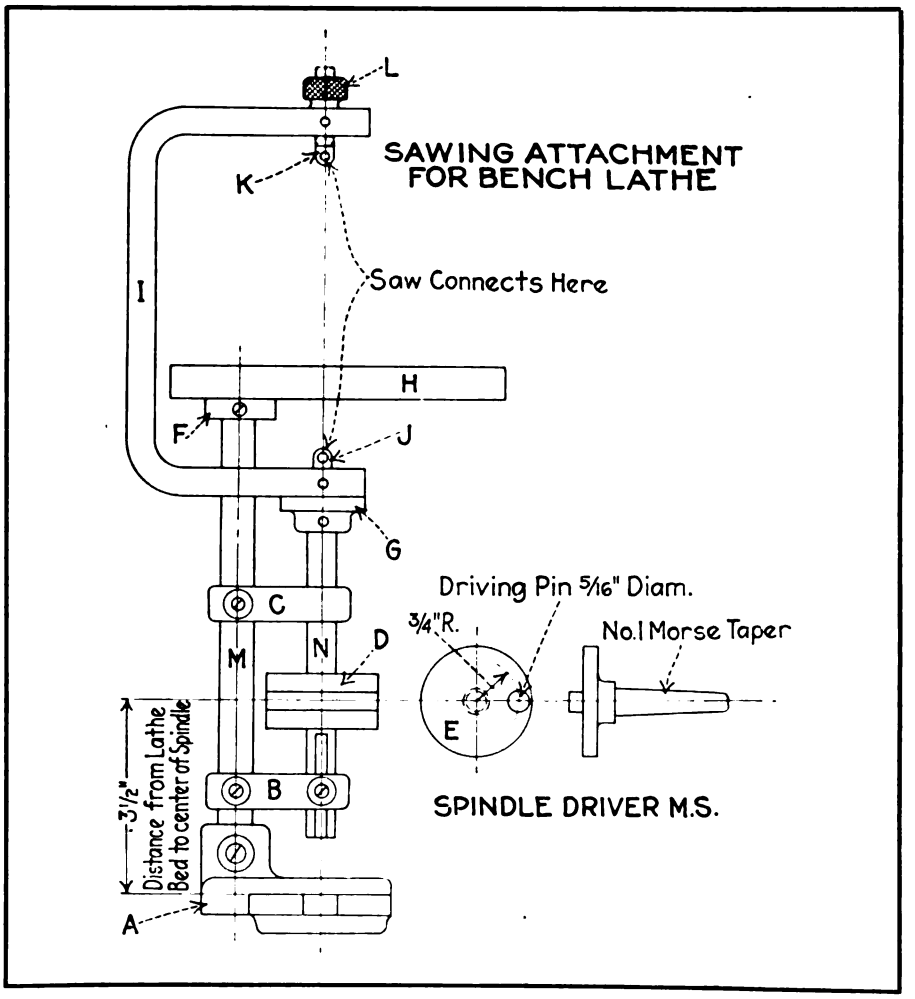
Part G. This is the saw bracket. A 1/2 in. hole is drilled .002 in. oversize so as to have a pressed fit on the end of the spindle. A 1/8 in. pin hole is also drilled in this member. The bracket is not pinned to the spindle until the saw frame is made. The screw holes should be transferred from the saw frame to the bracket. The assembled view shows to which side the saw frame is located.

Part H. The wood table used is 6 ins. in diameter, 5/8 in. thick with a 2 in. recess, 1/8 in. deep, to accommodate the bracket F. Drill a 1/2 in. hole for the saw through the table.

Part I. The saw frame is made of 1/2 in. square cold rolled steel bent as shown in the drawing. The two 1/4 in. holes are for screws and they should be transferred from this to the spindle bracket which has two 1/4 in. tapped holes on a 1/2 in. radius.

Part J. This is the lower saw stud and it should have a pressed fit in the saw frame, a 1/16 in. pin hole being drilled completely through as shown. A 1/8 in. pin is used for holding the saw in place.

Part K. This is the upper stud and one end is filed half way as shown and a 1/8 in. pin is used for holding the saw. This also applies to Part J.

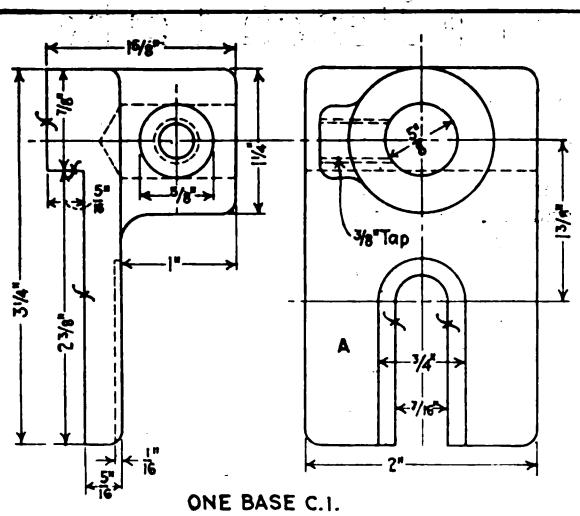


Parts M and N. M and N are the column and spindle rods and they are made from cold rolled steel stock with a bright finish.

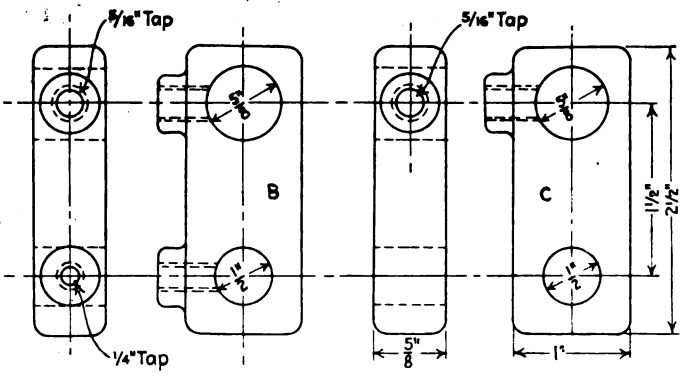
The saws used on the small sawing attachment can be purchased at any hardware store and they are what is known as 6 in. coping saws. The saws have looped ends which are very convenient for holding them to the saw frame. The price for these saws range from 12 cents to 45 cents per dozen.

The capacity of the sawing attachment can be increased by making the Part I (shown in the drawing on this page) larger. Larger saw blades must then be used.

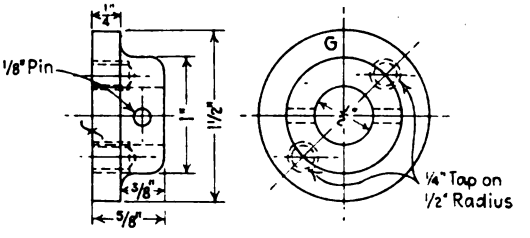
Digitized by Google



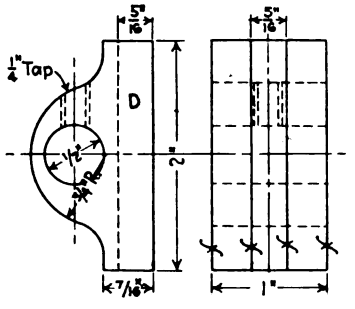
ONE BASE C.I.



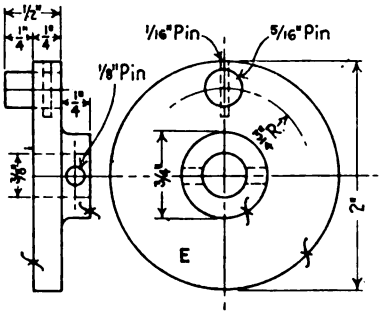
ONE LOWER BRACKET C.I. ONE UPPER BRACKET C.I.



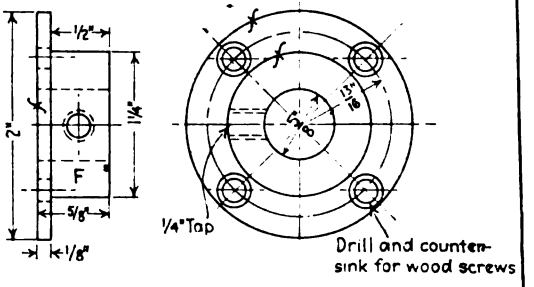
ONE SAW FRAME SPINDLE BRACKET C.I.



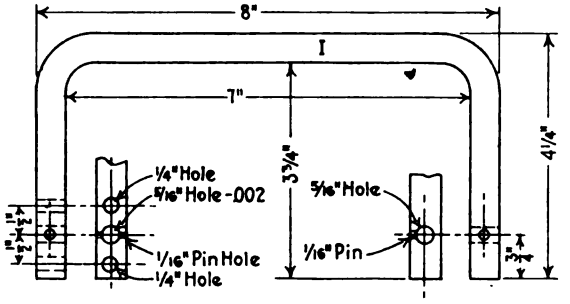
ONE DRIVING BLOCK C.I.



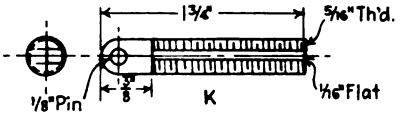
ONE DRIVING PLATE C.I.



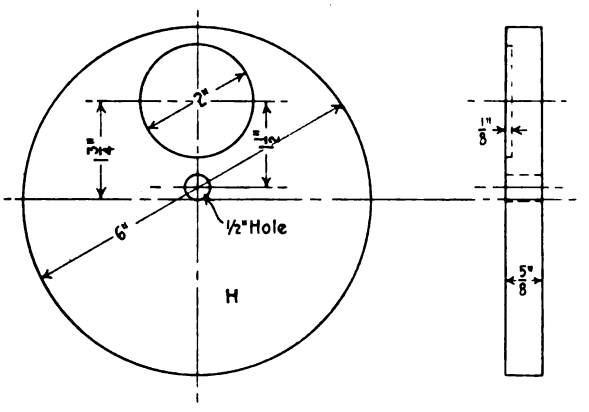
ONE TABLE BRACKET C.I.



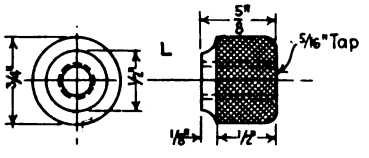
ONE SAW FRAME C.R.S.F. ½"SQ. STOCK



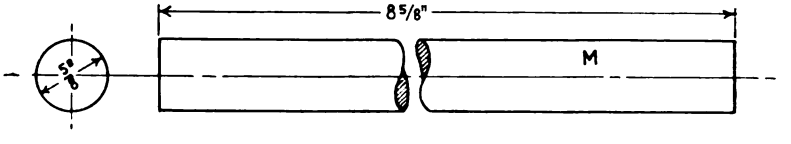
ONE SAW CLAMP SCREW M.S.F.



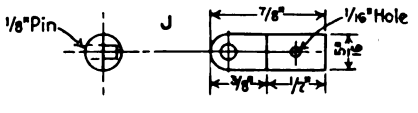
ONE SAWING TABLE (Hardwood)



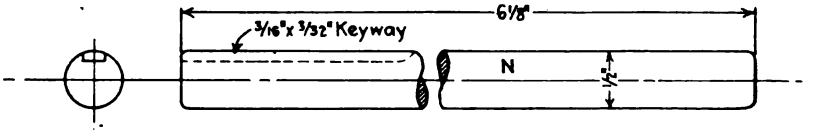
ONE KNURLED NUT M.S.F.



ONE COLUMN ROD C.R.S.



ONE LOWER SAW STUD M.S.F



ONE SPINDLE ROD C.R.S.

Digitized by Google

Fitting Gas Engine Piston Rings

By Victor W. Pagé, M. S. A. E.

As all gas engine pistons must be free to move up and down in the cylinder with minimum friction it is evident that to allow for heating and expansion they must be less in diameter than the bore of the cylinder. The amount of freedom or clearance provided varies with the construction of the engine, but it is usual to provide from .005 to .010 of an inch to compensate for the expansion of the piston, due to heat and also to leave sufficient clearance for the introduction of lubricant between the working surfaces in automobile motors. Obviously, if the piston were not provided with packing rings, this amount of clearance would enable a portion of the gases produced when the charge is exploded to escape by it into the engine crank case.

The packing members or piston rings, as they are called, are split rings of cast iron or steel which are sprung into suitable grooves machined on the exterior of the piston, three or four of these being the usual number supplied if they are the simple form, though three or four light steel rings may be used in each groove if multiple rings are employed. These have sufficient elasticity so that they bear tightly against the cylinder wall and thus make a gas-tight joint. Owing to the limited amount of surface in contact with the cylinder wall, the liberal use of lubricating oil, and the elasticity of the split rings the amount of friction resulting from the contact of properly fitted rings and the cylinder is not of enough moment to cause any damage and the piston is free to slide up and down in the cylinder bore.

These rings are made in two forms as outlined at Fig. 1. The design shown at A is termed a "concentric ring" because the inner circle is concentric with the outer one and the ring is of uniform thickness at all points. The ring shown at B is called an "eccentric ring," and it is thicker at one part than the other. It has theoretical advantages in that it is supposed to make a tighter joint than the other form, as it is claimed its expansion due to heat is more uniform. The piston rings must be split in order that they may be sprung in place in the piston grooves and also that they can expand to conform to the cylinder bore curvature, the types of split joints commonly used, being as outlined at C, D and E, Fig. 1. The butt joint at D is seldom used now.

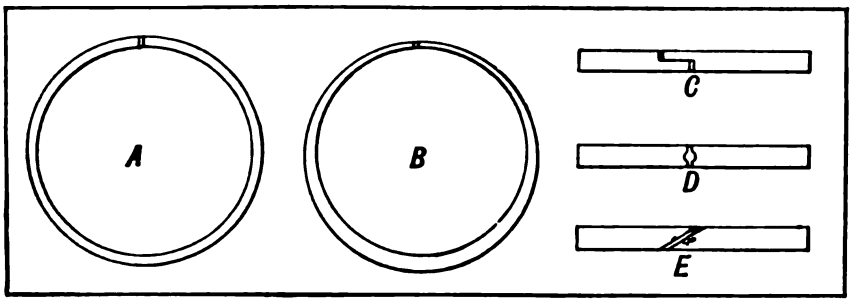


Fig. 1—Concentric ring at A, eccentric ring at B. The lap joint shown at C is widely used as is the diagonal cut at E. The straight butt joint at D should be utilized with pinned rings and is seldom employed at the present time

In order to avoid the leakage that is present with simple rings a number of compound rings of various types have been offered on the open market and some have been adopted by engine builders. Various designs of this nature are shown at Fig. 2. The construction of these rings is clearly shown in the illustrations. The simple ring still remains the most popular among engine builders as it is easiest to fit and is the most enduring.

If gas has been blowing by the ring or if these members have not been fitting the cylinder properly the points where the gas has passed will be evidenced by burnt, brown or roughened portions of the polished surface of the piston and rings. The point where this discoloration will be noticed more often is at the thin end of an eccentric ring, the discoloration being present for about ½ inch or ¾ inch each side of the slot. It may be possible that the rings were not true when put in. This made it possible for the gas to leak by in small amounts initially which increased due to continued pressure until quite a large area for gas escape had been created.

Piston Ring Manipulation

Removing piston rings is a difficult operation if the proper means are not taken, but is a comparatively simple one when the trick is known. The tools required are very simple, being three strips of thin steel about ¼ inch wide and 4 or 5 inches long and a pair of spreading tongs made up of ¼ inch diameter key-stock tied in the center with a copper wire to form a hinge. The construction is such that when the hand is closed and the handles brought together the other end of the expander spreads out, an action just opposite to that of the conventional pliers. The method of using the tongs and the metal strips is clearly indicated at Fig. 2.

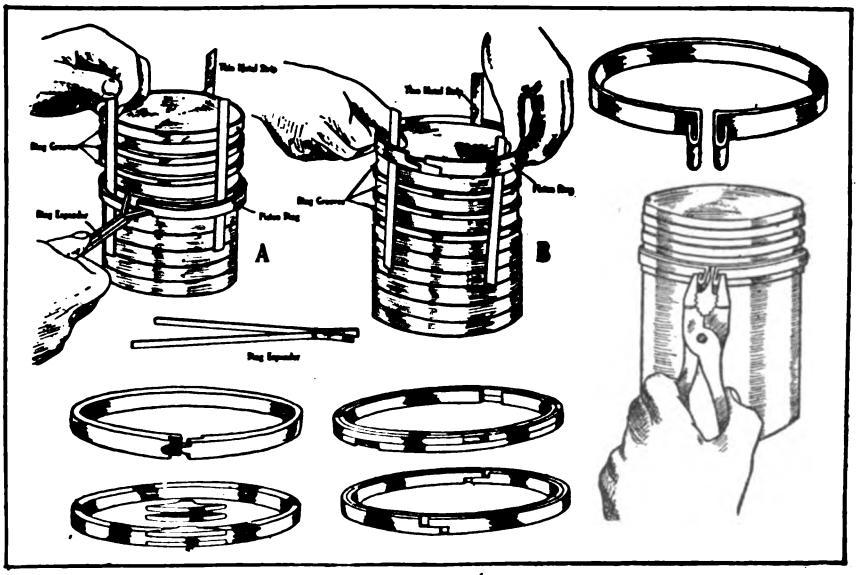


Fig. 2—The use of a ring expander and sheet metal strips to remove and replace rings in the piston grooves is clearly shown at A and B. Various types of compound and leak-proof rings are shown at left. At the right, a simple piston ring clamp to close rings so the cylinder can be slipped over the pistons and its use are outlined

At A the ring expander is shown spreading the ends of the rings sufficiently to insert the pieces of sheet metal between one of the rings and the

Digitized by Google

piston. Grasp the ring as shown at B, pressing with the thumbs on the top of the piston and the ring will slide off easily, the thin metal strips acting as guide members to prevent the ring from catching in the other piston grooves. Usually no difficulty is experienced in removing the top or bottom rings, as these members may be easily expanded and worked off directly without the use of a metal strip. When removing the intermediate rings, however, the metal strips will be found very useful. These are easily made by grinding the teeth from old hacksaw blades and rounding the edges and corners in order to reduce the liability of cutting the fingers. By the use of the three metal strips a ring is removed without breaking or disturbing it and practically no time is consumed in the operation.

Fitting Rings to Grooves

Before installing new rings they should be carefully fitted to the grooves to which they are applied. The tools required are a large piece of fine emery cloth, a thin, flat file, a small vise with copper or leaden jaw clips, and a smooth hard surface such as that afforded by the top of a surface plate or a well planed piece of hard wood. After making sure that all deposits of burnt oil and carbon have been removed from the piston grooves, new rings are selected, one for each groove. The ring is turned all around its circumference into the groove it is to fit, which can be done without springing it over the piston as the outside edge of the ring may be used to test the width of the groove just as well as the inside edge. The ring should be a fair fit and while free to move circumferentially there should be

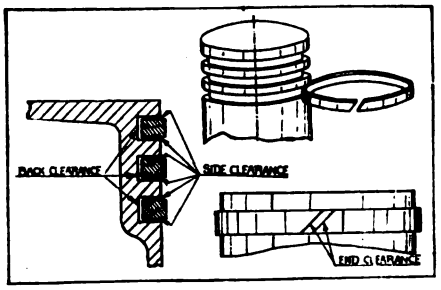


Fig. 4—Diagrams showing the various clearances that must be considered in fitting piston rings

no appreciable up and down motion. If the ring is a tight fit it should be laid edge down upon a piece of emery cloth which is placed on the surface plate and carefully rubbed down until it fits the groove it is to occupy. It is advisable to fit each piston ring individually and to mark them in some way to insure that they will be placed in the groove to which they are fitted. If the grooves in the piston are worn tapering or are much wider at the edge than at the bottom, the piston should be chucked in a lathe and the grooves machined out to uniform width the entire depth.

The Munger tool shown at Fig. 5 makes possible the easy truing of the grooves by hand. The device is wired to the piston and turned around so that the cutter removes the high spots, the depth of cut being easily adjusted by a set screw and the accuracy is insured by the guiding pads on each end of the cast metal yoke.

Fitting Rings to Cylinder

The repairman next turns his attention to fitting the ring in the cylinder itself. The ring should be pushed into the cylinder at least two inches up from the bottom and endeavor should be made to have the lower edge of the ring parallel with the bottom of the cylinder. If the ring is not of correct diameter, but is slightly larger than the cylinder bore, this condition will be evident by the angular slots of the rings being out of line or by difficulty in inserting the ring if it is a lap joint form. If such is the case, the ring is removed from the cylinder and placed in the vise between the soft metal jaw clips. Sufficient metal is removed with a fine file from the edges of the ring at the slot until the edges come into line and a slight space exists between them when the ring is placed into the cylinder. It is important that this space be left between the ends, for if this is not done when the ring becomes heated the expansion of metal may cause the ends to abut and the ring to jam in the cylinder.

Another method of fitting a piston ring is indicated at Fig. 3-B. A plug is made of soft wood, such as yellow pine, that will be an easy fit in the cylinder and one end is turned down enough so that a shoulder will be formed to back the ring. The turned down portion should be a little less than the width of the ring to be tested. The ring is pushed on this turned down end of the wooden plug and held by a small batten secured by a screw in the center. This does not hold the ring tightly enough to keep it from closing up. It is also important to turn the end of the wooden plug small enough so that its diameter will be less than the bore of the ring when that member is tightly closed. The cylinder bore is smeared with a little Prussian blue pigment which is spread evenly over the cylinder wall with a piece of waste and the ring is moved back and forth in the cylinder while it is held square by the shoulder on the plug. The high spots on the ring will be shown by color. Usually the ring will be found to bear hardest at each side of the slot. These high spots are removed carefully with a very fine mill file or piece of emery cloth and the ring is again inserted in the cylinder bore to find other high spots which are removed in a similar manner. When the rings fit fairly well all around, the entire surface will have a uniform coating of blue. This method of fitting is usually necessary only in the case of large rings.

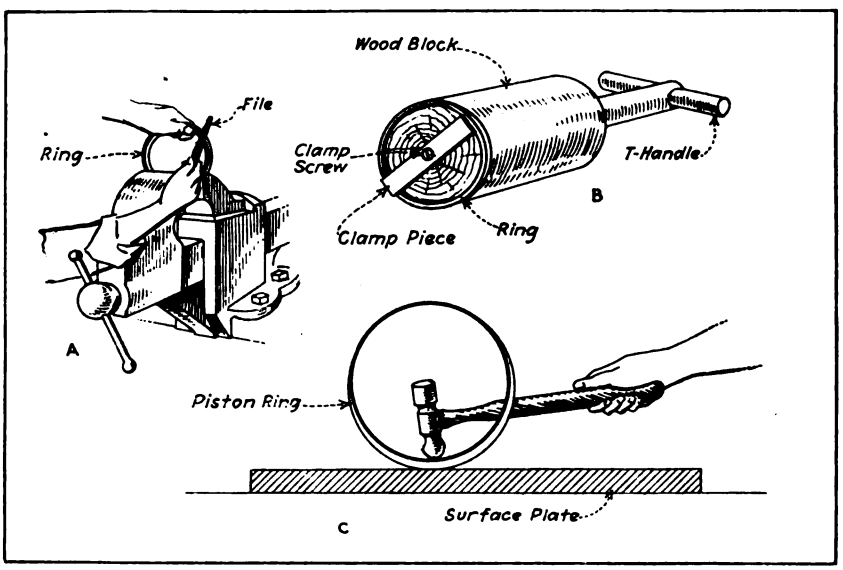


Fig. 3—How the proper clearance between ends of a diagonal cut ring is obtained is shown at A. The fixture at B shows a useful and easily made device for fitting large rings where great accuracy is necessary. Peening a used ring, as at C, sometimes imparts sufficient elasticity so it can be used again

Peening Ring Sometimes Helps

If the old piston rings are bright all around but appear to have lost their elasticity, a new lease of life may sometimes be given by a process known as "peening," which is shown at Fig. 3-C. The ring is stood on a surface plate and is tapped inside with the peen end of a light hammer, using the harder blows at the thick section and gradually reducing the force of the blow as the slot is approached. If skillfully done a ring may be stretched to some extent and considerable elasticity imparted.

Digitized by Google

It is necessary to use more than ordinary caution in replacing the rings on the piston because they are usually made of cast iron, a metal that is very fragile and liable to break because of its brittleness. Special care should be taken in replacing new rings as these members are more apt to break than old ones. This is probably accounted for by the heating action on used rings which tends to anneal the metal, removing some of the brittle qualities as well as making it less springy. The bottom ring should be placed in position first, which is easily accomplished by springing the ring open enough to pass on the piston and then sliding it into place in the lower groove which on some types of engines is below the wrist pin, whereas in others all grooves are above that member.



Fig. 5—The Munger tool makes it possible to true out piston ring grooves accurately without special machinery

The other members are put in by a reversal of the process previously outlined for removing them. It is not always necessary to use the guiding strips of metal when replacing rings as it is often possible, by putting the rings on the piston a little askew and manœuvering them to pass the grooves without springing the ring into them. The top ring should be the last one placed in position.

Precautions in Replacing Rings

Before replacing pistons in the cylinder one should make sure that the slots in the piston rings are spaced equidistant on the piston and if pins are used to keep the ring from turning one should be careful to make sure that these pins fit into their holes in the ring and that they are not under the ring at any point. Practically all cylinders are chamfered at the lower end to make insertion of piston rings easier. The operation of putting on a cylinder casting over a piston really requires two pairs of hands, one to manipulate the cylinder and the other person to close the rings as they enter the cylinder. This may be done very easily by a simple clamp member made of sheet brass or iron and used to close the ring as shown in Fig. 2. It is apparent that the clamp must be adjusted to each individual ring and that the split portion of the clamp should coincide with the split portion of the ring.

The cylinder should be well oiled before attempt is made to install the pistons. The engine should be run with more than the ordinary amount of lubricant for several days after new piston rings have been inserted. On first starting the engine one may be disappointed in that the compression is even less than that obtained with the old rings. This condition will soon be remedied as the rings become polished and adapt themselves to the contour of the cylinder. It may take fully 100 miles of road work to bring the rings to a sufficiently good fit so that a marked improvement in the compression will be noticed.

Practice has taught us that the proper or at least a perfectly safe formula for end clearance is to allow .002 inch per inch of cylinder diameter for the average automobile or truck motor. This clearance can be measured by placing the rings in their respective cylinders and measuring the joint gap by a thickness gauge. Suitable allowances should be made for the angle of the cut when angle joints are used. Thus the actual clearance would be 1.41 times the measured space with a 45° cut, and twice the measured space with a 30° cut.

CARE OF CLOTH UPHOLSTERY

DO not use an acid solution in cleaning cloth upholstery. Cloth is not affected by climatic conditions and withstands both heat and cold, and having no oil in its make-up, does not pick up or hold dust readily. To remove ordinary dust, beat cushions and backs lightly with stick or carpet beater, then remove dust with whisk-broom or brush. Grease or oil may be removed by the application of a solution of luke warm water and Ivory soap applied with a woolen cloth. Any of the approved methods for cleaning woolen cloth may be used with success on this upholstery. Gasoline and benzine have a tendency to spread instead of removing the dirt. Their use is not recommended for this reason, although they work no injury to the fabric.

FORD TIMING CORRECTION

IN the drawing of the Ford ignition system, diagram Fig. 5, on page 280 of the August issue, the timer roller should be in the space between segments 2 and 4 and about to contact with the latter, which is the next cylinder to fire. With the roller in position shown the timing would be late.

TESTING STEEL FOR BEST HARDENING TEMPERATURE

A BAR of the steel to be treated is provided with about nine notches running around it, spaced in distances of about 5/8 of an inch. Next, the foremost notched piece is heated in a forge in such a manner that the remaining portion of the bar is heated less by the fire proper than by the transmitted heat. When the foremost piece is heated to burning, i. e., to combustion, and the color of succeeding pieces gradually passes to dark-brownish redness, the whole rod is hardened. A test with the file will now show that the foremost burned piece possessed the greatest hardness, that several softer pieces will follow, and that again a piece ordinarily situated in the second third, whose temperature was the right one for hardening, is almost as hard as the first one. If the different pieces are knocked off, the fracture of the piece hardened at the correct temperature exhibits the finest grain. This will give one a rough-and-ready idea of the temperature to be employed for hardening the steel in question and its behavior in general. Very hard steel will readily crack at the notches in this process.

VARNISH AND PAINT REMOVER

DISSOLVE 20 parts of caustic soda (98 per cent) in 100 parts of water, mix the solution with 20 parts of light mineral oil, and stir in a kettle provided with a mechanical stirrer until the emulsion is complete. Now add, while stirring, 20 parts of sawdust and pass the whole through a paint mill to obtain a uniform intermixture. Apply the paste to the painted surface, allow it to remain in contact for a sufficient time to soften the paint and then rub off. Experimenting will be necessary to determine the length of time the paste should remain in contact with the surface to be cleaned, as this will depend upon the thickness, character and age of the covering.

MELTING SCRAP ALUMINUM

THERE are more ways than one of melting this metal correctly. The oxide is so nearly the same specific gravity as the metal that it does not allow the molten metal to clear itself when in small globules or grains. Because of this, mechanical aid has to be given. In practice, the scrap is heated in the crucible up to the point where it becomes a pasty mass, in which state it is pressed and kneaded for some time, preferably with an oak or other hardwood rod of fair cross-section and then the heat is raised and the molten metal is cleared of the dross and dirt with the same rod.

Digitized by Google

How to Make Forming Punches

By George F. Kuhne

THE making of forming dies by use of plaster of paris is a very economical as well as very rapid method of producing tools for the forming and bending of irregular shapes.

A little treatment concerning the subject with explanations as to the procedure in making such tool should interest all who may have occasion to do such work. Assuming that the brass shell in Figure 1 is required, let us proceed as follows: Procure two pieces of hard wood or brass of sufficient thickness so that when joined together by glue for wood (solder for brass) it will be more than twice the thickness of the model to be made. See Figure 2.

After this is done, chuck the piece in the lathe and finish as in Figure 1, representing a solid.

The next step is to make a box as shown in Figure 3, the size of which is governed by the dimensions of the product and its thickness.

Now separate the turned model, Figure 4, and mix some plaster of paris by adding some water and place into the box just made. Mix it to a paste, free from all lumpy matter. After the box has been filled, scrape off the top surface and place the one half of model now separated in the mould, as in Figure 5. Press it downward evenly, keeping it in position until the cast has hardened. The pattern should be pressed down a little below the surface, as shown. When the plaster has hardened, the pattern is removed, and the top surface of the mould can be cleaned up and, if desired, the shape as in Figure 6 may be given for clamping.

The mould is now ready for the foundry and a casting is made. There are two methods of obtaining the pattern or model for the punch; one is to pour some hot lead or Babbit metal into the die just made, and the other to use the one half of the turned model. It is now necessary to make the punch holder, Figure 7, which is made of wood, the shank being a separate part from the punch holder proper.

Then take the half model and fasten it to the holder as shown, placing a thin piece of cardboard of a thickness equal to that of the material to be formed under the model. This allows for shrinkage and the pattern for the punch is now complete. The two patterns are now sent to the foundry, and upon their return a little dressing or polishing will be necessary.

Unless a regular blanking die is made for the work, strips as in Figure 8 can be cut and laid in the nest B, as shown in Figure 6. The punch, in striking upon the strip, forms the piece as in Figure 9, and the surplus metal or webb must be trimmed off. This is done by means of a trimming punch and die, Figure 10. The work is laid into the die at C, and the punch D severs the webb from the form and is prevented from becoming attached to the punch D by the action of the pressure pad E.

The product from the die is now finished and if the halves are to be joined, a facing operation on an emery disc is resorted to, in order to remove all sharp edges.

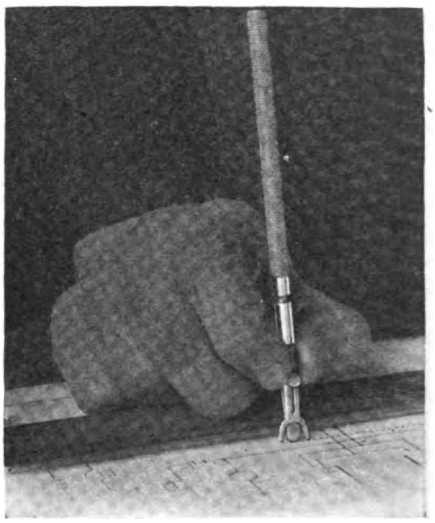
Should a model of the work be at hand, it is not necessary to make the half sections as described. The model can be used to make the impression into the plaster mould, and the pattern for the punch is made by pouring lead into the cast made as stated previously. The use of the box is merely to describe the method, although for numerous dies a standard form can be used.

Tools can be made in this manner for various classes of work. Bending and forming of irregular shapes can be done.

A Ruling Pen Which Makes Dotted Lines

WHILE some of us are thinking about new solutions for big problems, others are looking into ways of simplifying small ones. In the matter of financial success, small devices often bring as much or more profit than large and complicated machines.

The ruling pen illustrated here is an example. Those who have used dotted-line instruments will recognize the great improvements embodied in this device, and those who have not, will readily see the advantages in the use of this pen.



Essentially, it is like the ordinary ruling pen with the addition of a grooved, toothed wheel which extends just below the nibs. When ink is applied in the usual manner, it goes down upon the upper part of the wheel, filling the grooves of the teeth, but not the spaces between the teeth. Then, as the pen is moved over the paper, rotating the wheel, dotted lines are made.

By unscrewing the thumb nut, the nibs are separated and the wheel falls out. Different wheels can be inserted to give different lengths of dots and spaces, or dot and dash lines.

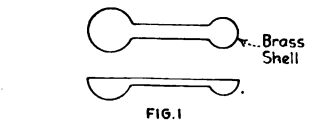


FIG. 1

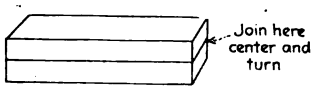


FIG. 2

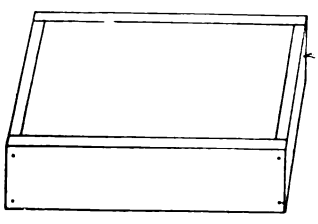
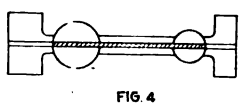
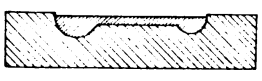


FIG. 3


FIG. 4


FIG. 5

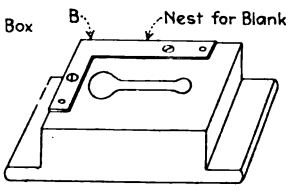


FIG. 6

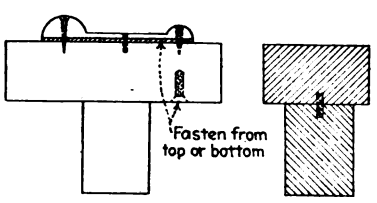
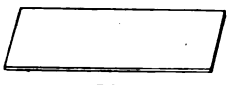


FIG. 7


FIG. 8

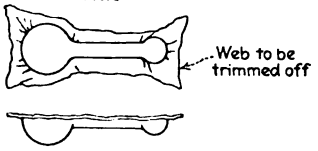


FIG. 9

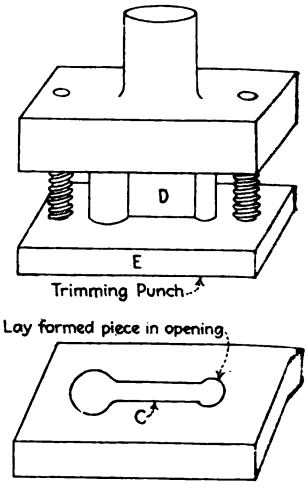


FIG. 10

Digitized by Google

AMERICAN SOCIETY OF EXPERIMENTAL ENGINEERS

ACTIVE WINTER PERIOD FOR A. S. E. E.

WITH many new local chapters forming throughout the country and new members joining the Society at the rate of fifty a month, the future of the organization looks very bright. A large number of the members who served in the Army are again joining the ranks of the Society. Before another year passes, the membership of the Society should reach a number of at least two thousand.

Mr. William G. H. Finch, an active Buffalo member, recently visited the Society headquarters at New York and plans were laid for the establishment of an energetic chapter in Buffalo. The experimental engineers of Philadelphia, Boston and Chicago are starting to recognize the great value of the organization and work is being carried on in these various communities to form chapters and laboratories. Mr. Joseph B. Entner, of Boston, has started work on the formation of a chapter in Boston and vicinity. Walter B. Russell, director of the Franklin Union Institute, has pledged his support to the movement and has promised the use of the large lecture hall of the Institute and also the loan of any piece of apparatus in its large laboratories for lecture purposes. Mr. J. A. Wakefield Hastie is in charge of A. S. E. E. activities in Philadelphia, Pa. A preliminary meeting of members in and around Philadelphia was called some time ago and plans were formulated for further work. A very successful chapter has been formed in Mansfield, Ohio, under the direction of W. D. Starrett and Mr. Richard Hautzenroeder. A large room has been rented and enough funds are on hand to meet expenses for some time to come. Although the Mansfield Chapter is not very large, it is extremely active.

Many plans are under consideration to increase the activity of the organization. With the limited source of funds available in the treasury of the organization, it is a very difficult matter to broaden the scope of the Society's work at the present time. With the increasing membership, it will not be long before many new activites will be made possible.

The purpose of the Society is to extend experimental activities, and to promote this aim every effort is being made.

Who's Who in the A. S. E. E.

HAROLD BLAKE ROBERTSON, B.S.

Mr. Harold Blake Robertson, B.S., enjoys an associate membership in the American Society of Experimental Engineers. He started his mechanical training in the De Witt Clinton High School, New York City. While attending this institution he became an active member of the Mechanic's Club. After graduating from the De Witt Clinton High School, Mr. Robertson entered Wesleyan University and graduated



from this place in the year 1914 with the degree of B.S.

For some time Mr. Robertson's attention was engaged in the design and development of a small automobile with extremely advanced design. He is now commodore of the Irvington (N. J.) Model Yacht Club, which organization is now conducting a boat race every Saturday afternoon. Mr. Robertson says that half of the joy of living comes through his work as a model engineer and he believes that of all hobbies, it is the most instructive and interesting. He firmly believes that the public in this country should be educated to look upon model engineering as a science by itself rather than a work of toy construction. He thinks (and rightly so) that the model engineers of this country should win the same consideration and respect from the general public as the model engineers of England.

Mr. Robertson was born in New York in the year of 1891.

What Is the A. S. E. E.?

We receive a multitude of letters asking us what the A. S. E. E. is and what its purpose is.

First and foremost, it is the purpose of the American Society of Experimental Engineers to organize the mechanical, electrical, chemical and radio experimenters of the United States and Canada into a solid body and to gain recognition for these men. When united, the experimental engineers of North America will become a more potent factor than they are at the present time in a disorganized condition. There are many thousand men engaged in experimental engineering throughout the country and it was with the purpose of bringing these men together in a solid body that the A. S. E. E. was formed.

The experimenters of America should be recognized as a serious class of men engaged in an important field of endeavor, whether they work for pleasure or profit.

The second purpose of the American Society of Experimental Engineers is to promote experimental science among its membership in every way possible. This work of promotion will not only be carried on through the publications of the society, but also by the establishment of local experimental laboratories throughout the country in which the members in the various communities and cities will be able to carry on their work. The experiments carried on in the various laboratories of the Society will be described in the Official Bulletin, which is published bi-monthly at the present time and issued to members only.

The possibilities of the Society are practically limitless at the present time, it enjoys the reputation of being a serious scientific body of men organized for mutual help and benefit. Men of every phase of scientific endeavor are eligible for membership.

Increased membership will make it possible not only to help more experimenters, but to give more assistance to each one. Each member should bear in mind that, by securing more members, he helps himself as well as the Society.

Digitized by Google



THE EVERYDAY MOTORIST

CONSTRUCTION — REPAIRS
DRIVING — OPERATION HINTS



Making Gas Engine Packings

By Arthur Alfred Alexander

BEFORE the cylinders are replaced on the engine base, heavy brown paper gaskets should be made to place between the cylinder base flange and top portion of the engine crank case. The best method of making these gaskets is to tamp them out by placing the sheet of brown paper over the mouth of the cylinder and directing a series of light blows with a machinist's ball peen hammer against the sharp edges of the casting. This will cut the paper exactly to the form of the base flange and cylinder bore. The holes in the flange may be indicated in the same manner or may be punched through with a steel drift. The same process may be used in making irregular shape gaskets of other materials such as asbestos or rubber packing.

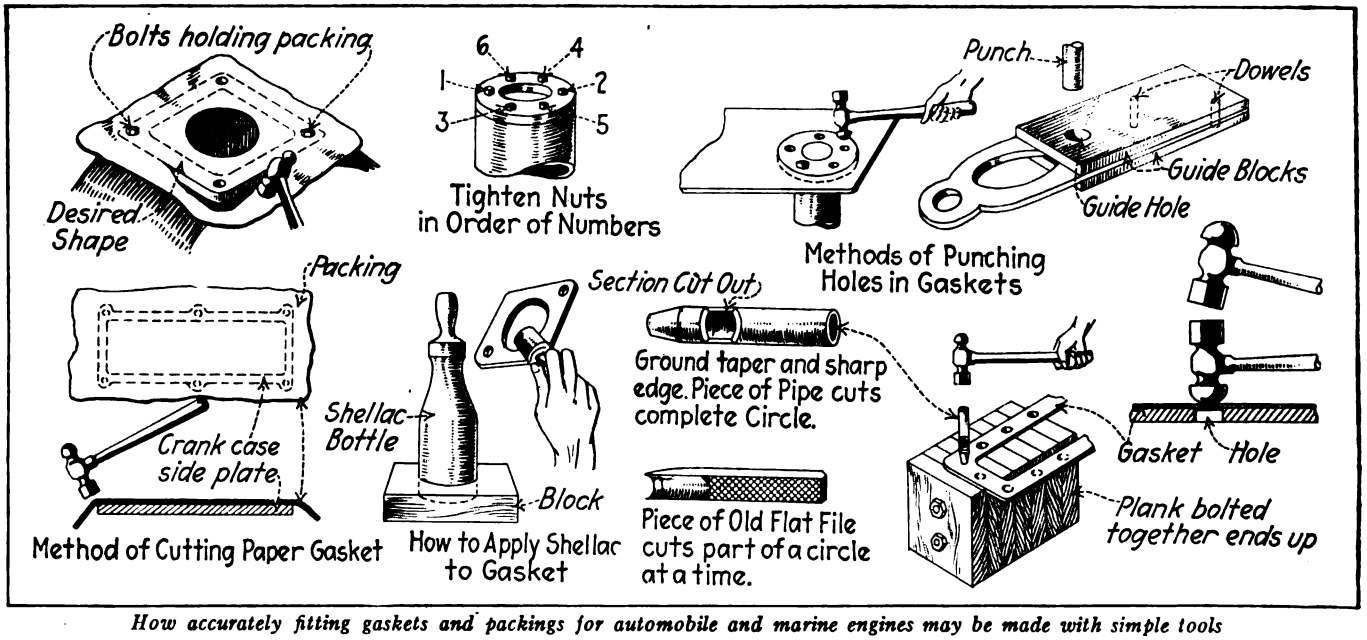
A number of cylinder designs, especially those in which two large or four small cylinders are cast in a block, have a large plate at the side which is used to close the water jacket, this forming a cover for an opening which had been left to facilitate foundry work when the cylinder was cast. This plate is either of sheet brass or aluminum; in some cases it may be an iron casting having a portion of the intake manifold cast with it. Leakage is prevented by a packing interposed between the plate and the cylinder, the plate being firmly secured to the water jacket by a number of closely spaced machine screws. This is a common method of construction and one often finds water leaks about the plate on inspection. The packing used is a rubber and fabric composition of the form known by the trade name "Rainbow" steam packing. This may be easily cut to proper size and holes punched in with a belt punch to allow the screws to pass through. In some instances simply removing the plate and smearing the gasket with shellac or red lead and then replacing the plate, taking care to screw down all the screws tightly, will cure the leak. One advantage of this plate is that it may be easily removed to permit of cleaning out the water jacket thoroughly of any accumulation of rust or sediment which may have become deposited there and which will interfere with proper cooling, this deposit being found in salt-water-engines more than in power plants operated on fresh water.

MOTOR FUEL FROM OIL-SHALE DEPOSITS

AS it is estimated that our present known natural liquid oil supply will be exhausted in about twenty years' time, the possibility of using fuels derived from oil-shale beds is now receiving some attention. These deposits are found in various parts of the country, but the most extensive are located in Utah and Colorado. In a recent article discussing the possibilities of exploiting these deposits and their value as a future source of internal combustion, motor fuels and other valuable by-products, the Engineering and Mining Journal states many interesting facts.

Oil-shale has no oily appearance indicating that it contains that material, but upon being subjected to heat its organic materials are broken up, and, among other things, oil and gas are yielded. The yield varies from 6 to 90 gallons of crude oil per ton of shale. The crude oil distilled may give 7 per cent to 12 per cent gasoline, 28 per cent to 49 per cent kerosene and 39 per cent to 62 per cent residium. Shale analysis indicated ½ per cent to 3 per cent moisture, 20 per cent to 52 per cent volatile matter and 45 per cent to 80 per cent ash. The asphalt varies from ½ per cent to 4 per cent and paraffin from 2 per cent to 9 per cent.

The by-products of shale are ex-



How accurately fitting gaskets and packings for automobile and marine engines may be made with simple tools

Digitized by Google

tremely valuable and include, in addition to oil products, enamels, varnishes, paints, rubber substitutes, manufacturing products for glass, pottery and ornamental tiles, dyestuffs, ammonium sulphate, flotation oils and producer gas. The Colorado shale area covers more than 2,500 square miles and the Utah area over 3,000 square miles. The strata vary from a few inches to 80 feet thick. The yield is from 31½ to 80½ gallons per ton.

In Scotland over 3,000,000 tons of oil-bearing shale are profitably treated annually, but it is only the ammonium sulphate produced as a by-product which makes the business pay. On the other hand, the prospects of the American oil-shale industry should be good, as in Colorado and Utah the shale beds are relatively thick, suitably located at sufficient heights for gravity transportation, and give a yield of 40 to 50 gallons per ton.

Notes on Cleaning Files

FILES which have become clogged with tin or lead are cleansed by dipping for a few seconds into concentrated nitric acid. To remove iron fillings from the spaces between the file teeth, a bath of blue vitriol is employed. After the files have been rinsed in water they are likewise dipped in nitric acid for a few seconds. File-ridges closed up by zinc are cleansed by immersing the files in diluted sulphuric acid. Such as have become filled with copper or brass are also treated with nitric acid, but here the process has to be repeated several times. The files should always be rinsed in water after the treatment, brushed with a stiff brush, and dried in sawdust or by pouring alcohol over them, lighting it and letting it burn off on the file.

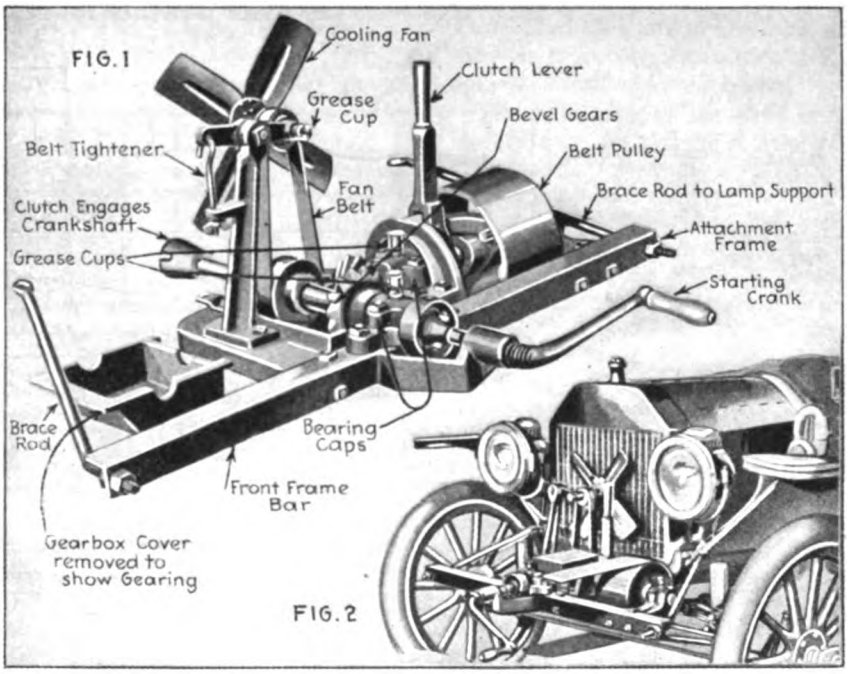
The uneven working of a file is usually due to the fact that filings clog the teeth. To obviate this evil, scratch brush the files before use and then grease them with olive oil. A file prepared in this manner lasts for a longer time, does not become so quickly filled with metal particles and can be conveniently cleaned with an ordinary rough brush when clogged.

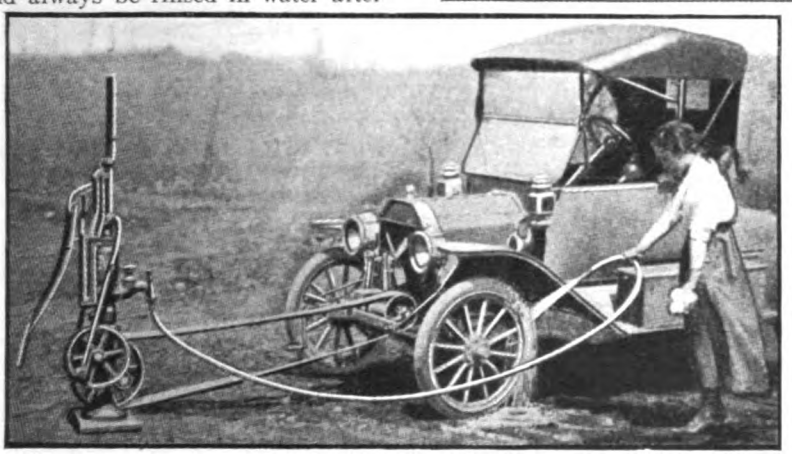
POWER TAKE-OFF FOR LIGHT AUTOMOBILE

By B. P. Fishbourne

VARIOUS attempts have been made to utilize the power from the engine of an automobile for driving different machinery. The simplest apparatus devised for this purpose ordinarily includes a drive pulley having its axis of rotation extending longitudinally of the automobile, the pulley being arranged at the front end of the automobile and connected with the crank shaft. The disadvantage of this arrangement is that the belt which receives the power from the drive pulley extends transversely of the automobile, and hence transmits strains in a direction transversely of the automobile. This action is found to be very detrimental to the automobile, and it is difficult to suitably brace the automobile against vibration and side play on account of the spring suspension.

The apparatus shown in the cuts successfully overcomes all of these objections, and may be easily attached to a Ford automobile to utilize the power due to the rotation of the crank shaft to the machinery to be driven. The apparatus in the cut (Figure 1) comprises a transverse frame to the ends of which are secured diagonal braces, apertured to receive the bolts which carry the lamp forks. The frame is also provided with apertured straps receiving the bolts which bind the front spring to the chassis. A shaft is arranged transversely of the frame and is journaled through bearings carried thereby. This shaft extends longitudinally of the automobile and its rear end is provided with a clutch element to engage with the transverse pin on the forward end of the crank shaft of the Ford automobile.





A power take-off for light automobiles is shown in detail at Fig. 1 and its attachment to the front end of a car at Fig. 2. The application to one of many possible tasks is shown at Fig. 3, where the car engine is pumping water

The opposite end of this shaft has a transverse pin to be engaged by the clutch element carried by the crank arranged forwardly thereof. This is the usual crank employed to start the engine. A second shaft is arranged at a right angle to the first shaft and is connected therewith by a pair of bevel gears. This second shaft carries the drive pulley which has its axis of rotation arranged transversely of the automobile.

An expansible clutch is arranged within the pulley and is operated by a lever, so that the pulley may be locked and unlocked from the transverse shaft. As the automobile is stationary, air is forced through the radiator by a fan arranged in front of the radiator and driven by the longitudinal shaft. Figure 2 shows the apparatus installed upon a Ford automobile, and Figure 3 shows the same operating a pump, suggesting one of the various uses to which the device may be applied.

Digitized by Google

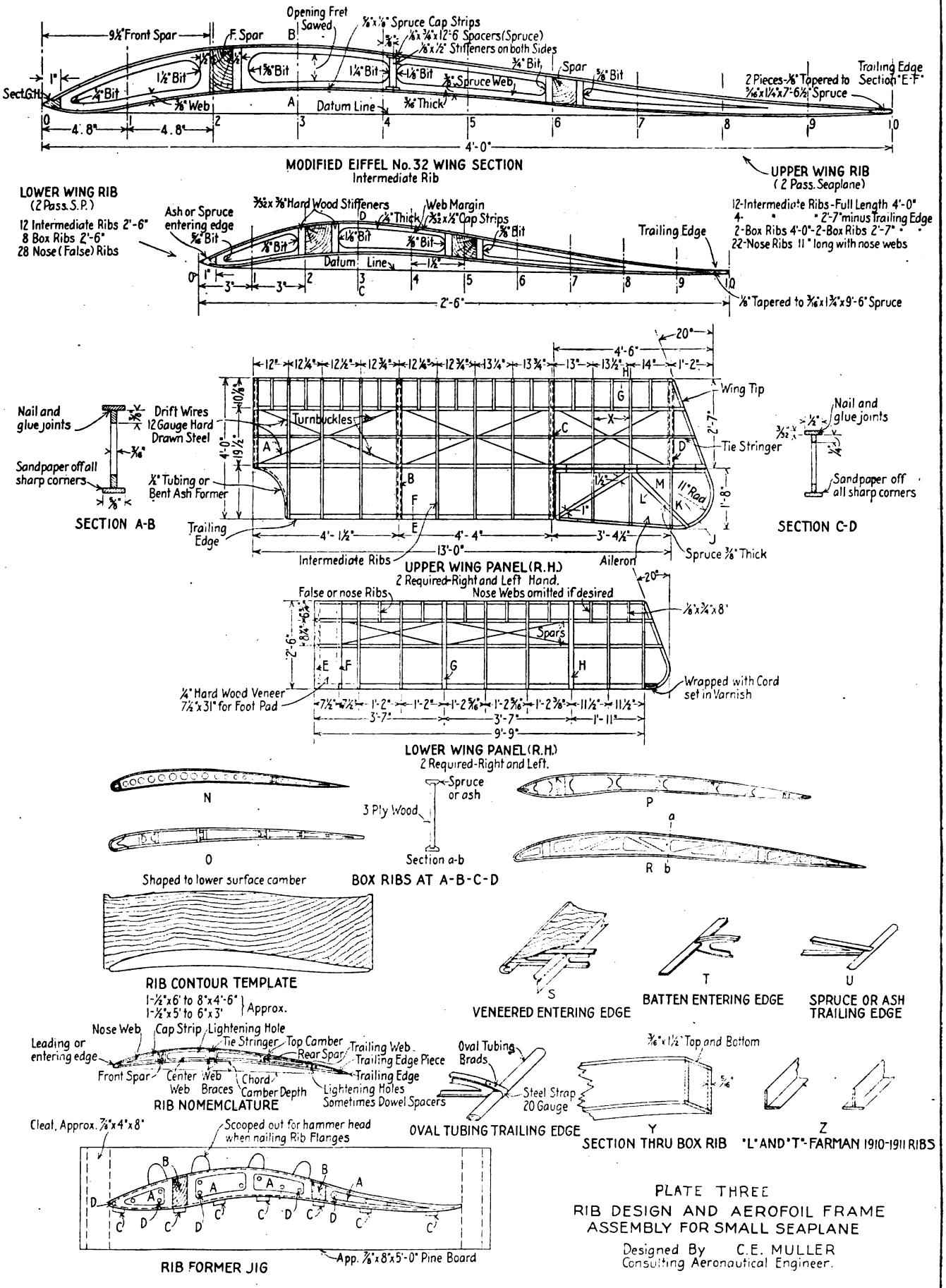


PLATE THREE

RIB DESIGN AND AEROFOIL FRAME ASSEMBLY FOR SMALL SEAPLANE

Designed By C.E. MULLER
Consulting Aeronautical Engineer.

Digitized by Google

Building A Two-Passenger Seaplane

By Charles E. Muller

Consulting Aeronautical Engineer

PART THREE

WING CONSTRUCTION

THE design and construction of the wings, aerofoils, planes or panels, as these components are variously named, unquestionably contribute the ultimate success or failure of the complete airplane. Due to considerable wind tunnel research by M. Eiffel at Paris, N. P. L. in England, and the Washington, D. C., laboratories, great progress has been made in plotting the aerodynamical characteristics of aerofoils. Up to and including 1911 Curtiss aerofoils were single surfaced, *i. e.*, the fabric only covering the top, the ribs and spars were exposed to view, The Farman, Graham-White and similar machines of that period had pockets for each rib and spar, but were single surfaced between ribs.

Designers no longer grope for aerofoil performances, but either select some tested wing section or submit a model for a test. There is no one best aerofoil curve. The selection of any particular wing curve depends on the performance desired. Speed and weight carrying have been the two greatest considerations. The future demand will be for a general all round machine with a very slow landing speed, as landing is, in the writer's opinion, the only real danger in flying. It is believed that any normal man or woman can fly an airplane after acquiring the manipulation of the controls, as the stability of the machine, if properly designed, is inherent. The writer's personal experience is that the lateral (sidewise balance) and longitudinal (fore and aft) stability control is perfectly natural in motion.

Many books have been and will be written on aerodynamics, and as the scope of this series of articles will not permit of this colossal mass of detail, it may be pertinent to recommend a most worthy book for reference. The A, B, C of Aviation by Pagé is an exceptionally fine treatise on the basic principles of airplane flight and aerofoil design and is recommended for the student either for home study or classroom instruction. Chapter IV very ably describes the aero-dynamics of aerofoils and design of these components in simple language that can readily be understood by the amateur builder of aircraft.

The upper intermediate wing rib illustrated by the accompanying cut in Plate 3 is practically the standard type of construction. It has been slightly modified from the Eiffel No. 32 wing section. The appended table gives its lift and drag co-efficients, lift-drag ratios, and the location of the centers of pressure at various angles of incidence.

AEROFOIL CHARACTERISTICS FOR A STAGGERED BIPLANE

Angle of incidence.	Drag.	Lift.	L/D Ratio.	Center of Pressure. Distance from leading edge. Ratio to chord.
0	.0000243	.00033	13.5	.220
3	.0000510	.000985	18.2	.235
6	.000127	.00161	12.6	.242
9	.000190	.00199	10.5	.269
12	.000273	.002175	9.5	.300
15	.000508	.002328	4.6	.319

The lower wing section is increased in depth because of structural necessity. This will increase the lift at low angles of incidence and slightly increase the drag at large angles of incidence. If a larger carrying capacity is desired the lower plane may be increased to 4'-0 chord, increasing the lift of the machine 20%, the center of pressure remaining as designed. This will not affect either the static or the dynamic balance of the airplane. The following table is given to show the extent of the modifications of the wing cambers:

COMPARATIVE CURVILINEAR ORDINATES

Eiffel No. 32 Aerofoil section 4'-0 chord in decimal fractions of an inch above datum line.

(See Plate 3.)

Station.	Bottom Camber. Eiffel.	Bottom Camber. Modified.	Top Camber. Eiffel.	Top Camber. Modified.
0	.48	.48	.48	.48
1	.336	.32	2.544	2.65
2	1.104	1.09	3.70	3.80
3	1.44	1.40	3.892	3.93
4	2.296	1.30	3.504	3.55
5	.96	.96	2.884	2.92
6	.576	.55	2.302	2.34
7	.240	.22	1.62	1.65
8	.096	.10	1.104	1.12
9	.00	.00	.76	.76
10	.144	.15	.406	.42

2'–6" CHORD LOWER WING

Station.	Bottom Camber. Eiffel.	Bottom Camber. Modified.	Top Camber. Eiffel.	Top Camber. Modified.
0	.30	.30	.30	.30
1	.210	.20	1.59	1.60
2	.69	.655	2.33	2.51
3	.90	.89	2.43	2.71
4	.81	.81	2.19	2.48
5	.60	.60	1.80	2.10
6	.360	.34	1.38	1.65
7	.150	.125	.99	1.20
8	.060	.07	.69	.73
9	.00	.00	.48	.465
10	.09	.095	.21	.25

The Eiffel No. 32 section was chosen as an excellent all around wing curve. Its maximum L/D corrected for scale is 18.2 at 3° incidence. It has reasonably fair values of L/D for high lift co-efficients. A most valuable consideration for the amateur flyer is the fact that its center of pressure movement is practically nil. The central parts or webs of the ribs are usually made of silver spruce, but may be made of whitewood, cotton wood, or white pine. Three-ply mahogany or birch are being used in increasing quantities, but are not recommended for seaplanes.

The lightening of the webs may be readily done by tacking a number together and fret or gig sawing to the holes bored to the sizes of the wood bits given in sketch to form the corners. Tightly clamp the webs together and bore until the spur of the bit protrudes through the last piece, then reverse the boring, thus obviating the splitting or slivering of the wood.

The nose webs, the center webs and the trailing webs are separate pieces until fastened together by the cap strips and should be held in a "former gig" when assembling these pieces as a rib unit. The cap strips are sawed with a fine tooth saw, from a five-eighth board of spruce or ash, but the same woods mentioned for webs may be used, but are to be avoided if possible. Elm is a good substitute if dry and straight grained. It is not generally used because of its tendency to warp and go out of shape. The writer used a considerable quantity of elm for ribs, as shown at Z, which proved fairly satisfactory, as early as the spring of 1911, at Waltham, Mass.

The cap strips will bend to shape, except possibly the lower nose camber. If any difficulty is found, this part may be soaked in hot water for a few minutes, then glued and nailed to the nose web with three-quarter inch No. 18 or 20 flat head wire brads which should be used to supplement hot glue. Great care should be used when nailing into the ribs to avoid splitting or running the brad out one side or the other.

As it is essential to have all ribs uniform, a jig similar to the sketch shown at AA may be made. In lieu of a trued up table or bench top a cleated board may be used to glue and nail on pieces A 7/32 inches thick, the identical shape and size of the webs, also blocks B the same size and shape as the wing spars. This will suffice if the lower cap strip be nailed on first. Of course, the ends where the trailing and entering edge pieces are fastened are left sufficiently open to permit these

Digitized by Google

members sliding through when assembling the wing structures. Blocks C may be fastened on permanently. Loose dowels may be inserted in holes at D to clamp rib against blocks C. If the cleats are screwed on, they may be reversed to other side, permitting the use of the other side for small rib jig.

The short ribs marked X are exactly the same as the other intermediate ribs minus the trailing web section. The nose ribs of the large wing are identical with that much of the intermediate ribs of the small plane or they may be steamed to shape and fastened on minus the nose web.

The box ribs indicated at A, B, C, D, E, F, G and H are doubly webbed, as shown at Y; the webs are sawed from 5/16″ spruce, or may be made of a 1¼-inch thick solid sawed out section spindled or scooped out between spars to an I beam section. These are necessary to take the compressional stresses due to the drift wires in the wing and the cross bracing of the interplane flying and landing wires which will be described in the next issue.

In same cases the ribs are all like the intermediate members, a strut of either steel tubing or wood is installed to take care of the compression, but as it necessitates an addition to the interplane strut fitting or a separate fitting, it is advisable for the amateur to accept the first method and use box ribs. The rib contour templates are necessary to check up the ribs as they are assembled in the panel and may be easily made as shown in the sketch.

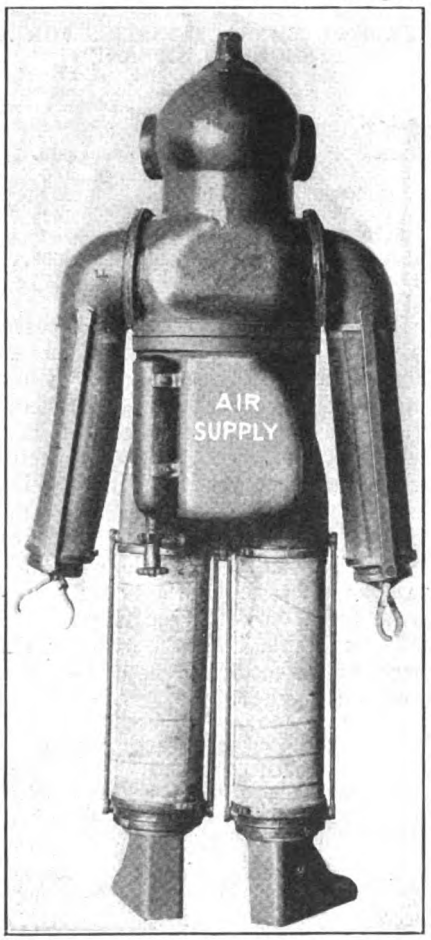
The wing tips are made stiff to resist the tension of the fabric when shrinking. The shape is largely a matter of taste and forms one of the distinctive features of the complete machine. It may be made of a piece of ash bent to the desired shape or sawed out of a spruce board joined together with long splices, or an oval tubing may be heated and bent to shape with the major axis horizontal. This is preferable for a seaplane. Also a laminated section may be used, using a number of ash or spruce strips ¼ x 1″, with the joints vertically disposed in the machine. It is bent and glued over a form, then dressed to suit conditions.

Trailing edges and entering edges are made in a number of ways, as the sketches graphically indicate. Figures N, O, R, S represent the spindled out entering edge for blunt nosed sections such as the Eiffel 13 bis, 33; U. S. A. sections 1, 2, 3, 4 and 5, R. A. F. 4; sharp nosed sections as the Eiffel 32, 36, 37, R. A. F. 3, 5, 6 and U. S. A. 6 require the methods shown at figures T and section G. H.

Figures U and V indicate the general forms of trailing edges now in use. The wire trailing edge is still used, giving a scalloped appearance like the French Spad and the German Taube.

When assembling wing panels 2-30″ high wood horses will be found convenient. Caution is required for spacing and preventing any distortion, due to shrinkage or swelling of components. Hot glue and brad all wood joints. Use 20 gauge sheet steel bands if steel tubing is used for trailing edges, and wing tips.

The top camber from the entering edge to front wing bar and sometimes to the stringer is covered with veneer as at figure S or covered with single ply or aluminum sheet, but may be omitted. The loss in efficiency is not great enough to compel this additional expense and the extra thickness of section will practically compensate for this deficiency. In high speed, high powered machines this part veneer, part cloth wing covering is desirable.



The improved Leavitt armor for deep-sea diving

When assembled the steel tubing should be wrapped with tape; then the whole mass should be given a coat of orange shellac, followed by a coat of Valspar varnish. As these coats of varnish are to protect the material from the weather (dampness, etc.), and not for appearance, fairly thick coats are applied. Carefully hang up the wing frames by the use of slings suspended from the ceiling to prevent warping out of shape while waiting for the covering.

(Ed. Note.—Fabric and dope work will be described in Part 5.)

New Deep-Sea Diving Armor

THE opportunities for deep sea salvage were never so great at any time in history as at the present. One of the biggest problems receiving attention from the Nations of the World is the recovery of ships and cargoes sunk during the war, whose total value is counted at billions of dollars. In all operations under the water, whether recovering cargoes only or raising ships, it is essential that divers must be on the job. Mechanical means alone are inadequate, they must be supervised and aided by men who can work and see.

The improved Leavitt diving armor shown herewith enables the diver to work in from one hundred to five hundred feet of water and allows all necessary movements, with no danger or inconvenience to the diver. He is encased in an all-metal suit that relieves him of all pressure, allows free movements of hands and arms, makes his air for breathing (sufficient for four hours' work at one time); has telephone connection with the ship above. He is unimpeded by air lines, signal cords and other objectionable features of the usual rubber diving suit.

The construction of the new Leavitt armor is different from any diving apparatus previously invented. The metal is manganese bronze, an alloy which will not rust, but which has the tensile strength of steel. Most joints would leak under water if made loose enough to allow motion, and if made tight enough to prevent leakage they would jam under the pressure. Mr. Leavitt therefore used ball-bearing joints at the shoulders, wrists and ankles, flexible hard-rolled interlocked copper tubing, wrapped with pure rubber, is used for arms and legs. The helmet has four windows of half-inch Triplex Safety Glass and a telephone with communicating wire built into the raising cable.

In addition to the diving armor Mr. Leavitt has perfected a system of electric lighting that will stand the pressure and illuminate a radius of twenty feet at depths to five hundred feet. By means of these inventions salvage work hitherto impossible is rendered comparatively easy.

The diving armor and lights have been thoroughly tested to a pressure of two hundred and twenty pounds per sq. in. equal to a depth of five hundred feet. Mr. Leavitt holds the world's record for depth of diving having walked on the bottom of Grand Traverse Bay for forty-five minutes at a depth of 376 ft. Also the armor has been successfully used in salvage operations, notably the recovery of the cargo of copper and valuables from the Steamer *Pewabic* sunk over fifty years in Thunder Bay in 176 feet of water.

Digitized by Google



THE JUNIOR EXPERIMENTER

How to Make a Simple Steam Turbine

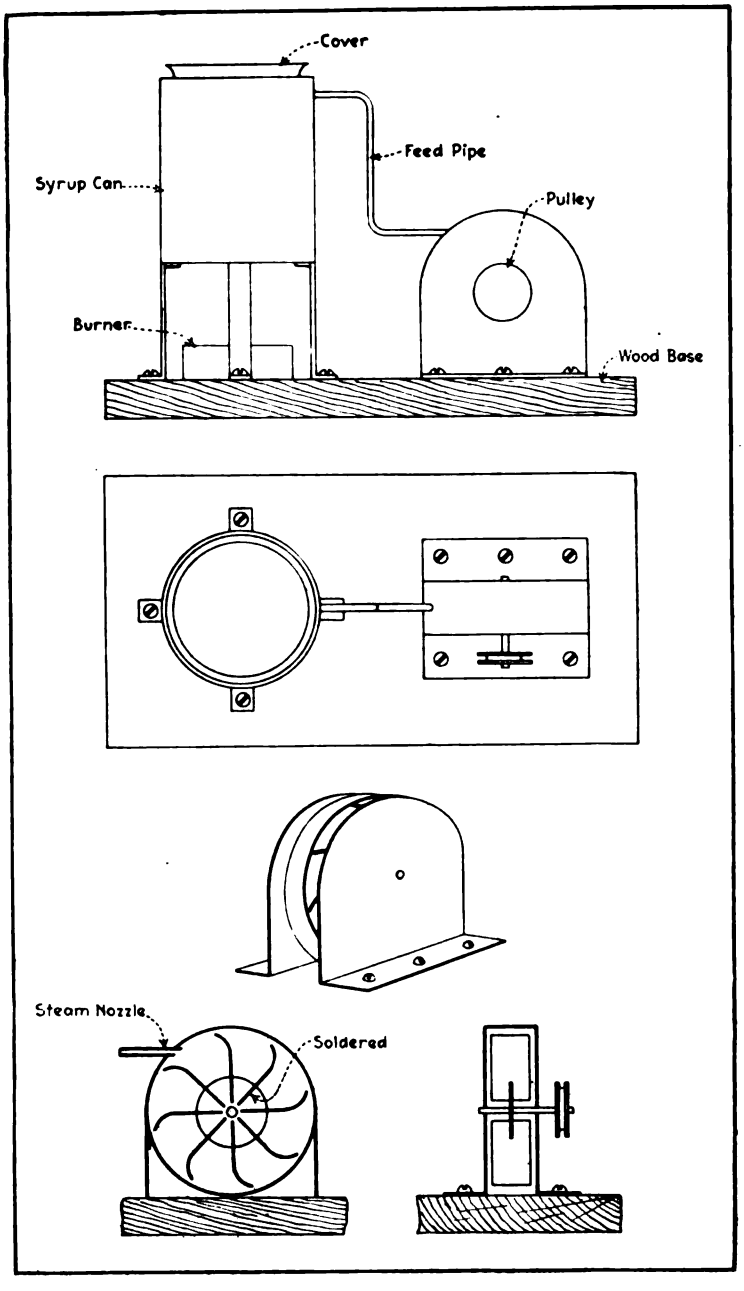
By George F. Carter

THE little steam turbine illustrated in the drawing is one with which a good many interesting hours can be passed, both in the construction of the device and in its operation. There is absolutely no danger of explosion with it and it possesses the advantage of easy construction with few tools.

The boiler will be considered first. A clean syrup can may be used for this. The paper covering, of course, should be removed and the can carefully examined for defects. Four strips of heavy gauge brass are bent as illustrated and soldered to the bottom of the boiler. These act as feet. They are drilled at one end so that small wood screws can be used in holding the boiler to the base board. Soft solder can be used to fasten the feet to the boiler, owing to the fact that the water in the boiler will prevent the solder from reaching the melting point. The top of the tin can is used both to fill the boiler and as a safety valve. If the supply pipe should become plugged, the steam pressure would blow the lid of the can off, thereby relieving the pressure immediately.

The burner is a small cover from a tin can filled with asbestos and covered with a small piece of copper or brass gauze. The alcohol which is used as the fuel is poured into the cover and it will burn for approximately fifteen minutes. It is advisable to make two of these burners, so that the turbine can be run continuously.

The turbine is very simple. A circular piece of sheet brass is cut out and eight slots are cut in it to accommodate the blades. The blades are also cut from sheet brass and their ends bent as shown. They are soldered into the slots of the circular piece. A small brass rod is placed in the center of the rotor for the shaft and this is also held with a drop of solder on each side. The sides of the turbine are cut and bent as illustrated. The circular covering between the sides of the turbine is formed by a strip of sheet brass with the ends soldered together. The sides are then soldered to this piece. The turbine is held to the base by means of six small wood screws, as shown. A small wooden pulley is placed on the protruding end of the rotor shaft. The steam feed pipe which connects the boiler to the rotor is copper or brass and it should be thoroughly heated before it is bent to the shape shown. This is to prevent it from kinking. In bending this pipe it is well to cut a little wooden form of the proper radius so that it can be bent around it. If the pipe is bent too sharply it will kink. A drop of solder on the point where the pipe enters the boiler and the steam turbine will render it steam tight. The position of the nozzle is shown in the cross section of the turbine.



With a very low pressure, this little turbine will develop considerable speed, but it delivers very little power.

In operating the little power plant, the boiler should never be permitted to become dry as this will melt the solder and probably cause leaks by undue expansion of the seams in the can. The water should not be permitted to stand in the boiler as it will cause rust. A little lubricating oil placed in the boiler will help to protect it from rust.

Those who wish to elaborate on this design can add more blades, or increase boiler capacity.

Digitized by Google

A Talk With Radio Beginners

The Boy Students or the Older Men Who Would Like to Work With Wireless Are Often Confronted With the Problems Which are Cleared Up in This Article

ALL kinds of interests are represented by the men who call at the offices of EVERYDAY ENGINEERING. Every one has, or is interested in, some particular hobby. Whatever the hobby, they are nearly all familiar to some extent with radio work, but, when the subject is brought up, so many say, "I'd like to have a wireless set, yet there are so many new and complicated instruments I haven't the time to get into it." Others, who had stations years ago, feel that they are too far behind the times, and some say the cost is prohibitive. There is also the difficulty of learning the code.

Not one of these objections, actually, is a reason for not having a radio station.

In the first place, the advances of the radio art has simplified, rather than complicated, the equipment required for a wireless station. The men who used to have sets, back in the dark ages, will find that receiving and transmitting with new apparatus is more reliable and can be carried on over greater distances than ever before. The cost of receiving instruments for a simple set is, in spite of general increased prices, lower than of equipment to do the same work five years ago. Finally, our Governments perhaps, to make up for its treatment of the experimenters, has established a broadcast schedule to give the beginners a code practice at slow speed.

And now, possibly, some of those same objectors are wondering, "What kind of a set can I have, how much will it cost, and how can I copy this code practice?"

Almost everyone can remember that, before the war, there appeared to be a high-mast competition. In fact, the antenna height was about the most important thing about the station. That is no longer the case. Sending antennas are limited in size by Government regulations. Aerials for receiving are almost entirely of the single wire type. They require no masts or spreaders, and can be put up on natural supports. Antennas are broadly classed as Short, Long and Super Range. The first class are 30 feet high and 100 feet long. They will receive the Arlington time signals, with a simple tuning coil or loose coupler, galena detector, and reliable 2,000-ohm phones, at a distance of 500 miles, under ordinary conditions. Second class antennas, 30 feet high and 200 feet long, with the instruments just mentioned, will receive Arlington up to 1,000 miles, while the third class, 30 feet high and 300 feet long, using a single Audion detector, will receive Lyons, France, up to 5,000 miles.

As for the apparatus required, this need be no more complicated than the knowledge of the operator is extensive. In the September issue of EVERYDAY ENGINEERING a simple receiving set was described. If the equipment is purchased, a tuning coil costs only four or five dollars, or a good loose coupler ten or twelve. Detectors are sold at prices ranging from one to five dollars, and telephones from four to sixteen. A one-dollar fixed condenser and a buzzer are also needed. Complete materials for a Long Range antenna cost about three dollars.

The price of the instruments for a complete receiving set, then, amounts to around fifteen dollars. This can be cut in half if the experimenter makes his own apparatus, and the instruments are so simple that no special skill is required.

The code requires a certain amount of application and practice. It will be found that, in many cases, commercial messages are not transmitted at as high a speed as was used before the war. Also, the Navy Department has inaugurated a nightly code practice which will be of great assistance to beginners. A further announcement is given on page 46 of this issue.

The plan is to use the usual Continental signals, but to arrange the letters of the words by a special code, furnished by the District Communication Superintendent. This method makes it impossible to guess at the letters; each one must be copied accurately to make possible an accurate decoding.

For the benefit of those not familiar with the Continental Code, now used entirely for radio communication, the characters are listed here.

A	. –
B	– . . .
C	– . – .
D	– . .
E	.
F	. . – .
G	– – .
H	. . . .
I	. .
J	. – – –
K	– . –
L	. – . .
M	– –
N	– .
O	– – –
P	. – – .
Q	– – . –
R	. – .
S	. . .
T	–
U	. . –
V	. . . –
W	. – –
X	– . . –
Y	– . – –
Z	– – . .
1	. – – – –
2	. . – – –
3	. . . – –
4	. . . . –
5	. . . . .
6	– . . . .
7	– – . . .
8	– – – . .
9	– – – – .
0	– – – – –
.	. . . . . .
,	. – . –

In memorizing the code, it is not advisable to think, for example, "dot dash, a, dash dot dot dot, b," but, "Dt da, a, da dt dt dt, b," and so on, as these sounds are more like the sounds of the signals. When possible, it is of great assistance to have some one send from a newspaper or book. This gives excellent practice to the beginner. Then, when the characters have been fairly well mastered, letters can be picked out, here and there, from commercial messages until, with a little more experience, all the letters are understood.

A copy of the Government Radio Regulations can be obtained from the Government Printing office for fifteen cents cash or money order. Stamps are not accepted. This gives all the details for obtaining a transmitting license—no license is required for a receiving station—and describes the methods used in radio communication. It also contains a list of abbreviations and special signals.

As soon as possible, the experimenter should apply for an amateur operating license. Altho this is not required, where a receiving station only is operated, it is essential for the owner of a transmitting set, and is always a valuable thing to have. The book of Government Regulations tells all about the different classes of licenses and the methods of application. Special arrangements are made for those who cannot go to the office of the Department for examination, and also for temporary licensing of isolated transmitters.

In the coming, as well as in the past, issues of EVERYDAY ENGINEERING there will be articles on the construction of simple apparatus for those who are just taking up radio work. Any inquiries for information on circuits or apparatus should be addressed to the Radio Department, EVERYDAY ENGINEERING.

Digitized by Google

A Three-Foot Flying Model Nieuport Speed Scout

By Elmer Ross

FIRST, we will make our full sized layout for forming and bending the longerons of our fuselage. Make the layout of one side and then form both sides in the same form. Place headless nails along the outside lines to hold the longerons in shape while drying. Then boil the longerons in water for ½ hour, after which they are placed in the form and permitted to stand until dry. While you are making the layouts, boiling and bending the wood, make the layouts for the two upper and two lower wings, the balanced rudder, elevators and stabilizer. The reed can be boiled along with the longerons. Returning to the fuselage: After you have the longerons bent, cut them to shape and fasten in place the fuselage struts, making up two complete sides. This done, cut and fasten in place the top and bottom fuselage struts. Fasten each strut in place by glueing and nailing with a small brad, and always be sure to drill a hole with a No. 61 drill before doing the nailing or the members will split.

Landing Chassis

When the fuselage is complete, cut it to size and fasten in place the landing chassis struts, which are made in one piece to the size shown. To facilitate construction, cut a small slot in the lower portion of the chassis members for the axle to slide in, pass the axle through and fasten it in place with the brace wires. The axle is 1/16 in. in diameter by 9 ins. long, and the wheels are 2½ ins. streamlined discs. Chassis struts are cut out of ⅛ in. wood, then given streamlined shape, and trued up to dimensions on the drawing.

Tail Skid

The tail skid is a piece of ⅛ in. x ⅛ in. bass wood 2½ ins. long and fastened to the lower longeron 1⅛ in. from the top end of the skid and 1⅝ ins. back from the tail post of the fuselage. Pivot on long brad passed through both lower longerons and then attach rubber bands, as shown, to take up some of the shock of landing.

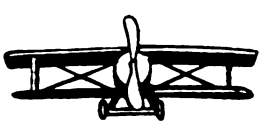
Motor Stick

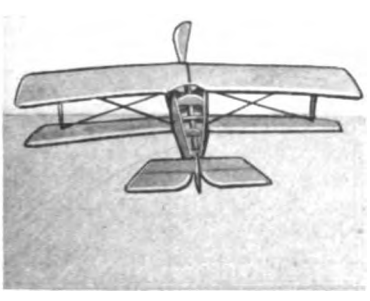
The motor stick consists of one piece of spruce 5/16 in. square by 15 ins. long, one aluminum propeller hanger, one ball bearing propeller shaft, one rear rubber hook, one 12 in. propeller and five doubled strands of 3/16 in. flat rubber. Connect them as shown in the April 1919 issue of EVERYDAY ENGINEERING in the writer's article on "A Model Curtiss JN4." Fasten in the fuselage at No. 2 and No. 3 top fuselage struts only and *exactly* in the center.

Engine Cowling

Make an aluminum cowling to the shape and size shown from 1/64 in. thick aluminum. To fasten the cowling to the fuselage it will be necessary to cut off the first section of the fuselage and fasten it in place to the four longerons at section No. 2, after cutting off section No. 1. Drill a ⅞ in. hole in the cowling, as shown, for the propeller hub to project through. After putting the cowling in place, put the propeller on the hub and tighten up the nut.









Side and Turtle Deck Formers

Make the side and turtle deck formers to the sizes indicated and fasten in place to the fuselage in the position shown, by glueing and drill a hole and place a small brad in it for extra strength. The formers can be lightened if desired by drilling holes in them, or, if a scroll saw is at hand, by cutting out the centre portion.

Interplane and Cabane Struts

The interplane struts are cut 4⅝ ins. for the rear and 6½ ins. for the front and streamlined. Bass wood is used. The struts over the fuselage are made from 5/16 in. O.D. aluminum tubing flattened out to streamline shape and entirely flat at the top. The bottom end is left round to fit over a small strut socket. You will need four made to the dimensions shown. The special V-socket on the bottom plane can be bought ready made up. Other strut sockets are the ordinary upright kind.

Wing Construction

After the layouts are made and the wood boiled, place it in forms to dry. During this time the ribs can be cut out. Ribs will be needed for each top wing and each bottom wing, and they are made of 1/16 in. thick spruce to the size shown, with the exceptions of the ones which are ⅛ in. thick. The drawings of the wings only show the ribs altogether, but the writer used a 1/16 in. rib spaced in the middle of each rib shown on the drawing. If the wings are made as shown in the drawing, the model should only weigh 11¾ ozs., which will give a few feet more in the flight length. After the reed edging is dry and the ribs cut out and drilled, assemble as shown in the drawing. The writer has made the wings in one piece, but the drawings show the proper size of the ailerons; if you desire to use them on your model, place strut sockets on spars at points shown in rigging sketch.

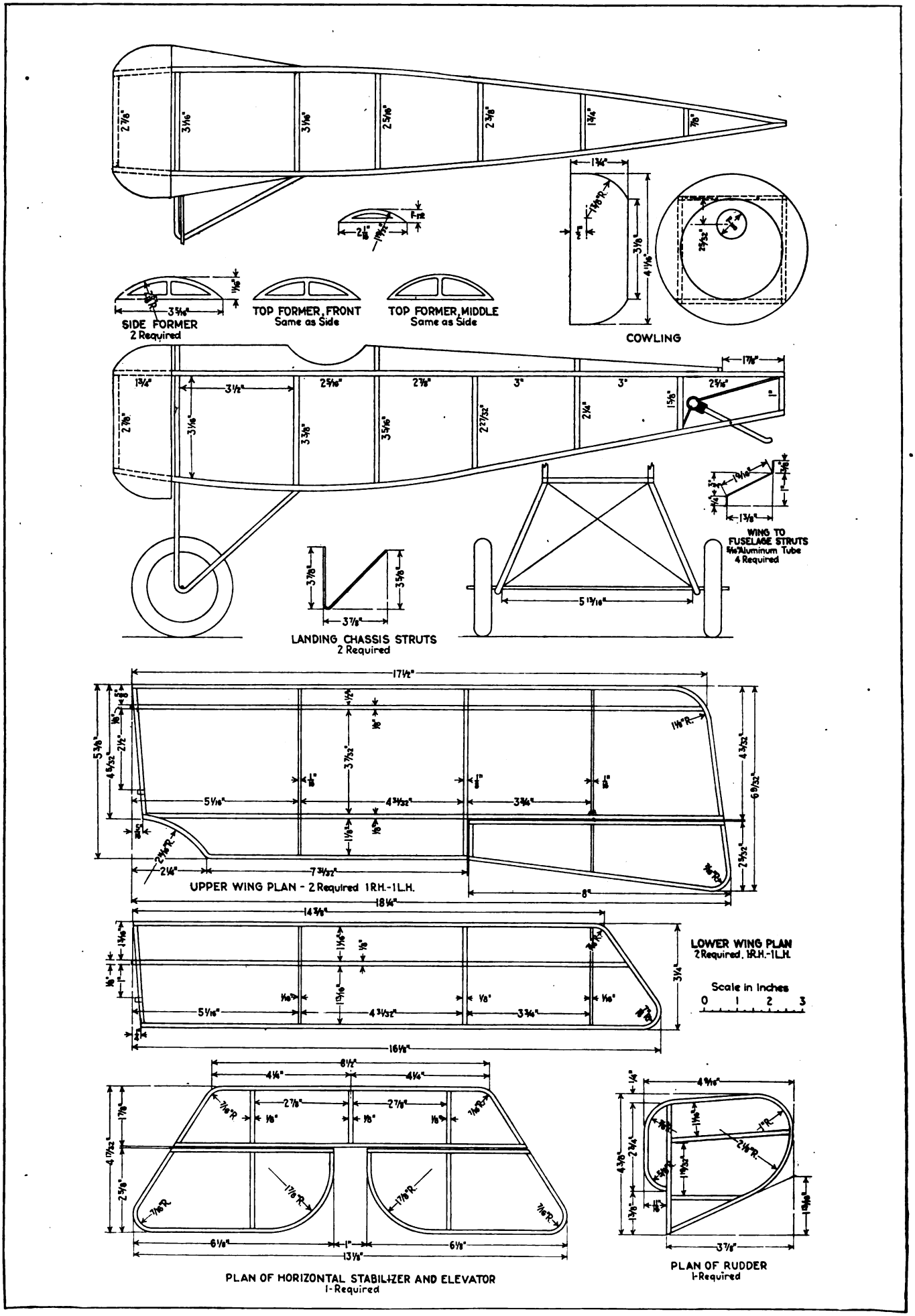
Stabilizer, Elevator and Rudder

The stabilizer, elevator and rudder are made from ⅛ in. reed for the edging and ⅛ in. square bass wood for the filling in pieces. The stabilizer and elevators can be made in one piece if desired, but by making them separate and adjustable you can correct the tendency of your model to fly in anything but a straight course.

Covering and Doping

The wings, fuselage and controls are all covered with bamboo paper and doped with doping solution described in the April issue, or the builder can purchase bamboo varnish and use it. They both cost about the same. When covering the parts, be sure and remove all wrinkles out of the paper. It is

Digitized by Google



Digitized by Google

best to give the machine two coats of the doping solution.

Assembling

The model is assembled as shown in the sketch and should be perfectly square with the fuselage in every respect, with the exception of the arrow shape which the leading edges of the top and bottom wings will have and which is taken care of by the slant of the inner rib of each wing. Fasten the brace wires in place as shown and do not tighten securely until the wings are in the correct position. The writer used small turnbuckles on his machine, which still leaves the weight 13 ozs. The builder can use them, too, if desired, but by leaving them off a reduction in weight is effected.

To fly the model, choose a field in which the grass is a little bit long, and if the wind is blowing over 10 miles per hour, head your model with the wind. It is a good practice to get a good distance flight to head the model with the wind.

With the amount of rubber specified, give the propeller no more than 165 to 170 turns, but for the first flight give 150 and as the rubber gets older you can then work up to 170 turns. If the model is properly constructed, you should get at least 200 ft. from it, and if, while building it, you think you can cut down some weight, it will give proportionately longer flights. Also be careful to get the wings in the proper place or the model will not balance and consequently will not fly properly as its course will be erratic.

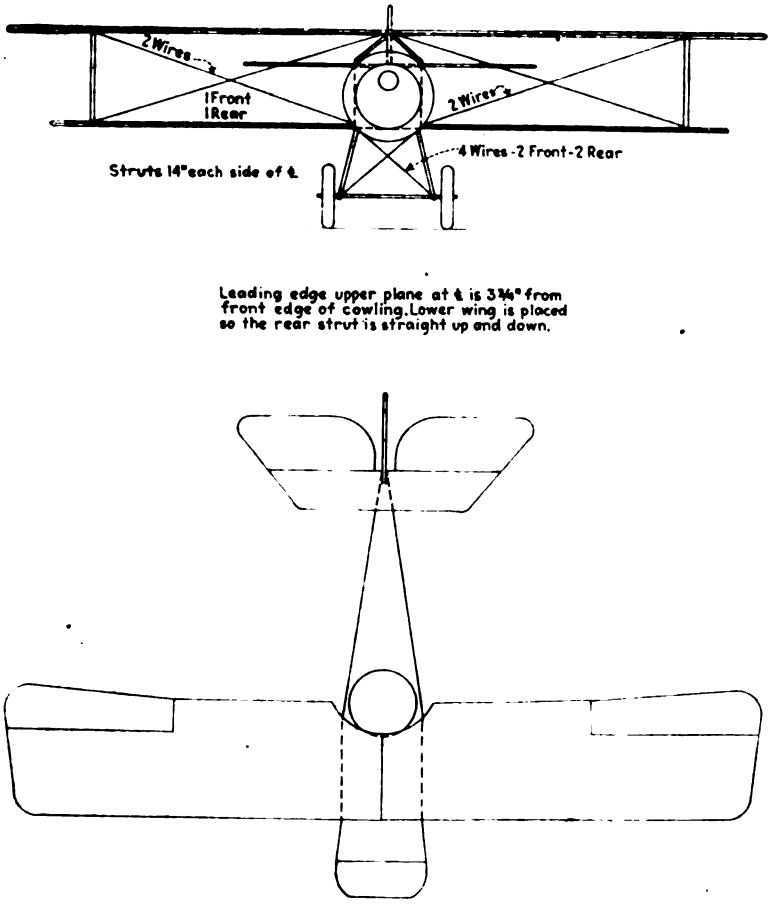
Remarks

The fuselage of the model Nieuport speed scout is 20⅜ ins. overall. The struts can be either made streamlined or ⅛ in. doweling can be used.

The landing chassis struts can be produced by either making them out of one piece of 3-ply ⅛ in. wood or it can be a piece of ⅛ in. round reed boiled and bent to shape as shown. To do away with the aluminum cowling, make a cowling out of split bamboo bent to the same size as the aluminum cowling. If you wish, you can take split bamboo for the turtle deck and side formers. Bend it to the proper shape, fasten to the fuselage with glue and thread, which will do away with the ⅛ in. thick pieces of wood for formers.

The motor stick could be made from a piece of 5/16 in. O. D. aluminum tube, and made 5/16 in. square at the propeller and with a 5/16 in. square piece of wood 1½ ins. long, in order to be able to fasten the hanger and the rear rubber hook could be inserted in a 1/16 in. hole drilled in the other end of the tube. This could be fastened with the small nuts that come with a rear rubber hook.

By using a 1/64 in. thick aluminum turtle deck made in one piece and fastened along the side of the top longeron, you can readily take it off to fix the motor any time you wish. A good idea is to have the engine cowling, side cowling and turtle deck all made of one piece of aluminum.



Above all, be sure and have each part square with each other, and keep any extra added weight off the tail.

The complete fuselage is made out of ⅛ in. x ⅛ in. square basswood. The writer used 5/32 in. x 5/32 in. in order to have the machine stand more rough use during tryouts to find the proper position of the wings.

Carry an indelible pencil in your tire repair kit. When you find a leak in a tube you must mark it so as to find it again. A black lead pencil is useless, but indelible mark will remain.

PROPERTIES OF BALSA WOOD

A VERY light wood, known as balsa is now used widely in making life rafts, buoys and floats, airplane components and other uses where a wood of this nature is desirable. It also possesses valuable heat insulating properties. Prof. W. W. Rowlee, of Cornell University, who was sent to Central America last year by a New York company to study balsa in its native environment has just published an article in the *Journal* of the Washington Academy of Science on the botanical characteristics of the wood.

The balsa tree belongs to the genus "Ochroma." Formerly only two species were recognized, the one which was the source of the wood imported to this country being known as "Ochroma lagopus." Professor Rowlee's investigations increase the number of known species to nine. It grows with astonishing speed, often attaining a height of 60 feet or more in five or six years. In its natural state the wood is very perishable, decaying with about the same rapidity as a cotton fabric. The balsa wood of commerce is made durable and waterproof by a special treatment. In tropical America this tree bears many names besides "balsa," which is merely a Spanish word for "raft," in an allusion to the fact that rafts of this wood are used for transportation purposes on the South American rivers. In Nicaragua, the tree is called "gatillo", in Guatemala "cajeto," on the west coast "moho," in Jamaica "corkwood" and "down tree," because of its lightness.

Balsa proved its utility in the war when it was not only used extensively for life-rafts and life-boats but also in the construction of the 250-mile mine barrage across the North Sea, which included 80,000 floats made of this buoyant wood. In aeronautical work it has been used for seaplane floats and pontoons, for airplane wing rib webs and for streamlining and fairing steel struts, bracing wires and any tubular members of circular crosssection. Investigations are now in progress to determine and plot its strength—weight ratio and other physical characteristics.

No doubt many other uses will be found in the future for this remarkable wood despite its great cost.

Digitized by Google



EXPERIMENTAL CHEMISTRY

METALLURGY-ELECTROCHEMISTRY PHYSICAL CHEMISTRY

Metallurgy for Beginners

By E. Hurley

IT has been conceded that there is a lack of research and serious investigation in the laboratory of the amateur chemist.

In many localities there are valuable mineral deposits as yet not discovered and it is the object of this article to endeavor to give to the amateur chemist information that may aid him in his investigations for valuable ores, also furnishing an insight into the work involved in determining the metals in these ores.

The subject is not treated in a technical manner neither is it the purpose to describe all the processes that have been devised or even the modifications and adoptions of these processes that are now being used in the analysis of the principal ores.

The reagents and apparatus used are those generally found in the laboratory equipped for elementary qualitative analysis. The reagents for the work are prepared as follows:

Aluminum

Aluminum is of common occurrence and is one of the chief constitutents of the earth's crust. It is found in most rocks but there is but one ore, bauxite, that is of commercial value. This mineral contains approximately 74% aluminum oxide when pure. It has a dull lustre and is found in various colors, particularly red, brown, gray, etc. The electrical furnace is the only successful method of extracting the metal from its ores.

Test

Aluminum compounds, are, as a rule, insoluble in acids and to obtain the aluminum in solution, it is necessary to subject the ore to an alkali fusion. Dissolve the residue in hot water and add hydrochloric acid. Evaporate to complete dryness and when cooled, add 10 cc. hydrochloric acid. Then heat it three minutes over a bunsen burner and add 50 cc. water. Boil and filter, washing the filter with hot water. Dilute the solution to about 250 cc., heat it until it boils and then pass hydrogen sulphide gas through the hot solution. Filter and add a few drops of hydrochloric acid to the resulting filtrate and boil three minutes. Now add 15 cc. ammonium chloride and enough ammonium hydroxide to make the solution decidedly alkaline and if a precipitate is formed, filter it off. *No precipitate here indicates the absence of aluminum.* If a precipitate is formed, filter and wash it and then make a hole in the filter paper so that the precipitate can pass through to the test tube. To the solution in the test tube add 20 cc. of concentrated potassium hydroxide, boil and filter, reserving the precipitate. To this filtrate, add 50 cc. of ammonium chloride and if aluminum is present a white precipitate will be formed which will not dissolve on the addition of ammonium carbonate solution.

Barium

The principal ores of barium are barite, a heavy whitish mineral. It is used in the manufacture of white lead and also in the paper and sugar industry. It occurs in Missouri, Tennessee, North Carolina, Kentucky and many other states.

Take a gram or a small quantity of the finely pulverized ore and add to it 15 cc. of moderately warm sulphuric acid. After heating, filter and discard the filtrate. Boil the residue for twenty-five minutes in a concentrated solution of potassium carbonate and filter, washing the precipitate well. To the precipitate add 10 cc. dilute hydrochloric acid by pouring it through the filter on which you have the precipitates, collecting the solution that passes through. Add three grams of ammonium chloride and then 5 cc. warm sulphuric acid. *No precipitate here indicates the absence of barium.* If one is obtained filter it off, boil again as before with a solution of concentrated carbonate solution, filter and wash thoroughly. Dissolve it in acetic acid and to the solution add a few drops of potassium dichromate and if barium is present a yellow precipitate will be thrown down.

Bismuth

The principal ore is bismuthinite with a lead-gray color. It contains 81% bismuth. Bismutite has a white and yellow color and contains approximately 88% bismuth. Tetradymite has a steel gray color and contains 69% bismuth. It has been found in several localities of the United States, an excellent grade coming from Arizona. Its principal use is in alloys, one of which is composed of lead, tin and bismuth with a very low point of fusibility.

Place a small quantity of the finely pulverized ore in a porcelain dish and add 10 cc. of hydrochloric acid and 10 cc. of nitric acid, and heat to boiling. Boil most of the solution off and then dilute with an equal amount of water and filter. Take a test tube, half full of water and add to it a little of the filtered solution. If bismuth is present a white precipitate is formed. Dissolve a small quantity of this precipitate by adding to it a few cubic centimeters of hydrochloric acid and add an excess solution of potassium stannite (made by adding to a little stannous chloride in a test tube enough potassium hydroxide to re-dissolve the first precipitate formed) and if bismuth is present a black precipitate will result.

Chromium

The principal ore is cromite. It is a brownish to black and slightly magnetic. This mineral is distributed widely over the United States. Its principal use is in the manufacture of chrome steel.

Fuse a small quantity of the pulverized ore in a small porcelain crucible with about four times as much sodium peroxide, using a blow pipe or blast burner. Dissolve the melt in hot water and filter. If chromium is present, the solution will be yellow. Make the solution acid with acetic acid and add a few drops of the lead acetate solution and if chromium is present it will be precipitated as yellow lead chromate which dissolves on the addition of sodium hydrate.

Copper

The principal ores are chalcopyrite and cuprite. There are many other copper ores. Copper is used extensively in the making of alloys, etc.

Digitized by Google

Place a small quantity of the finely pulverized ore in a test tube and add 5 cc. of nitric acid. When the solution is cold add enough ammonium hydroxide to make the solution decidedly alkaline. Filter off any precipitate. A blue color indicates the presence of copper. To a part of the filtered solution add enough acetic acid to neutralize the ammonia and into this solution put a bright piece of iron and the copper will appear as a metallic deposit on the iron.

Cobalt and Nickel

These ores are generally found together and will be treated accordingly. The principal ores of nickel are niccolite and millerite of cobalt-cobalite and smaltite.

Place a small quantity of the finely pulverized ore in a porcelain dish and add 30 cc. one-half strength nitric acid and heat. Apply heat until most of the acid is driven off and then add 40 cc. water to the residue and then heat to insure a good solution of cobalt and nickel. Filter and pass hydrogen sulphide gas through the solution for five minutes. Filter again and add to the solution filtered a few drops of nitric acid and boil one minute. Then add 10 cc. ammonium chloride and enough ammonium hydroxide to make the solution decidedly alkaline. Again filter and into the ammonical solution pass hydrogen sulphide gas and if cobalt and nickel are present they will be thrown down as a black precipitate, the absence of which is evidence no cobalt or nickel are present. If a precipitate is present wash and filter with a solution of one part hydrochloric acid to four parts water and dissolve the remaining precipitate in dilute nitric acid. Heat to expel the acid and then add 15 cc. ammonium chloride and then potassium ferrocyanide as long as a precipitate is formed and stir the solution rapidly, adding ammonia in excess. A dark precipitate will separate from the solution and shows that cobalt is present and ammonium sulphide added to the filtrate will show a black precipitate if nickel is present.

FROZEN SOAP BUBBLES

SOMETIME ago experimenters with low temperatures succeeded in freezing soap bubbles by the aid of liquid air. Considering the almost inconceivable thinness of a soap bubble, this was indeed a remarkable experiment. The actual thickness of a soap bubble has never been accurately determined but scientists claim that the amount of tangible matter contained in a bubble is almost unbelievable. The bubbles were frozen into a hard, fragile crystal. The life of a frozen bubble is extremely short unless it is maintained at low temperature.

TO CASE-HARDEN LOCALLY

IN case-hardening certain articles it is sometimes necessary, or desirable, to leave spots or sections in the original soft, uncarbonized condition while the remainder is carbonized and hardened. This may be effected by first covering the parts to be hardened with a protecting coat of japan and allowing it to dry. Then put the piece in an electroplating bath and deposit a heavy coat of nickel over the parts not protected by the japan. The piece thus prepared may be treated in the usual manner in case-hardening. The coat of nickel prevents the metal beneath being carbonized, so it does not harden when dipped in the bath.

A plating of copper answers the same purpose as nickel and is often used. A simple plan, where the shape of the piece permits, as when the outside or inside of a ring is to be treated, is to protect it from the action of the carbonizing material with an iron pipe or rod closely fitted or luted with clay. Another scheme is to machine the parts wanted soft after carbonizing but before hardening. By this procedure the carbonized material is removed where the metal is desired soft, and when heated and quenched these parts do not harden.

STRENGTHENED FILTER PAPER

WHEN ordinary filter paper is dipped into nitric acid (specific gravity 1.42), thoroughly washed and dried, it becomes a tissue of remarkable properties, and one that deserves to be better known by chemists and pharmacists. It shrinks somewhat in size and weight, and gives, on burning, a diminished ash. It yields no nitrogen, nor does it in the slightest manner affect liquids. It remains perfectly pervious to liquids, its filtering properties being in no wise affected, which, it is needless to say, is very different from the behavior of the same paper "parchmented" by sulphuric acid. It is as supple as a rag, yet may be very roughly handled, even when wet, without tearing or giving way. These qualities make it very valuable for use in filtration under pressure or exhaust. It fits closely to the funnel, upon which it may be used direct, without any supports, and it thus prevents undue access of air. As to strength, it is increased upward of ten times. A strip of ordinary white Swedish paper ⅛ of an inch wide will sustain a load of from ½ to ¾ of a pound avoirdupois, according to the quality of the paper. A similar strip of the toughened paper broke in 3 trials, with 5 pounds 7 ounces and 3 drachms; 5 pounds 4 ounces and 36 grains; and 5 pounds 10 ounces, respectively. These are facts that deserve to be better known than they seem to be to the profession at large.

SOLDERING PASTE

ONE of the semi-liquid masses ordinarily termed soldering paste is produced by mixing zinc chloride solution or that of ammonia zinc with starch paste. For preparing the composition, ordinary potato starch is made with water into a milky liquid, the latter is heated to a boil, with constant stirring, and enough of this mass, which becomes gelatinous after cooling, is added to the above mentioned solutions to cause a liquid resembling thick syrup to result. The use of all zinc preparations for soldering presents the drawback that vapors of a strongly acid odor are generated by the heat of the soldering iron, but this evil is offset by the extraordinary convenience afforded when working with these preparations. It is not necessary to subject the surfaces to be soldered to any special cleaning or preparation. All that is required is to coat them with the soldering medium, to apply the solder to the seam, etc., and to wipe the places with a sponge or moistened rag after the solder has cooled. Since the solder adheres readily with the use of these substances, a skillful workman can soon reach such perfection that he has no, or very little, subsequent polishing to do on the soldered seams.

SOLUTIONS FOR BATTERIES

THE almost exclusively employed solution of sal-ammoniac (Ammonium chloride) presents the drawback that the zinc rods, glasses, etc., after short use become covered with a fine, yellow, very hard to dissolve, basic zinc salt, whereby the generation of the electric current is impaired, and finally arrested altogether. This evil may be remedied by an admixture of cane sugar. For a battery of ordinary size about 20 to 25 grams of sugar, dissolved in warm water, is sufficient per 50 to 60 grams of sal-ammoniac. After prolonged use, it is stated, only large crystals (of a zinc saccharate) form, which, however, become attached only to the zinc rod in a few places, having very little disadvantageous effect upon the action of the batteries and being easy to remove, owing to their ready solubility.

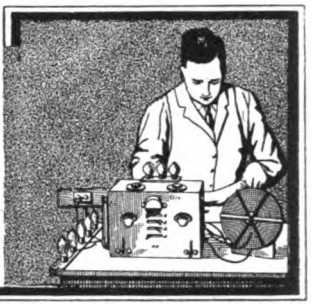
RECUTTING OLD FILES

OLD files may be rendered useful again by the following process: Boil them in a potash bath, brush them with a hard brush and wipe off. Plunge for half a minute into nitric acid, and pass over a cloth stretched tightly on a flat piece of wood. The effect will be that the acid remains in the grooves, and will take away the steel without attacking the top, which has been wiped dry. The operation may be repeated according to the depth to be obtained. Before using the files thus treated they should be rinsed in water and dried.

Digitized by Google



RADIO
TELEPHONE AND TELEGRAPH APPARATUS



Construction of Apparatus on Standardized Panels

A Method by Which Radio Apparatus Can be Kept Up-to-Date Without Discarding Instruments

By M. B. Sleeper

WHEN radio experimenting first became popular, the different instruments were made separately, with no regard for co-ordination as to electrical or mechanical design. They were spread around over the operating table, arranged in a haphazard fashion.

Figs. 1 and 2 illustrate a simple receiver made up on standardized panels. The instruments used are a loose coupler, secondary variable condenser, and buzzer test. A separate crystal detector completes the set. This can also be used with an audion cabinet.

If, for example, it is necessary to use

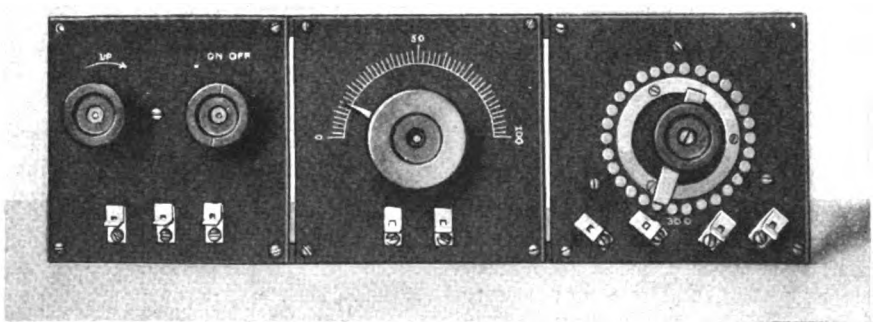


Fig. 1. A receiver of which any experimenter may well be proud

Next came the panel type equipment, a decided advance over the first method. All the receiving instruments were mounted on a single panel, and all the transmitting equipment on another. Only the control handles were visible at the front. This made it far easier to operate the set, and, with the new devices, carried the panel type equipment up to its marvelous present advance.

The great difficulty, however, has been that, to keep panel sets up with the latest developments, they must be discarded altogether or torn down frequently. Now, the standard panel method has come to the rescue with a combination of separate and panel mounting. In this system, each instrument or special combination of instruments, is mounted on an individual panel, of a size 5 x 5 ins., 5 x 10 ins., 10 x 10 ins., or 10 x 15 ins. By standardizing on these sizes, panels of different shapes can be grouped together, to form a rectangle. If they are put in a case, the only change necessary, if instruments are added or taken away, is a new cabinet. However, no case is needed when the panels are simply supported by angle brackets.

the condenser for another experimental circuit, it is only necessary to unfasten the brass straps; later, it can be put back in place. Thus it is possible to use any instrument for temporary circuits without tearing up the receiver and it can be replaced in a minute. Additional apparatus can be put in, or the entire set rearranged.

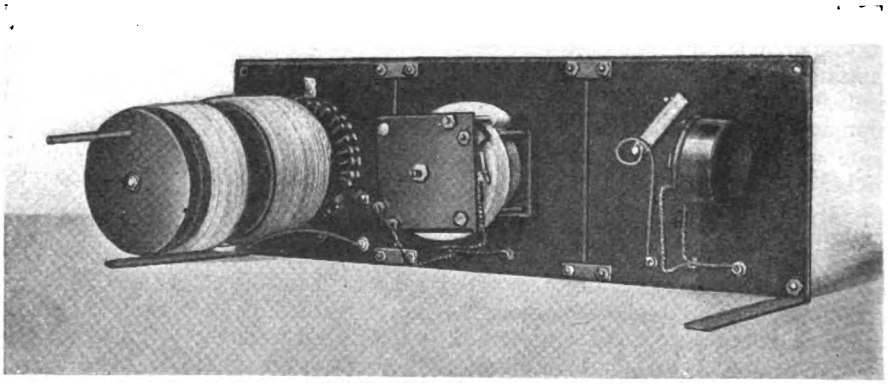


Fig. 2. A near view of the Standardized Panel set

A 200 to 1,000 Meter Receiver

Any type or kind of transmitting and receiving equipment can be made upon standardized panels, but to illustrate the method, a simple yet surprisingly efficient receiver is described here. It is intended for use on experimental and the ordinary commercial wavelengths up to 1,000 meters.

The primary of the loose coupler has 30 taps, while all the secondary tuning is done in the variable condenser. The buzzer test indicates, when its signals are heard in the telephones, that the detector is adjusted.

This is an easy set to operate, for all the tuning can be done with two knobs. When the primary handle is turned, it moves the switch arm; pulled out or pushed in, it varies the coupling. Sharp tuning is accomplished with the secondary condenser.

The Loose Coupler

Details of the loose coupler are given in Fig. 3. The primary coil is wound on a tube 3½ ins. long and 3 ins. in diameter. At the panel end, the tube is cut back so that there are three mounting legs ½ in. wide and ¾ in. long. This cutting must be done with a very fine saw, or, preferably, a sharp knife. Fig. 3 shows the brass angle brackets fastened to the legs by 8-32 machine screws and nuts.

The winding is composed of 100 turns of 3-16 No. 38 high frequency cable, wound in three banks, tapped every three turns, beginning with the thirteenth. At the end of each bank,

Digitized by Google

when the wire is brought from the top turn down to the tube, two holes are made, one for the end of the section, and the other to take out the start of the next.

When the winding has been completed, the taps are cut to length, and each end heated red hot and dipped in alcohol twice. This removes the enamel insulation on the wires. An accident which occurred when this set was built will serve as a warning to others. In the first place, a small bowl of alcohol was used. During the work, a tap was put into the alcohol when the insulation was burning. This ignited the alcohol and, in some way, the bowl was tipped over. The result was a sheet of flame over the arms of the builder and on the floor and table of the shop. Then a small paint can cover was substituted for the bowl. If that had been tipped over, the small amount of alcohol would have done very little harm.

All the taps prepared, the two adjacent wires are twisted and soldered together, ready to be soldered to the switch points later.

The secondary coil is wound on a 3 in. tube 1¼ ins. long. This winding has 58 turns of 3-16 No. 38 cable, in four banks, with no taps. Fitted at the outer end is a flanged wooden disc ¾ in. thick, in the center of which is a ¼ in. brass rod, 2 ins. long, drilled out with a No. 16 drill. This, as will be seen later, acts as a bearing for the square main shaft.

Another hole is made in the wooden end piece, 1 in. from the center, with a No. 20 drill. It will take the guide rod which prevents the coil from turning, as shown in Fig. 3.

The next step in constructing the loose coupler, is to assemble the switch parts. A 5 x 5 in. panel is used, preferably ¼ in. thick. This set was made with ⅛ in. bakelite, but it was not quite rigid enough for the weight of the parts.

Thirty ¼ in. diameter switch points are set in a circle 3 ins. in diameter. In the center of the panel a ¼ in. hole is drilled to take the switch shaft. The 3-ply switch arm has a No. 16 hole for the square shaft and two No. 36 holes to slip the 2-56 machine screws which hold it to the bearing. This bearing is of brass, ¾ in. long, turned down for ½ in. to ¼ in. diameter, while the remaining ¼ in. is ½ in. in diameter. It is to this head that the switch arm is secured by the 2-56 screws.

Through the center of the bearings a No. 16 hole is drilled from the back almost to the front end. The hole is completed by a No. 30 drill. Next, the smaller hole at the front is carefully filed square, to take the ⅛ x ⅛ in. shaft. Finally, a collar ¼ in. thick and ½ in. in diameter, with a ¼ in. hole, is made to fit over the end of the shaft. Two 6-32 machine screws act as set screws.

When the parts are assembled, the bearing is put into the panel from the front and the collar fitted on from the rear. Thus, the shaft is free to turn, but cannot pull out, while the square shaft can move in and out, but, when rotated by the adjusting handle, it must turn the bearing and the switch arm attached.

The secondary coil must not turn with the main shaft. The shaft is threaded at the rear end with a 6-32 die, and two nuts are put on it at the outside and inside of the secondary end piece bearing. They are just loose enough to allow the shaft to turn in the brass insert, yet tight enough to prevent end play. Further provision against turning is made by a ⅛ in. brass rod which passes through the end piece. It is secured to a wooden strip glued inside the primary coil.

Fahnestock binding posts are provided at the front of the panel, though, in some cases, it is preferable to have only screws protruding at the rear, to which connections can be soldered.

Condenser Panel

The condenser shown in Fig. 4 is of the Clapp-Eastham make. The maximum capacity is 0.0006 mfd. The wavelength range is smaller, however, than with a 0.001 mfd. type, so that, for the full range, the larger condenser should be used.

Although it was not necessary, it was thought advisable to put solid bakelite end pieces on the condenser. The metal pieces, with bakelite inserts, offered a possible leakage path across the plates which would result in broad tuning and loss of efficiency with an audion.

The construction of new end pieces should be attempted only by a skilled mechanic, for it is an easy matter to put the plates all out of alignment. Moreover, it will be found necessary, in all probability, to make a new upper bearing for the shaft. In drilling the holes in the bakelite pieces, the metal plates were used as templates.

If the construction of the condenser is not changed, it is an easy matter to secure the upper plate to the panel with small machine screws. Because there is no way to secure the handle to the shaft except by means of set screws, two 6-32 screws were put into the smaller part of the knob. The heads were cut off and slotted, so that they hardly protrude.

The pointer is simply a piece of ⅛ x ⅛ in. brass rod, filed down at one end, and threaded with a 6-32 die at the other. The condenser dial and figures on the panel were simply scratched with a compass and a sharp steel point, after which they were filled with whiting slightly moistened with linseed oil. When dry, this mixture becomes hard.

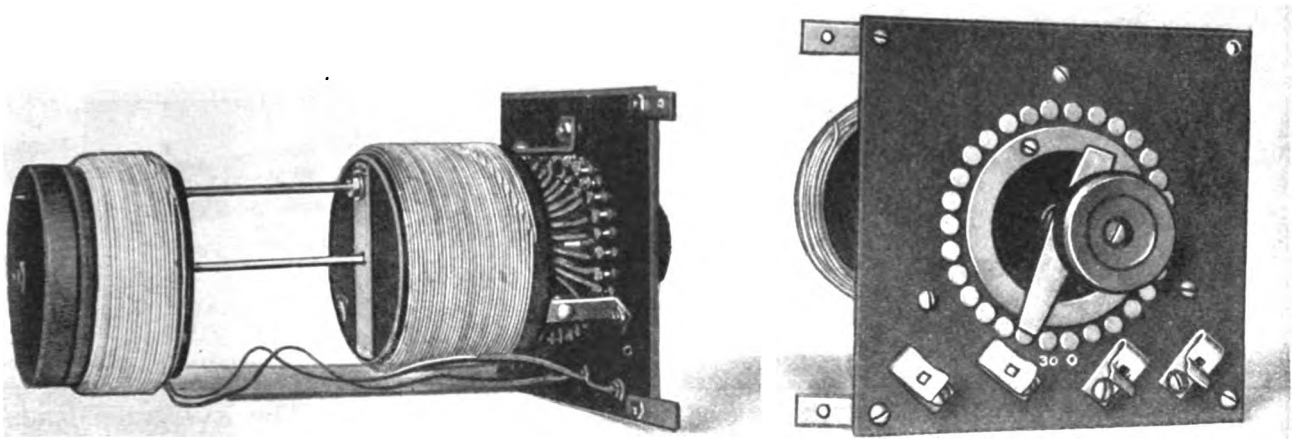


Fig. 3. Two views of the Standardized Panel type loose coupler. If a different coupler is made later, this can be removed and used for other purposes, and the new one set into place

Digitized by Google

Buzzer Test Panels

Fig. 4 shows the buzzer test. A new feature of construction is the vibrator screw control. A 2-56 thread is put in a hole in the thumbscrew. Then the shaft of the handle is soldered to the screws. To make it possible to put on the cover, a small slot is made in the side, to fit around the shaft. The ⅛ in. shaft was simply filed down at one end for the 2-56 thread.

The angle piece which holds the buzzer is joined to one of the buzzer connecting screws so that the switch clip can be held by the same screw which holds the angle piece. A brass strip, 1/16 x ⅜ in. acts as the contact arm.

Three binding posts are furnished, two for the battery, and another, wired to the vibrator screw, to connect to the ground. When the switch is closed and the buzzer operated, a sound is made in the receivers if the detector is in adjustment.

Arrangement of the Panels

Holes are made with a No. 18 drill in the corners of each panel, ¼ in. from the edges. These are for the supporting strips. The strips are made of 1/16 x ⅜ in. brass, drilled with two No. 18 holes ⅝ in. apart. This allows ⅛ in. between the panels, and gives a slight leeway for discrepancies in drilling.

Additional panels can be arranged at the side or above those shown in this article, if the standard sizes of panels are used. Other apparatus, built by this method, will be described in the coming issues of Everyday Engineering.

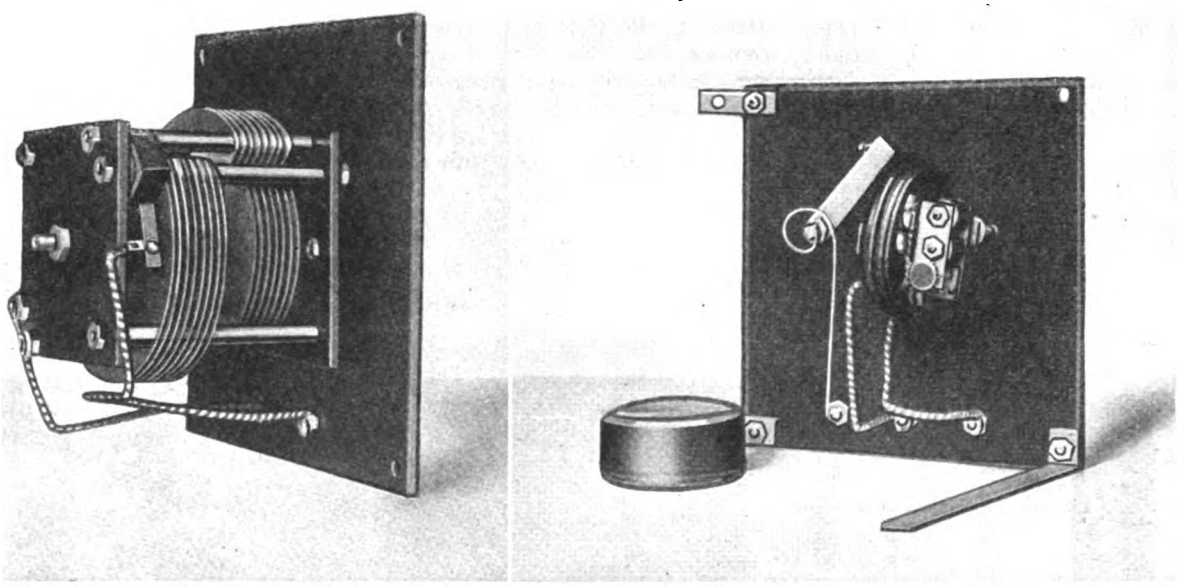


Fig. 4. Details of the condenser and buzzer test panels

Nycssa Radio Club

THE Nycssa Radio Club was organized this summer at Camp Nycssa where it built and successfully operated a station. The club will resume activities this winter under Mr. Filden at the West End Presbyterian Church, where we will install a station. The club has fifteen active members and expects to double that number before long. The Nycssa Radio Club would be pleased to hear from other radio clubs concerning their activities. All communications addressed to C. Stanley Johnson, Jr., Secretary, 160 Wadsworth Avenue, New York City.

Telephone Transformers

IT HAS been pointed out in the series of articles by Mr. Clement that the impedance of the telephone circuit of a detector or amplifier should be equal to the internal impedance of the last tube. Since the impedance of an ordinary telephone receiver is too low to meet this requirement, a transformer connected between the plate circuit and the telephones will improve the results.

The telephone transformer shown here is designed to give a combination of impedances of which the correct one can be determined by experiment. The plate is connected to the first primary terminal and the other side to any of the other primary binding posts. The



telephones are put across any of the secondary posts until by experiment the proper combination is found. The easiest way to carry out the test is to couple an inductance connected in the battery circuit of a buzzer to the secondary inductance of the receiving set. When the signals are heard with the greatest intensity the proper transformer connections have been found.

The Evergreen Radio Association

IN August, 1919, the Evergreen Radio Association of Long Island, N. Y., was organized. An invitation is extended to all experimenters in the vicinity to join this club. The primary purpose of the association is to promote good fellowship among all amateurs, to increase the knowledge of its members and the efficiency of their stations and to reduce QRM to a minimum. Those who are interested will kindly communicate with the secretary, George H. Roy, 681 Grandview Avenue, Evergreen, L. I., N. Y.

The Experimenters in France

IN the first issue of T. S. F., the French radio magazine, now resuming activities since the war, is a protest against the experimental radio situation in France. So far, no permission to send or receive has been granted. At the first of the war, privately owned apparatus was taken over, and has not yet been returned. We may wonder in what condition the instruments are now, if their construction was not far superior to the average homemade sets built by American experimenters four years ago.

Digitized by Google

The Radio Department

WHEN you look at a piece of radio apparatus and say it is a "nice piece of work" you make a strictly neutral statement. You have not criticised the faults or laid stress on the good points. The only thing accomplished is the saying of the expected.

Really, the man who did the work hoped you wouldn't see the imperfections and is satisfied that you are pleased, if non-committally.

When you look through the Radio Department of EVERYDAY ENGINEERING, you may say it is "good stuff." If you write and tell us that, we are pleased. We may put out our chests a bit.

Really, you have increased our lung capacity but you haven't added anything to the alleged store of gray matter on which we depend for judgment as to what should or should not go into these pages.

The success of EVERYDAY has made it possible to give its readers whatever they want. We have an idea that we are doing this now, but we want to make sure. But remember, we are after constructive criticism. If something about the department is good now, we want to know why it is good. If it is not, we want to know why it is not. There will be differences of opinion, and to create a discussion we shall publish letters which contain not words of praise but worth while comment on the Radio Department.

There are five dollars waiting for the man who gives us the best letter on What I Think of the Radio Department and Why. A maximum of five hundred words may be used.

TRANSMITTING is still a thing of the future, but the prospects deserve serious consideration. So many new men have taken up radio work, that, in the cities, difficulties from interference are imminent. Mention has been made of the possible use of short wave, undamped transmitters. Two hundred meters wavelength means a million and a half cycles. At this frequency, using heterodyne reception, a difference of less than one meter will bring the signals in or out. Obviously such sharp tuning will be of tremendous help in reducing interference.

High frequency alternators and frequency changers are beyond experimenters, but the versatile audion affects the rescue. Immediately the thought arises that audion transmitters are greatly limited in range. As a matter of fact, with a single tube receiver, telephone conversation has been carried on with one Marconi-De Forest bulb as a transmitter over a distance of forty-five miles. To be sure, four hundred volts were used on the plate, but the lack of plate voltage can be made up by an amplifier at the receiving station, or two or more tubes can be used in parallel for sending. However, for straight telegraph transmission, a much greater distance can be covered than by telephone.

The subject of transmitting has been rather neglected in EVERYDAY, but it is to be given its share of space in the coming numbers.

IN the April, 1919, issue there was an article on Standardized Design of apparatus. The ideas incorporated in it have been carried out in the article on receiving instruments in this number, and will be continued.

The advantage of using standardized panels, with separate or supplementary instruments on each panel, is a great advantage. It makes possible, in the first place, the panel mounting type of construction. It practically overcomes the problem of discarded sets, for while a complete outfit may become obsolete, there are always uses for the individual instruments if they can be retained in good condition, a thing almost impossible where they have all been mounted on and fitted to one panel. Ideas of radio sets change so rapidly that only a multi-adaptable system of construction will allow the experimenter to keep his equipment up to date without constantly discarding expensive instruments.

THE demand for radio operators shows no signs of abatement. Particularly on the Shipping Board vessels, a shortage has been caused by the demobilization of the Navy, and the withdrawal of Naval operators from those ships. In this service men are paid $100 and $125 per month in addition to all expenses.

In practically every Post Office of the country notices are posted which show the location of the nearest Sea Service Bureau where applications are received. Men employed as operators during the war are only required to pass the Department of Commerce examination.

Any further information will be given to those who address their inquiries to the Radio Department, EVERYDAY ENGINEERING MAGAZINE.

EXPERIMENTERS who are just starting in at radio work have some strange ideas. A month ago a New York manufacturer sold a simple crystal receiving set to a man in Michigan. It was a good set, too, one in which the company took considerable pride. However, all was not well. Two weeks after the set was shipped, a letter came, indicating that the purchaser was in no kindly frame of mind. He was plainly shocked at the deceitfulness of the manufacturer who took advantage of mail order customers.

"I am using a tree antenna with your crystal detector set and can't even hear Arlington time signals."

Can you blame the maker of the equipment for tearing his hair and feeling as exasperated as the customer? You won't if you have used a tree antenna. Which goes to show what comes of talking a lot about general applications of a thing intended for special use, and the harm from magazine articles written by ignorant men.

The work actually done with tree antennas by the Signal Corps is set forth in a paper given by Major General Squier at the Franklin Institute, June, 1919. Copies can be obtained from the Franklin Institute, Philadelphia, Pa. In this paper it is stated that seven stage amplifiers were used, and apparatus representing the highest developments of the art.

What chance was there, with a crystal detector, to repeat the results obtained by the Signal Corps?

NEXT month will have some rather pleasant surprises if the Navy Department does not withhold their approval. But perhaps we should wait and let the November issue speak for itself. One thing, however, will give you an idea of what is coming. Have you heard anyone speak of loop transmission? Probably, like the Englishman's, the comment was that it couldn't be done over any distance.

In France, an English loop transmitter accomplished the remarkable feat of sending three miles. The men at the American Signal Corps field laboratory just smiled at that report, rubbed their bumps of Yankee ingenuity and produced a loop transmitter that worked over forty-five miles. One of the men who did it is going to tell the readers of EVERYDAY about it.

Radio Engineering and Radio Experimenters

All kinds of opportunities are coming up in radio work, not only in the United States but in foreign countries as well. Men to fill these positions cannot be located readily, but they will be found through the Radio Register. Is your name among the others?

There are obvious uses of such a listing. The data required is:

Name.
Address.
Engineer or Experimenter.
Age.
Experience.
Special qualifications.
Radio station owned, if any.

Address your letters to the Radio Department, EVERYDAY ENGINEERING.

Digitized by Google

Audion-Crystal Receiver for Destroyers

A Highly Developed Receiver Manufactured by the Wireless Specialty Apparatus Company for Use on the U. S. Navy Destroyers

THE radio equipment designed by the Bureau of Steam Engineering of the U. S. Navy Department, and such designs as have been accepted by it, can be properly called the highest developments in efficient and substantial radio equipment. Dependability sums up, in a word, the construction and operation of Navy apparatus.

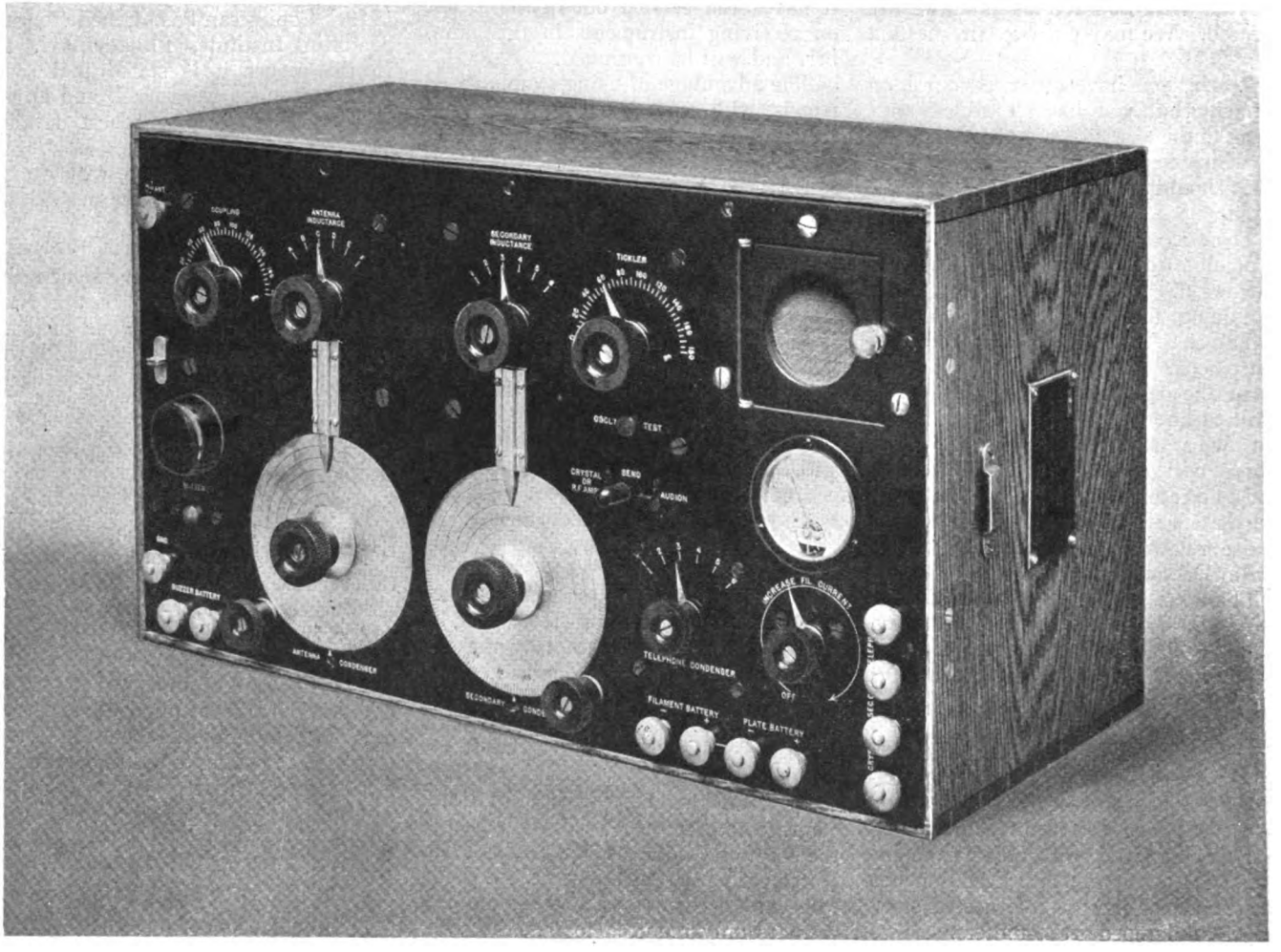


Fig. 1. Sturdy construction is an outstanding feature of this Navy set. Much of the Navy apparatus is designed by the Bureau of Steam Engineering instead of private concerns, as is largely the case with Signal Corps equipment

A typical example is the Destroyer type receiver described in this article. Fig. 1 shows the outward appearance of the set. It is intended to operate on 250 to 8,000 meters using a crystal or audion for damped wave reception, and a feed-back coupling with the audion for undamped waves.

The circuits are of the usual loosely coupled type, having a 6-step antenna inductance and series condenser for the primary, and a secondary coupling coil, 6-step inductance, and shunt tuning condenser in the secondary circuit. One-half of the condenser dials are divided into 180° scales, while the remainders are used for wavelength calibrations. As the inductance switch is turned, the pointer moves to a corresponding arc on the dial. Vernier adjustments of the condensers are provided by the handles which can be seen at the lower part of the panel near the dials.

At the left-hand side are the coupling control, safety spark gap, buzzer, and buzzer press button. On the right, the tickler coupling adjustment, oscillation test, crystal-audion switch, and telephone shunt condenser are mounted. There are also an audion mounting, filament current ammeter and rheostat.

The instruments themselves can be seen in Figs. 2 and 3. A metal shield covers the rear of the panel, to reduce interference from the body of the operator and to prevent any capacity coupling between the primary and secondary circuits.

The audion socket is of a design which absorbs vibrations, an important consideration, for vibration during operation causes a noise in the telephones and also reduces the life of the tube. Six sets of expansion-compression springs are fastened alternately to the three panel supports and the bakelite socket mounting disc, while a bakelite ring is held at the middle of all six springs. Cotton is packed lightly in the springs to prevent them from vibrating at their natural period.

Below the audion mounting is the filament rheostat. This is made up of resistance wire wound between brass pins set into the peripheries of two bakelite discs. A switch arm, passing over the set of pins next to the panel, gives the resistance regulation.

At the side of the rheostat, an adjustable mica condenser is secured to the panel. This condenser is shown in the circuit diagram between the filament side and the plate impedance. The impedance is of the closed core

Digitized by Google

type; it can be seen in Fig. 2 just below the mica condenser.

The secondary inductance and tickler coil, as well as the primary and secondary coupling coil, with their 45° mounting, are illustrated in Fig. 2. Balanced condensers, with one-half of the plates at one side, and half at the other, are used in tuning the primary and secondary circuits.

connecting the unused parts of the coil, they are simply shortcircuited by the four contact fingers. Connections are made to the first active section by the last contact and the metal segment to which the antenna is attached. Both primary and secondary switches are mounted on panels located behind the main instrument panel. A small coil, put around the antenna lead, is joined

At the end of the secondary is a rather unusual arrangement for tickler coupling, in which a part of the tickler inductance is wound on the secondary tube, and the remainder on a separate form. A short-circuiting switch is provided around the tickler to test for oscillating.

Negative grid voltage is obtained by means of a tap taken from the filament

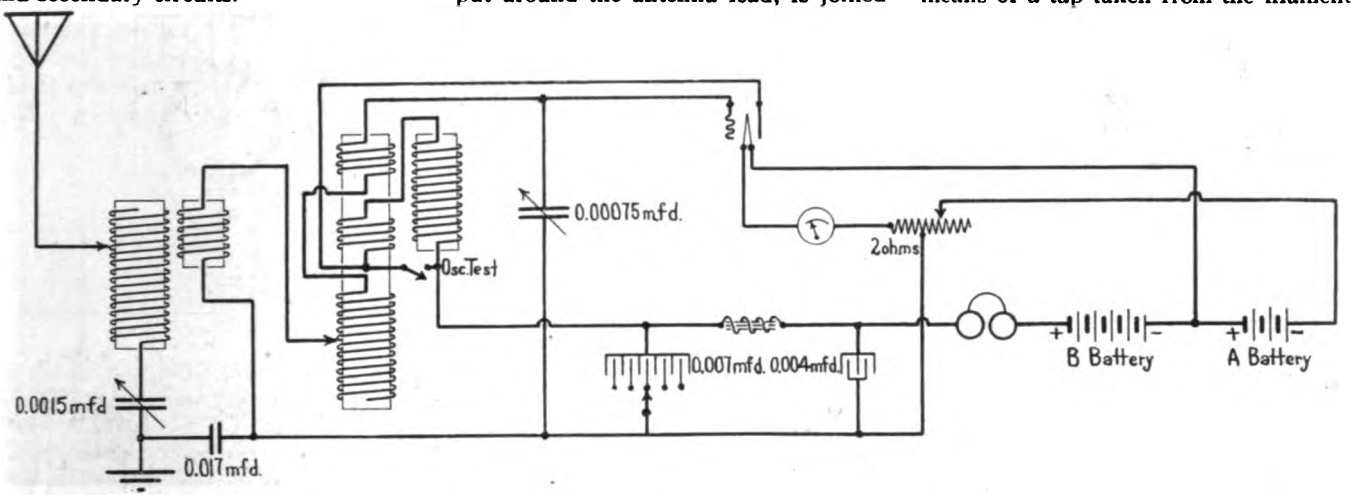


Fig. 5. An unusual arrangement is used for the secondary and tickler. The inductance of the tickler is varied by the variometer method as the coupling to the secondary is changed

Figs. 4 and 5 show the circuits employed in this set. Fig. 4 indicates the arrangement as viewed from the rear of the panel, while Fig. 5 gives the connections when the crystal-audion switch is at the audion position.

The antenna circuit is made up of a tuning condenser of 0.0015 mfd. and a six-step inductance. Instead of dis-

at one end to the armature of the buzzer. Excitation is obtained in this way for the buzzer test. The shield which covers the rear of the panel is wired to the ground, to prevent interference from the hands of the operator.

Fig. 5 shows that there is a small coil, in series with the secondary tuning inductance, coupled to the primary.

rheostat so that 2 ohms resistance are always in the circuit to the grid. Since the positive terminal of the filament battery goes directly to the filament, the grid tap from the rheostat is more negative than the filament by an amount depending upon the current through the filament circuit. In other words, the difference in potential across the 2 ohms

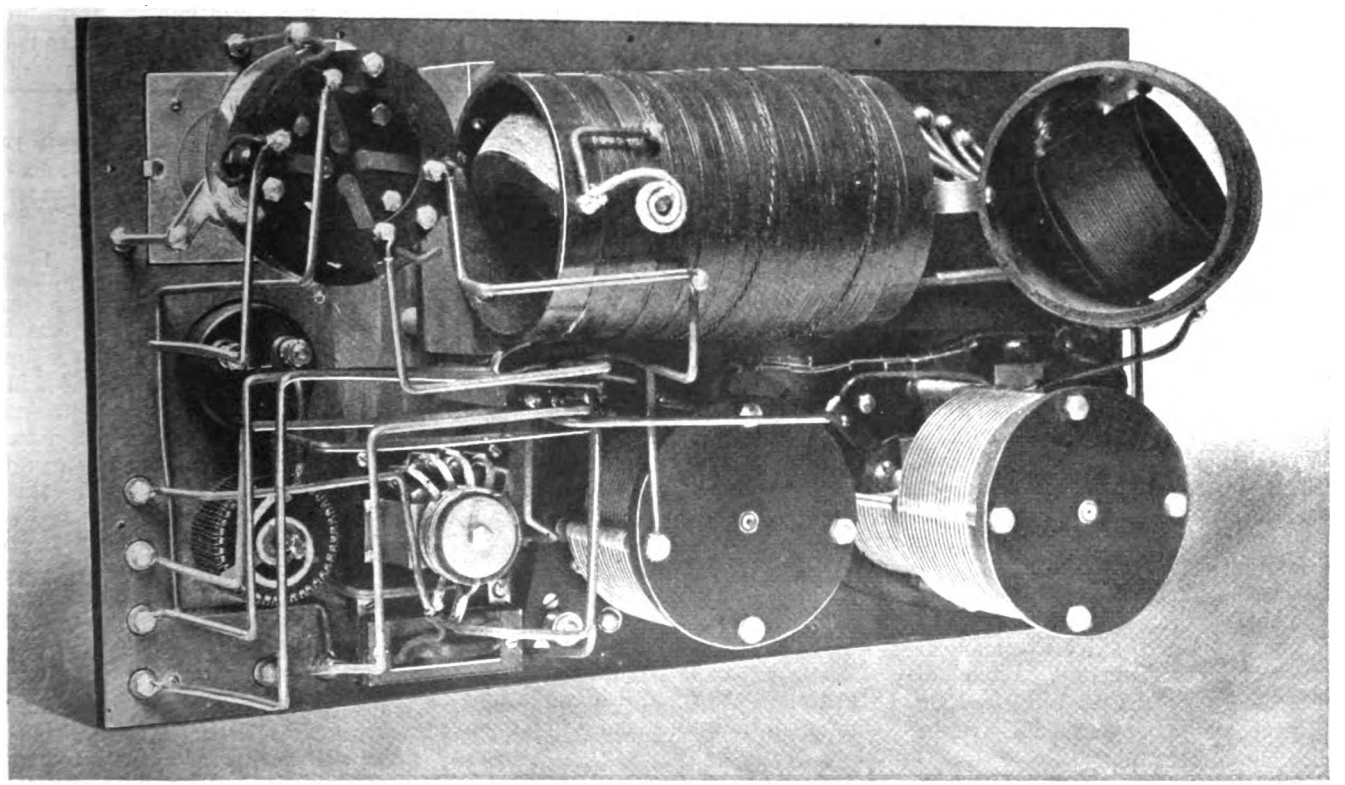


Fig. 2. A 45° mounting is used for the antenna inductance and secondary coupling coil, as will be seen in this rear view

Digitized by Google

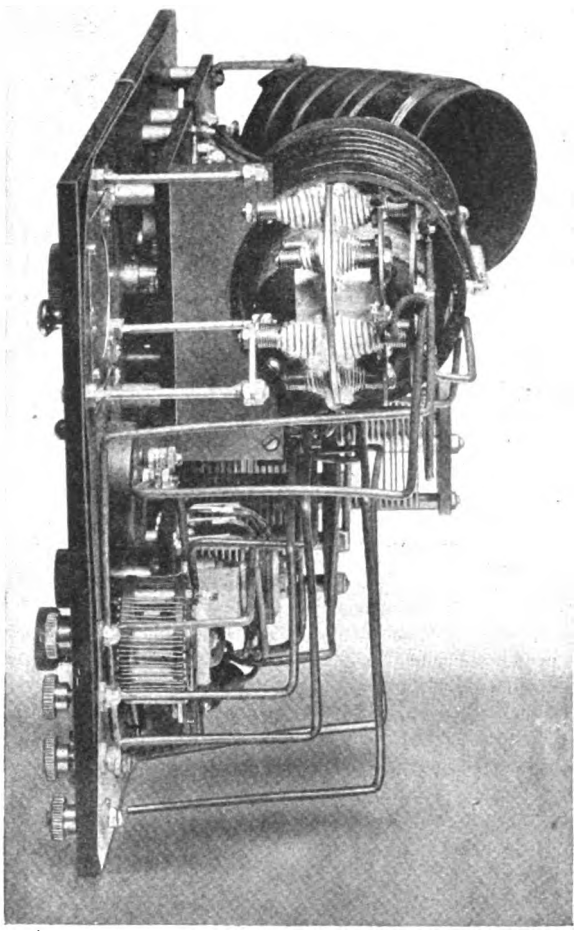
is where
E = I x R,
E = difference in potential,
I = current through resistance,
and R = resistance.

If, therefore, 1.3 amperes is flowing in the circuit, the negative grid potential will be

E = 1.3 x 2

or grid potential—2.6 volts.

impedance, and telephones are in series around the secondary tuning condenser, with the fixed condenser around the phones, and the adjustable condenser across detector and tuning condenser.



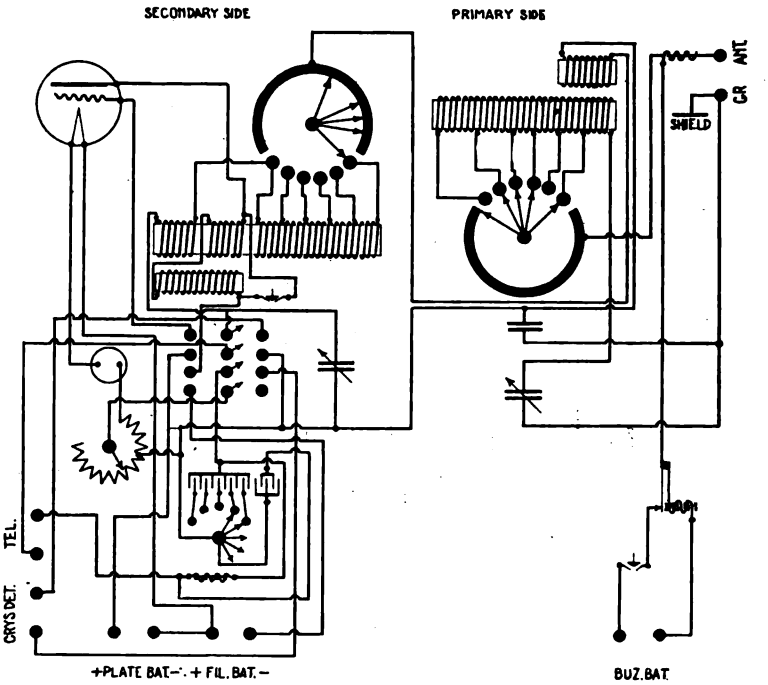


Fig. 3. Left, a side view of the set, showing particularly the audion, mounting. Fig. 4. Above, connections for the instruments as they appear from the back of the panel

In the plate circuit there is a small impedance and two condensers, one fixed, of 0.0004 mfd. and one variable in six-step up to 0.007 mfd. The latter is shunted across the battery and telephones.

When the set is connected for the use of a crystal detector, the detecor

At the detector adjustment, if no crytsal detector is used, a radio frequency amplifier and detector can be connected to the adjacent crystal and phone posts. These posts lead directly to the secondary condenser, so that the tickler and all the local audion circuits are not connected.

This set offers a number of features which should suggest new ideas to those who are building their own apparatus.

Coded Messages to be sent by the Navy for Code Practice

BY authority of the Director Naval Communications, commencing October 5th, a code broadcast schedule, addressed to all amateurs, will be transmitted by the Naval Radio Station, 44 Whitehall Street, on 1500 meters. This broadcast will be transmitted immediately following the 9:00 P. M. press schedule.

Various items of interest to amateurs, such as the establishment of new stations and changes in wave lengths of high power stations, will be transmitted in this broadcast schedule.

Copies of the code to be used may be obtained by any amateur by sending a request to the District Communication Superintendent, 44 Whitehall Street, New York City. When writing this request an amateur should give the following information:

1. Name.
2. Address.
3. Age.
4. Date concerning any military service.
5. Commercial experience, if any performed.
6. Class of operator's license, if any.
7. Number of words per minute he can copy.
8. Education.
9. Size and power of transmitting set, if any erected.
10. Type of undamped wave receiver, if one installed.
11. Name of any radio organization or club to which he may belong.

The object of this radio broadcast is to maintain the interest of radio amateurs and to train them in receiving code.

It is expected that, later on, the signals will be undamped.

Book Review

PRINCIPLES OF TRANSFORMER DESIGN, by Alfred Still. 216 pages; 5 x 7¼ inches; 67 illustrations; cloth binding; price $2.25. Published by John Wiley & Sons, Inc., New York City.

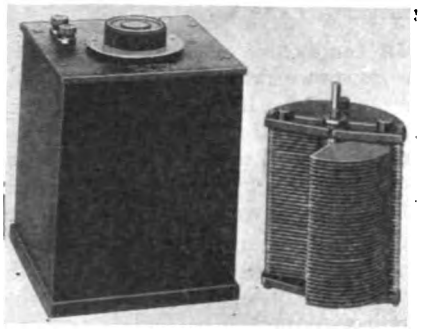
Experimenters during some phase of their work almost always run up against problems in building transformers for various purposes. Mr. Still in his new book does not go into complex formulas and difficult calculations, but presents, in a way that can be readily understood, the various problems of transformer design. The six chapters carry the reader through a discussion of various types and constructions; the insulation of high tension transformers; efficiency and heating; magnetic leakage; reactance and regulation; procedure in designing transformers and transformers for special purposes.

This book has much of interest to radio men, as well as general electrical experimenters, as it will serve as a complete guide for those who make their own transformers.

Digitized by Google

A Variable Air Condenser

THE variable air condenser shown in the accompanying illustration is designed not only for use in radio receiving sets, or vacuum tube transmitters, but as a laboratory standard as well. While this type of condenser does not incorporate the extreme refinements which have been advanced,

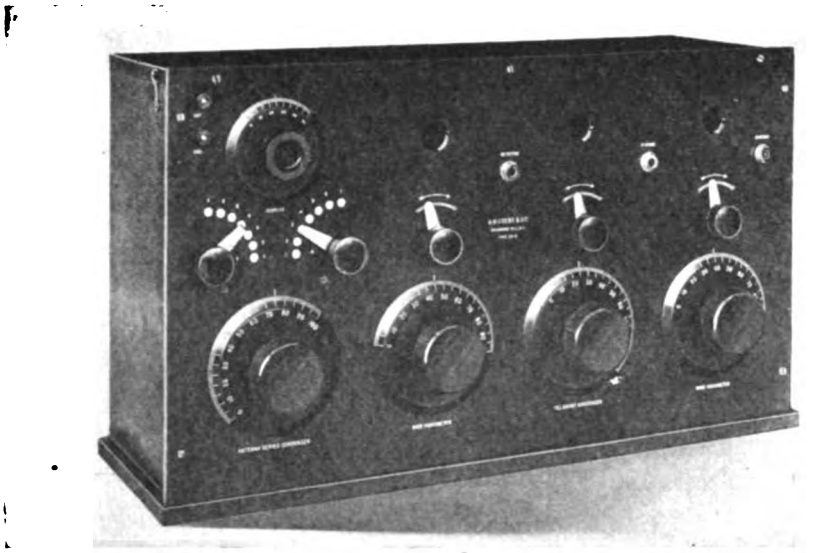


it is entirely suitable for work where a calibrated condenser of ordinary accuracy is required.

Considerable care in design and manufacture is used to give perfectly tight bearings to prevent variations in capacity from continued use. Cast bakelite and plates provide a maximum of insulation. The top plate also serves for mounting the condenser on a panel. Instruments of this type are made with capacities of 0.0015, 0.003 and 0.005 mfd.

A Short Wave Receiver and Two-Step Amplifier

ONE of the new receivers in the line brought out by the A. H. Grebe Company is made up of a short-wave regenerative set and a two-stage amplifier. Operators who are preparing for



long distance relay work will find that this set covers all that they can require.

The wavelength controls, consisting of inductance, condenser, and coupling adjustments, are at the left of the panel. Looking toward the right, on the bottom row, are the grid variometer, telephone shunt condenser and wing variometer. Three rheostats are provided for the tubes, the brilliancy of which can be observed through the openings in the panel.

Connections for the telephones are made in any one of three plug switches, marked DETECTOR, 1ST STAGE and 2ND STAGE.

One feature of this set is the arrangement of the telephone switches. Inserting the phone plug at the first jack lights the detector filament and puts only that part in operation. The same is done at the two steps of amplification.

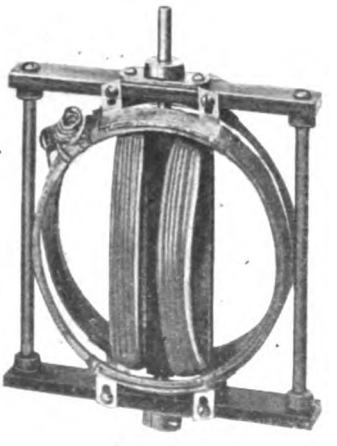
All the internal apparatus is mounted on the panel, so that the set can be removed as a unit from the case. A hinged top gives access to the vacuum tubes.

In a discussion of high powered transmitting vs. high powered receiving, this set presents strong argument for the latter case.

A Variometer with Self-Supporting Windings

A CHANGE in the usual methods of making variometers is incorporated in the type shown here. The method of winding possesses advantages which will appeal to those who





are interested in making their own equipment.

In the instrument shown, the windings are made of high frequency cable wound on spherical forms. Then they are impregnated so that the wires are held together firmly, making a solid unit. The coils have several layers wound by the banked method. The two inside coils are secured to a bakelite strip in the ends of which the shaft is held. The square frame carries, at the top and bottom, brass pieces to which the outer coils are bound. By using spherical forms, the coils can be made very close to each other, giving a maximum inductance range.

Connections on the panel make it possible to join the outer and inner coils in series or parallel. An inductance range of approximately one to fifty can be obtained. That is, a small size gives a variation of 0.008 to 0.4 mh., and the largest size 0.4 to 20.0 mh.

Audion Hints

When there is an unusual rumbling in the telephones, examine the contact points in the audion. Oftentimes they become slightly oxidized and form a microphonic contact.

Do not use sandpaper or a file on the points. Simply hold the tube firmly in an upright position and rub the points over a sheet of clean paper.

Another cause of noises is a poor grid or plate connection at the socket. Although sockets now supplied are fitted with screews, the wires should be soldered. There is such an infinitesimal amount of current at best that no precaution should be overlooked to prevent a loss of energy.

Digitized by Google

High Frequency Resistance

Showing the Results of Skin Effects at Radio Frequencies

HIGH frequency cable, or what was known before the war as Litzendraht, has come into wide use for radio equipment. The purpose of its use is to reduce resistance, desirable because energy is lost in resistance, and because resistance makes the tuning of a receiver less sharp.

Various kinds of high frequency cables are made, some of which are advantageous, and some are not. This cable, strictly speaking, is made of a number of wires individually insulated from each other. Stranded bare wire should not come under this name.

It has been determined that, at high frequencies, electricity travels on the surface of conductors, instead of distributing itself through the wire. As the frequency is increased this effect becomes more marked, and the resistance is increased very considerably.

The most useful way to express the increase is as a resistance ratio, or the number of times greater the resistance is at high frequencies than with direct current. The ratio is

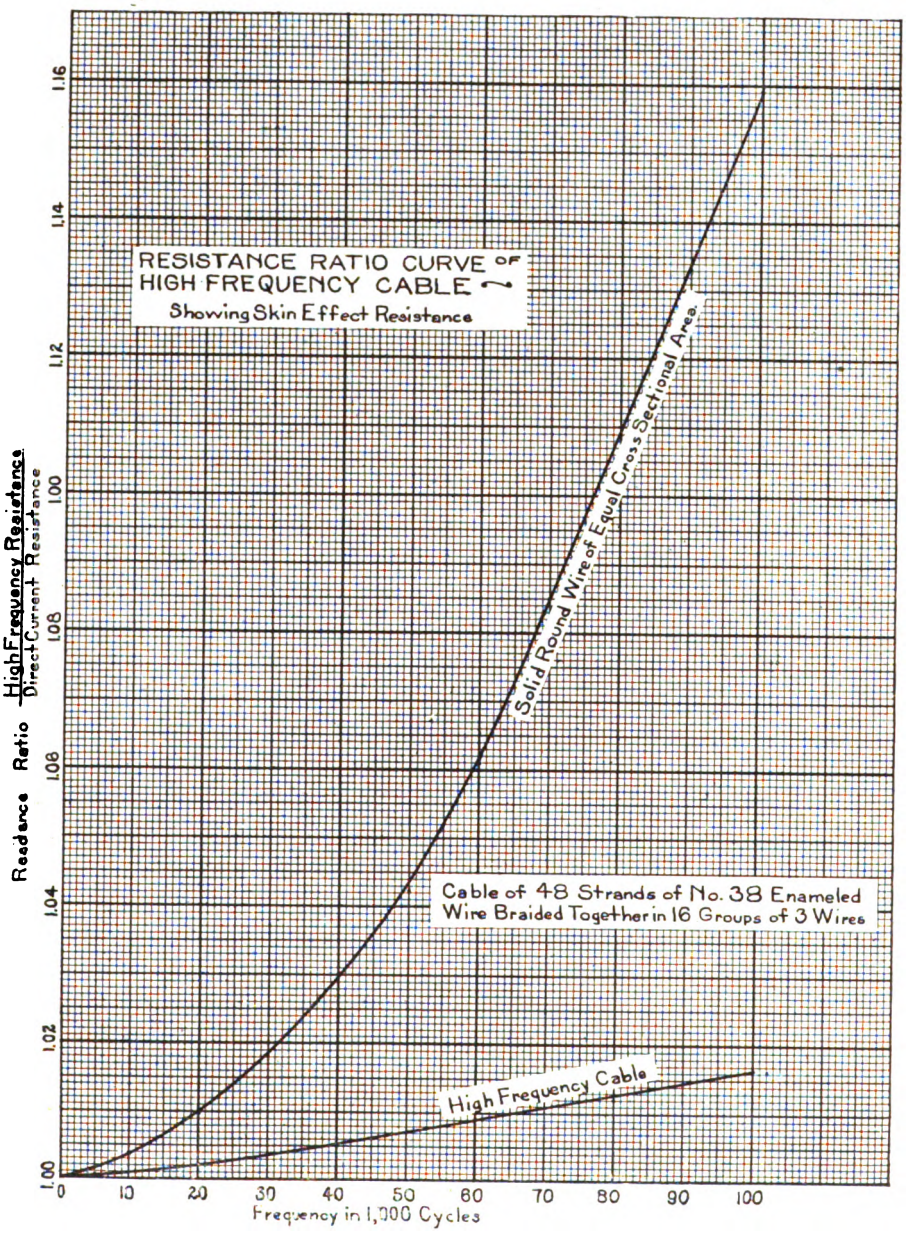
$$\text{Resistance Ratio} = \frac{R_1}{R}$$

where

R_1 = High frequency resistance

R = Direct current resistance,

that is, if the resistance of a given straight length of wire is 100 ohms at 50,000 cycles, and the direct current resistance for this same wire is 50 ohms, the resistance ratio is 2. Therefore, any amount of this wire will have 2 times the resistance, at 50,000 cycles, that it has with direct current.



When bare wire strands are used, the outside and inside conducting areas are not much greater than solid wires of equivalent cross section. Also, there is a tendency for the current to flow from one wire to the next, and the imperfect contacts introduce resistance. Therefore, there is no advantage in its use.

In conductors of insulated strands, the resistance ratio falls as the strands are separated. It is essential, however, that the material used to space the wires shall be a good dielectric. This result is accompanied by using an enamel insulation on the wires.

Some cables are made with a slight twisting or spiralling of the wires, others have groups of twisted wires twisted together. Another method is to braid the wires in the form of a hollow tube. The first method increases the resistance ratio; the second effects a slight reduction, while the third is best of all.

The lower curve here shows the resistance ratio, at frequencies of 0 to 100,000 cycles, for standard Roebling cable made of 48 strands of No. 38 enameled wire. The strands are divided into 16 groups, which are braided together to form a hollow tube. Another curve is given to show the rapid increase in resistance of a solid wire equivalent in conducting area to the cable.

The advantage of the use of high frequency cable is clearly shown in the curve. At 0 cycles, or direct current, the resistance of both are the same. At 100,000 cycles, corresponding to a wavelength of 3,000 meters, the cable has a resistance only 1.016 times that with direct current, while the solid wire goes up to 1.16 times.

Winding wire into coils increases its resistance, and with multi-layer or pancake coils it is more than with a simple layer solenoid.

The standard cable sizes are 10-No. 38, 20-No. 38, and 3-16 No. 38. Large inductances are generally wound with 10-38 if the space is limited. This size is particularly easy to handle in making banked windings, as it is stiffer in proportion to its diameter than the larger cables.

20-38 should be used where space will permit. The diameter is not much greater than that of 10-38, and its resistance lower. 3-16-38 is used almost exclusively on U. S. Navy receivers and is also employed for audion transmitter inductances. The losses in transmitting circuits are of great importance, and it has been found that one of the first precautions to be taken is the use of heavily stranded cable.

Digitized by Google

The Man Who *Wouldn't* Stay Down



He was putting in long hours at monotonous unskilled work. His small pay scarcely lasted from one week to the next. Pleasures were few and far between and he couldn't save a cent.

He was down—but he *wouldn't stay there!* He saw other men promoted, and he made up his mind that what they could do *he* could do. Then he found the *reason* they were promoted was because they had special training—an expert knowledge of some one line. So he made up his mind that *he* would get that kind of training.

He marked and mailed to Scranton a coupon like the one below. That was his first step upward. It brought him just the information he was looking for. He found he could get the training he needed right at home in the hours after supper. From that time on he spent part of his spare time studying.

The first reward was not long in coming—an increase in salary. Then came another. Then he was made Foreman. Now he is Superintendent with an income that means independence and all the comforts and pleasures that make life worth living.

It just shows what a man with ambition can do. And this man is only one out of hundreds of thousands who have climbed the same steps to success with the help of the International Correspondence Schools.

What about *you?*

Are you satisfied merely to hang on where you are or would you, too, like to have a real job and real money? It's entirely up to you. You don't *have* to stay down. You *can* climb to the position you want in the work you like best. Yes, you can! The I. C. S. is ready and anxious to come to you, wherever you are, with the very help you need.

Surely when you have an opportunity that means so much, you can't afford to let another priceless hour pass without at least finding out about it. And the way to do that is easy—without cost, without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 60598, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Toolmaker
- ☐ Machine Shop Practice
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Ship Draftsman
- ☐ CHEMICAL ENGINEER
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Show Card Writer
- ☐ Outdoor Sign Painter
- ☐ RAILROADER
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ Traffic Management
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ STATIONARY ENGINEER
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE
- ☐ Navigator
- ☐ Poultry Raising
- ☐ AUTOMOBILES
- ☐ Spanish
- ☐ French
- ☐ Italian

Name _____

Occupation & Employer _____

Street and No. _____

City _____ State _____

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer
144 Owen Building Washington, D. C.

PATENTS

INVENTORS Send sketches or a model of your invention and a description of the device for advice in regard to the best way of obtaining patent protection. Our practical experience covers a period of twenty years. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today.

Talbert and Talbert
Patent Lawyers
4368 Talbert Building Washington, D. C.

PATENTS

LACEY & LACEY

Attorneys-at-Law—Patent Practice Exclusively
Solicitors of
U. S. and Foreign Patents
Trade-Marks, Copyrights
655 F Street, N. W., Washington, D. C.
Write Us for Our Free Inventors' Book
PATENT-SENSE
ESTABLISHED 1869

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

PATENTS

Prompt, personal efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years actual experience, full information upon request.

B. P. FISHBURNE
321 McGill Bldg., Washington, D. C.

Fleming's Pocket Book of Formulae
360 pages of formulae and information for the radio experimenter. Price, $2.00
EVERYDAY ENGINEERING

Learn Mechanical Drafting
Earn $35 to $100 A Week

"Get into the profession of big pay and Rapid Advancement with the help of the school that has started hundreds on the Road to Success. I am ready to help you." Roy C. Claflin, President, Columbia School of Drafting.



Learn At Home In Spare Time

You don't have to stop work or leave home in order to become a trained Draftsman. Through our practical home study Training we will teach you Right in Your Own Home so that you will soon be able to qualify for a good position at Big Pay. We will continue to instruct and help you until we know you have the knowledge necessary to succeed.

No Previous Training Necessary

Right now — TODAY — there are openings for thousands of Draftsmen in the Government Departments, industrial concerns, and the big engineering offices. One department alone recently called for 1,800 draftsmen. With this tremendous demand has come a big increase in salaries.

Draftsmen Are Getting $35 to $100 a Week

with big chances for even better pay as the demand grows. By enrolling NOW for our practical Home Study Course in Drafting you can quickly qualify for a position as Draftsman and by properly applying the principles we teach

You Have a Chance to Become a Chief Draftsman

and get to the very top in this fascinating profession. Our course will give you just the knowledge you need to make good as chief draftsman when your chance comes.

Industrial Activity Demands Draftsmen

With the problems of reconstruction facing the nation the demand for draftsmen is Greater Than Ever Before In American History. All big engineering, construction and manufacturing projects must go through the drafting room before the workmen can commence. You can help in the work of reconstruction and secure a Big Salary with excellent opportunities for advancement. Many Big Men in industry got to the top through Drafting.

We Will Help You Secure a Position

as soon as you complete our course. We have already placed hundreds of our graduates in good paying positions and are constantly in touch with vacancies for which Draftsmen are Urgently Needed.

Men Needed Right Now

Government Departments and Private Concerns are continually calling upon us for our graduates because they know that our instruction produces draftsmen of the caliber they need.

Drawing Outfit FREE As soon as you enroll you will be sent our special drawing outfit FREE so that you will be sure to have it to work with while taking the course. This set will be yours to keep. You are not asked to return it after completing the course.

Illustrated Book of Particulars Sent Free

Fill in the coupon below—send it to us and we will send you FREE a copy of our illustrated book telling you all about our special Home Study Course and how you may secure our instruction at once on Easy Terms so as to quickly qualify for one of the Big Positions Now Open.

Mail This Coupon To-day

Columbia School of Drafting
Dept. 1058, 14th and T Sts., N. W.
Washington, D. C.

Without obligation to me, please send me your illustrated book telling how I can secure your complete Home Study Course, the FREE DRAWING OUTFIT, and your help in securing a position as Draftsman.

Name .....

Address .....

City ..... State .....

Digitized by Google

Composition of Brazing Brass

THIS term is usually applied to yellow brasses, of composition ranging from 80 to 85 per cent copper and 20 to 15 per cent zinc, which will stand brazing with ordinary yellow brazing solder (50 copper, 50 zinc) without melting or cracking. These defects are liable with the brasses of low copper content, such as 60—40, on account of their lower melting points. If tin is present in the brazing brass cracking is liable to occur, while lead also should be absent. The 80 copper, 20 zinc mixture is yellow in color, but when the zinc is reduced to 15 per cent, with 85 per cent copper, the metal has an orange tint. The melting point of the lower zinc mixture is, of course, slightly the lighter of the two, and hence it is the more suitable, unless the color is a matter of importance.

Testing Plating Solutions

PLATING solutions evaporate much more rapidly than is usually imagined. In a warm plating room, with a large surface that is exposed to the air, evaporation is continually going on. The plating solution, therefore, is constantly becoming concentrated. At least once a week the plater should test the solution with a hydrometer, and add what water is necessary for bringing the bath up to the right degree. Many platers who usually neglect this operation will be surprised at the quantity of water which has evaporated prior to making their tests.

An Interesting Magnetic Alloy

AN interesting alloy with marked magnetic properties, known as Heussler alloy, can be produced by the experimenter. A mixture of powdered manganese and antimony in the proportion 1 : 3 is placed in a test tube and heated over a bunsen flame. The resulting alloy possesses remarkable magnetic characteristics. It is strongly magnetic and filings of the alloy may be used in place of iron filings used ordinarily.

Waterproofing Blue Prints

Immerse a number of pieces of an absorbent cloth about one foot square in melted paraffin until saturated. When withdrawn and cooled they are ready for use at any time. To treat a blue print, spread one of the waxed cloths on a smooth surface, place the dry print on it with a second cloth on top, and iron with a moderately hot flatiron. The paper absorbs paraffin from the cloth until saturated, and becomes translucent and completely waterproof.



BE A CERTIFICATED ELECTRICIAN

I WILL TRAIN YOU AT HOME

A Real Position Like This—for YOU

The country needs thousands of trained, Certificated Electricians to fill good positions—and at big pay. It's all a matter of knowing how, and I will teach you by up-to-date, modern instruction. You can learn at home, without interfering with your regular work, by my highly successful method of **Home Instruction** in **Practical Electricity.**

Prepare NOW, and be ready in a few months to earn your

$46 to $100 A WEEK

Send for this Book—

My book, "HOW TO BECOME AN EXPERT ELECTRICIAN," has started thousands of young men on the way to splendid success. A new edition of this has just been printed. I want every young man interested in Electricity to have a copy, and send you one ABSOLUTELY FREE AND PREPAID. Write me today.

How I Train My Students

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to enable him to get and hold good positions, and to earn big pay. I have trained hundreds of men who are holding splendid electrical jobs.

I give each of my students personal attention and a complete and thorough training. I give him a SPLENDID ELECTRICAL OUTFIT FREE, and much of the training is done by actual work. When my students graduate and receive their Certificate they are ready for a real position. But **still more,** at any time you wish you can come to our splendidly equipped Electrical Shops for special training. No other school can give you this.

A Real Opportunity for YOU

Wishing is never going to make your dreams come true. You've got to **study**—to **learn.** A man is worth only $2 or $3 a day from his neck down—and no more; but there is **no limit** to what he can be worth from his neck up.

A **trained mind** is what gets the big pay. It is this training that you need, and I can train you in a few months. Are you ambitious to make a real success—then send me the coupon—today.

Electrical Outfit Free

To every student who answer this ad I am giving a splendid Electrical Outfit of standard size Electrical Tools, Instruments, Materials, etc., **absolutely free.** Furthermore, to every Electrical Student I give a truly **valuable** surprise that I cannot explain here.

Free Employment Service

I am continually receiving requests from employers to send them trained Electrical men. I assist my students to secure good positions. I keep in touch with them for years, helping and advising them in every possible way.

Write Now—Don't Delay

Delay never got you anything. Action is what counts. Get started—and get started now. Write me, or send me the coupon, right NOW.

L. L. COOKE, *Chief Engineer*

CHICAGO ENGINEERING WORKS

DEPT. 240

441 Cass Street : : : : CHICAGO

USE THIS "FREE OUTFIT" COUPON

Chief Eng. Cooke,
Dept. 240
441 Cass St., Chicago, Ill.
Sir: Send at once—fully prepaid and entirely free—complete particulars of your great offer for this month.
Name.....
Address.....
City .....State.....

YOU CAN DO IT

Digitized by Google

The apprentice says:

"Almost the first tool I ever heard of was a Starrett 'mike.' Somebody pinched Dad's out of his jumper pocket and the fuss he made showed he thought it was *some* tool, even if he had had it close on twenty years.

"When I got into the shop myself, I noticed the toolmakers and everybody who had 'fussy' jobs preferred Starrett Tools.

"There's something about 'em that the fellows like. Yeh! They're accurate and they're convenient, but I guess the fact that the men who make 'em are pretty good mechanics themselves, has something to do with it.

"What? Sure I'm getting me a set of Starrett Tools—I need 'em every day. Yes, I got me one of those seventy-five cent Starrett Apprentice Books, too. It saves me asking the foreman a question every five minutes. Now, when I want to know how to do something, I can look in the book and study it out myself."



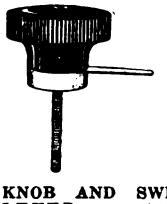
Starrett Tools



The L. S. STARRETT COMPANY
THE WORLD'S GREATEST TOOLMAKERS
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

For thirty-nine years Starrett Tools have measured the accuracy of the world's work. Catalogue No. 21 "M.B." free upon request.

42-972



WIRELESS PARTS SUPPLIES

BAKELITE-DILECTO PANELS

All Panels are Black XX Grade, the Best Insulating Material. Include Postage on 3 lbs. on all Size Panels.

9½ x 19 x ¼	$4.00
19 x 19 x ¼	8.00
9½ x 19 x 3/16	3.00
19 x 19 x 3/16	6.00

KNOB AND SWITCH LEVER, mounted on brass bearing and shaft 2 inches long threaded 6/32. As illustrated above. Each, 40 cents; postage, 5 cents. KNOB only, 1¼ x ¾ with hole for mounting, each 20 cents postpaid.



No. CP-1 Contact, head 7/32 x 7/32 with screw for mounting postpaid per dozen 25c.



No. CP-2 Contact, head same as No. CP-1. Has smooth shank to force through tight hole in panel. Per dozen 25c postpaid.



No. CP 4 Contact with nut for mounting. Head same as No. CP-1. Per dozen 40c postpaid. All 3 styles polished brass.

DEALERS:—Get our prices on these parts, they will interest you. Audiotron, Detector, Amplifier, 2 Filament Bulbs, postpaid, $5.10.

Send 5 cents for our catalog and get on our mailing list for future bulletins free.

A. H. CORWIN & CO.
924A Kinney Building Newark, New Jersey

Reciprocating Engines

The *Practical Engineer* states that the turbine has definitely become recognized as the most efficient type of engine for the propulsion of steam-driven ships. and many prophets go so far as to say that, in conjunction with double reduction gearing, it will very soon entirely displace the steam reciprocating engine. With this view we are not disposed to agree; both on account of its greater reliability and because it is far simpler to manage it will long be utilized for the propulsion of tramp steamers and cargo vessels of low power, where engineers of the highest skill are seldom employed; and for this reason attempts will continue to be made to improve the efficiency of the reciprocating set. It is hardly likely that any fundamental changes will occur, but attention to details is often instrumental in bringing about a considerable economy in operation. One of the most important details, and one which is worthy of the closest attention of designers, is the arrangement of steam ports. With a view to reducing the clearance volume to a minimum, short straight steam ports at the ends of the cylinder can be employed in conjunction with a long valve, this having the additional advantage of reducing the internal surface, which is cooled by the passage of the exhaust steam, and upon which the incoming steam will condense. Again, the cylinder covers should make joint with the possible; in this way, while the clearance volume may be unaffected, the internal surface upon which steam may condense is again reduced to a minimum.

To Loosen a Glass Stopper

Make a mixture of:

Alcohol	2 drachms
Glycerine	1 drachm
Sodium Chloride	1 drachm

Let a portion of this stand in the space above the stopper for a few hours, when a slight tap should loosen the stopper. A circular adjustable clamp, to which is attached a strip of asbestos in which coils of platinum wire are imbedded, is obtained. By placing this on the neck of the bottle, and passing a current of electricity through the coils of wire, sufficient heat will be generated to expand the neck and liberate the stopper. Heat may also be generated by passing a yard of cord once around the bottle neck and by taking one end of the cord in each hand, drawing it rapidly back and forth. Care should be taken that the contents of the bottle are not spilled on the hand or thrown into the face when the stopper does come out.

Digitized by Google

Cutting Lubricants

AN authority claims that "sticky" water is the best cooling media for general purposes. Half a pound of soft soap to 1 gallon of soft water, with the possible addition of 3 per cent caustic soda, gives a very good general purpose emulsion for the usual machine shop. The amount of soap should be lessened in cold weather. Plain water splashes too much, the addition of the soft soap beside its lubricating qualities increased the skin tension of the fluid, and caused more intimate adhesion of the fluid to work, chip and tool. There is considerable choice in the matter of soft soap; some is perfectly bland, some has the vilest odor and color imaginable. After all, it depends upon the initial ingredients, and whatever these are in a cutting emulsion, the oil must first be saponified to emulsify. In the case of soft soap made from good vegetable oil the first stage on the road to emulsification has already been performed. Caustic soda, if added, tends to prevent rust. Submerged bath lubrication with a load not too severe (under 50 pounds per square inch) and without agitation, are conditions where a solution of soft soap and distilled water will give perfect results at a lower cost than oil. If a strong solution is first made, diluted to half strength for use, a daily addition of a small quantity of the strong liquor will rectify the fluid and prevent deterioration. For all practical purposes the fluid with the highest specific heat is the best cooler—in other words, water is better than oil in this connection. To get the best results from soft soap distilled or condensed steam water is far and away the best.

An interesting point in the operation of the gyroscopic stabilizer on vessels is its apparently insufficient size. It seems impossible that so small an apparatus should effect so fully the stabilizing of a ship of a size altogether disproportionate to the instrument restraining its motions in a seaway. The power of the instrument and its action without straining the ship is due to the fact that the motions of a ship are due to successive impulses from waves, one following the other, but neither having more than 4° effect on the vessel. Therefore, in a case where a ship might roll through 30° or more, such roll would be due to the actions of a number of waves. The gyroscope with only what may be called a 4° power will control a ship in such a case, taking care of each wave as it comes along, and never having more than a possible roll of 4° to take care of; hence its small size and power over a very large ship's motions.



Put Your Name On This Pay-Roll

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

AUTO BOOKS

6 Volumes Shipped Free

Now ready for you—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,650 pages and 2,100 illustrations, tables and explanatory diagrams. A library that cost thousands of dollars to compile, but that comes to you free for 7 days' examination.

Partial List of Contents

More than 100 blue prints of wiring diagrams
Explosion Motors
Welding
Motor Construction and Repair
Carburetors and Settings
Valves, Cooling
Lubrication
Fly-Wheels
Clutch
Transmission
Final Drive
Steering Frames
Tires
Vulcanizing
Ignition
Starting and Lighting Systems
Shop Kinks
Commercial Garage Design and Equipment
Electrics
Storage Batteries Care and Repair
Motorcycles
Commercial Trucks
Glossary

Only 7c a Day

Not a cent to pay in advance. First you see the books in your own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2 in seven days and $2 a month until the special introductory price of $19.80 has been paid. (Regular price $30.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This great bargain offer must soon be withdrawn.

SEND NO MONEY NOW

Don't take our word for it. **See the books without cost.** There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—only the coupon!**



FREE!

With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

American Technical Society

Dept. A-357, Chicago, Ill.

American Technical Society, Dept. A357, Chicago, Ill.

Please send me the 6-volume set, Automobile Engineering, for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2 within 7 days and the balance at $2 a month until the $19.80 has been paid. Then you send me a receipt showing that the $30.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the seven days' trial I will return them at your expense.

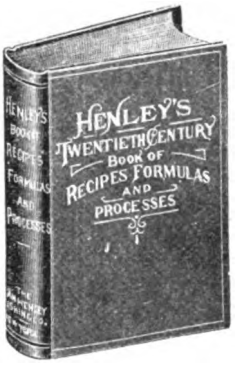
Name .....

Address ..... Reference .....

Digitized by Google

The Greatest Book
Ever Offered to the Public
1919 EDITION — JUST READY

Henley's Twentieth Century Book of
RECIPES, FORMULAS AND PROCESSES



10,000 Trade Secrets
Practical Recipes
Chemical Processes
Scientific Formula

HOW TO MAKE EVERYTHING
FOR THE HOME, THE FACTORY AND THE WORKSHOP.

Antiseptics, Waterproofing, Lubricants, Rust Preventatives, Dyes, Filters, Cleaning Preparations, Enameling, Beverages, Inks, Adhesives, Polishes, Disinfectants, Flavorings, Cosmetics, Ceramics, etc., etc.; how to make fly paper; to color flowers artificially; to estimate weight of ice by measurement; to make materials fireproof; to work with metals — aluminum, brass, etc.; to make anything and everything, from A to Z.

THIS IS THE BOOK
every one who seeks PRACTICAL, ACCURATE KNOWLEDGE and guidance in his everyday work MUST HAVE at his command.

It is a money-maker and a money-saver; it appeals to the young as well as to the old. Great business enterprises owe their success to the manufacture or sale of simple inventions or compounds, usually the result of an experiment at home. One woman writes: "I am supporting myself and two small children from the sale of toilet articles I put up by following directions in your book." Profit by the knowledge that has made others successful. GET THIS BOOK TODAY.

Price $3.00

Delivered to any address

Send for our catalogue of practical books including a description of above book.

THE NORMAN W. HENLEY PUBLISHING COMPANY
2 West 45th St., New York, N. Y.

Everyday Science Notes

By Prof. T. O'Connor Sloane

IT is found that as illuminating and heating gas is now made, there is a considerable tendency for it to corrode the pipes, especially if there is any moisture present. The removal of water has become an object and in England the Helps system is under trial. To carry this out the gas is compressed and cooled so as to cause the water to precipitate. It is then released from pressure and admitted to the mains at greatly reduced pressure, practically free from water. As much as fifty pounds compression is cited as having been given in one case. Cyanogen acids are largely at the root of the trouble, and here a sort of paradox is encountered. If moist gas is exposed to the action of steam and incandescent coke the cyanogen radical gives ammoniacal gas. Here the presence of water is desirable, for if ammoniacal gas is exposed to incandescent coke in the absence of steam it gives the troublesome cyanogen compounds again.

The catalytic process of making sulphuric acid has to an extent revolutionized the old-time industry, the sulphurous acid gas being passed over finely divided platinum, to bring about its combination with oxygen. It has greatly cheapened the production of fuming sulphuric acid, now in extensive demand by manufacturing chemists, the acid costing only one-tenth the old price. At first, in the catalytic process gas made from pyrite gave trouble, but that has been overcome. The platinum is very expensive. The metal for a single plant may at present prices easily cost half a million of dollars.

The *London Engineer* describes and illustrates two Newcomen steam engines which have been running since the years 1787 and 1823 respectively, so it is supposed. This engine, it will be remembered, antedates Watts' invention of the condenser; the steam entered below the piston and forced it up. At the end of the stroke the steam was cut off and a jet of water was discharged into the steam-filled cylinder, condensing the steam so that the atmospheric pressure operated to force the piston down. The engine did its work on the down stroke only, the heavy pump rods worked the pump on the up stroke, for the engines are of the beam engine type. Originally a chain connected the outer end of the beam to the pump-rods. These, of course, in some cases were extremely long.

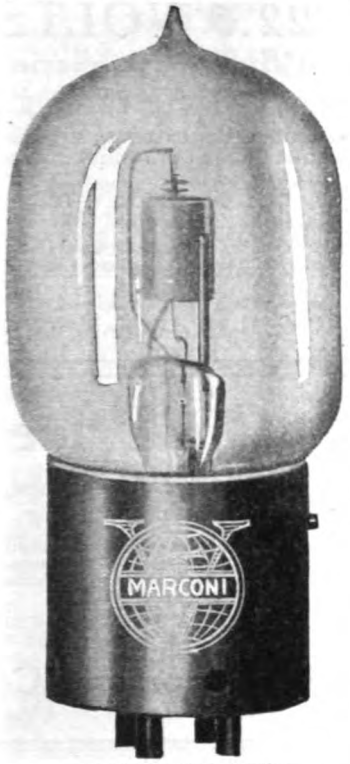
One of the curiosities in the history of the development of incandescent electric lighting relates to the metal osmium, which it was proposed to employ as the filament. The high conductivity of the metal and its fragility operated against its use. But the curious fact is, that although one pound of the metal will make 30,000 filaments, it is estimated that there is not in the whole world enough osmium available to provide a year's supply of filaments.

Heat detecting paints to be applied to shafts and bearings, and which paints change color if the bearings became heated and so call the attention of the operator to the fact that a little oil is needed, have long been known. Two formulas have recently been published of double iodides. The first one is cuprous mercuric iodide, Cu_2I_2, $2HgI_2$. This is a vivid vermillion when cold, but changes to chocolate well below the temperature of boiling water, at about 150° F. The other compound is silver mercuric iodide, Ag I, HgI_2. This is lemon yellow at ordinary temperatures and changes to carmine red at a point just below the boiling point of water. A mixture of 85% of the first compound with 15% of the second is vermillion when cold and black when hot. They are readily made by triturating the two salts in proper proportions in a mortar together, or may be precipitated from solution, potassium iodide being employed to dissolve the mercury iodide. White shellac varnish or acetone varnish are recommended as mediums for their application. It is well to paint a band or other surface of white next to them on the shaft or bearing to act as a contrasting object.

A. N. Winchell and E. R. Miller have published an account of their observations on a dust fall, which extended over the states of Wisconsin and Michigan, on March 8th, 1918. Vast quantities of dust were transported by a wind storm probably from Arizona or the old Indian Territory region. The evidence gathered went to show that one million tons of rock were carried a distance of over one thousand miles, showing what profound geological changes may be brought about by the agency of the wind.

It is stated that of some two hundred different compounds in coal tar only half a dozen are of commercial value. They are benzol, toluol, phenol, xylene, naphthalene and anthracene.

Digitized by Google



Fleming Pat. No. 803684
De Forest Pat. Nos. 841387-879532

THE HEART OF THE WIRELESS ON THE NC 'PLANES

Also used on the Vickers Vimy Trans-Atlantic Flight

MARCONI V. T.

$7.00 each

Standardized Socket . ,$1,50 additional

Agreements recently effected have made vacuum tubes available for experimental use. The Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

A highly developed, all-around tube for use as a detector and amplifier in wireless communication. It has practically the same electrical constants as the tube used by the Allied armies and navies throughout the war in continuous wave transmission and reception.

The approximate operating life of the MARCONI V. T. is 1,500 hours.

Class I—Designed for use as a detector; operates with plate potential of 20 to 60 volts.

Class II—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.

SEND ALL REMITTANCES WITH ORDER

COMMERCIAL DEPARTMENT

Marconi Wireless Telegraph Co. of America

Sole distributors for
De Forest Radio Telephone & Telegraph Co.

Room 1868 Woolworth Building, 231 Broadway, New York

BRANCH OFFICES

Schofield Bldg. Cleveland, Ohio	Insurance Exch. Bldg. San Francisco, Cal.	301 Commercial Bank Annex New Orleans, La.
American Bldg. Baltimore, Md.	136 Federal St. Boston, Mass.	109 South 2nd St. Philadelphia, Pa.



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr.,
U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE. YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
169 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 129 Rowland Bldg., Detroit, Michigan

ELECTRICAL ENGINEERING training again open to civilians. Over 3000 men trained for electrical industries in experience of more than a quarter of a century. For men of ambition and limited time. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity, Mathematics, Steam and Gas Engines, Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma. **IN ONE YEAR** complete



Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.

Write for catalog. 27th year opens October 1, 1919.

BLISS ELECTRICAL SCHOOL
140 TAKOMA AVENUE, WASHINGTON, D. C.

A Big Message in a Small Space
ORDER YOUR NOVEMBER "EVERYDAY" EARLY

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6060-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BOOKKEEPER
☐ BRIDGE DRAFTING	☐ Stenographer and Typist
☐ MACHINE DESIGN	☐ Cert. Public Accountant
☐ ELECTRICAL ENGINEER	☐ TRAFFIC MANAGER
☐ Electric Lighting and Railways	☐ Railway Accountant
☐ Electric Wiring	☐ GOOD ENGLISH
☐ Telegraph Engineer	☐ Teacher
☐ Telephone Work	☐ Common School Subjects
☐ MECHANICAL ENGINEER	☐ Mathematics
☐ Machine Shop Practice	☐ CIVIL SERVICE
☐ Gas Engine Operating	☐ Railway Mail Clerk
☐ CIVIL ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Surveying and Mapping	☐ Auto Repairing
☐ STATIONARY ENGINEER	☐ PLUMBING AND HEATING
☐ Marine Engineer	☐ Textile Overseer or Supt.
☐ ARCHITECT	☐ CHEMIST
☐ Contractor and Builder	☐ Navigation ☐ Spanish
☐ Concrete Builder	☐ AGRICULTURE ☐ French
☐ Structural Engineer	☐ Poultry Raising ☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Digitized by Google

G. A. STANDARDIZED B BATTERY 22.5 VOLTS

Built to the Specifications of the U. S. Signal Corps and Bureau of Steam Engineering

When the General Apparatus Company decides upon a standard, whether it is material or apparatus, it must be the best—not just as good, but the best that can be produced, regardless of price.

The G. A. Standardized B Battery is built to Government Specifications. Ninety per cent of the batteries used by the U. S. Signal Corps were of the identical design of the G. A. Standard. Only one chemist knows the formula. You can have in G. A. Batteries the same battery that the Government bought by the hundreds of thousands.

There is no better battery at any price—none as good at the same price. That is why the Army and Navy bought this type of battery almost exclusively. The G. A. Battery is not new, it has proved its value in the Service.

G. A. Signal Corps type, 3¼" long, 2" wide, 2½" high, operates one Audion 250 hours continually, average life, 3 months. Price $1.50, postage 10c.
G. A. Navy type, 6⅝" long, 4" wide, 3" high, operates one Audion 1000 hours continually, average life 10 months. Price $2.50, postage 15c.

No Higher Claims Can Be Made Honestly

157 East 18th Street **THE GENERAL APPARATUS COMPANY** New York City

INSTALL A NEW

Grebe Regenerative Receiver

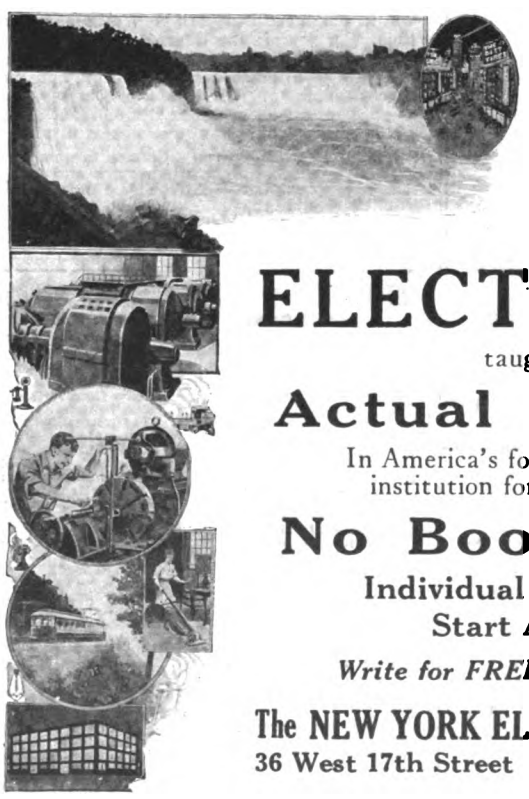
In Your Radio Station



Short-wave Regenerative Receiver Type CR-2. Designed for long distance relay work on wavelengths between 170 and 580 meters. This receiver is characteristic of our advanced design and methods of construction and will fulfill the most exacting requirements.

Various models designed to operate on Wavelength Ranges from 170 to 20,000 meters are described in our Bulletin, sent upon request.

A. H. GREBE & COMPANY
RICHMOND HILL NEW YORK



Learn By Doing

Every phase of all branches of

ELECTRICITY

taught by

Actual Practice

In America's foremost and oldest institution for trade training.

No Books Used

Individual **Instruction.**
Start **Any Day**

Write for FREE 64-page catalog

The NEW YORK ELECTRICAL SCHOOL
36 West 17th Street New York City

Get Our Prices

on the Wireless Apparatus you need, before buying.

We handle new and second hand instruments on which we can save you money. All Second Hand instruments guaranteed to be in perfect working order.

WHAT DO YOU NEED?
Send us your list now.

Radio Equipment Co.
630V Washington Street Boston, Mass.

DO YOU KNOW

the latest developments in radio? Circuits, vacuum tubes, loops, ground antennas, amplifiers, transmitters? We can furnish the information you desire, on any phase of radio communication. Three questions for one dollar.

CAPITAL RADIO LABORATORIES
Brookland Washington, D. C.

SELENIUM CELLS

Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.

Write for Catalog

Selenium Laboratories
Good Ground, Long Island, N. Y.

CAN YOU DRAW DOTTED LINES AS FAST AS FULL ONES?

YOU CAN WITH A

BERGGREN PEN

The Berggren Pen draws any style of dotted line without blot or blur. Nothing complicated or bothersome, used like your regular pen. When you are ready to put in the dotted lines, fill your



Berggren Pen and carry on. The result is a perfect dotted line, made as fast as you move your hand

Our pamphlet describes the pen and shows the styles of lines.

Berggren Drafting Pen and Six Wheels, $3.00

UNIVERSAL DRAFTING PEN CO
BRIDGEPORT, CONN.

Digitized by Google

Send for
HALCUN Radio Catalogue
Full Line of
Amateur Requirements
Halcun Radio Co.
San Francisco, Calif.
Formerly Haller Cunningham Elec. Co.

FOUR NEW BOOKS
WIRELESS EXPERIMENTERS
will be interested in this NEW BOOK on—

SELENIUM CELLS. Design, construction and use of the various makes. Illustrated with drawings and half-tones. 80 pages, 7½ x 5 in., cloth $1.50.

AUTOMOTIVE MAGNETO IGNITION, Its principles and applications, by MICH. E. TOEPEL. Second Edition, revised and enlarged. Profusely illustrated.
Limp Cloth, $2.00

AERONAUTICAL ENGINES, by F. J. KEAN. Second Edition, revised and enlarged, 96 pages, 48 diagrams, 29 page plates and 5 folding plate. Cloth, $2.60.

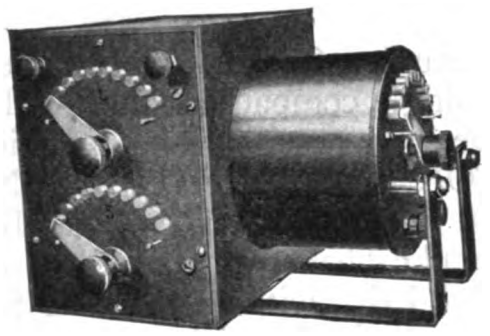
LATEST MAGIC, The New Book, by PROF. HOFFMANN, (Angelo Lewis) New and original, fully illustrated, handsomely bound in cloth—gilt. $1.65 Post paid.

Spon & Chamberlain
122 E. Liberty St. New York City

QST
A MAGAZINE DEVOTED TO AMATEUR WIRELESS
Official Organ: American Radio Relay League
Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work all A. R. R. L. News, Humorous Stories by The Old Man. All these and many more are included in QST.
SPECIAL TRIAL OFFER
Regular price $1.50 per year, 15 cents per copy. Introductory rate, 9 months subscription for $1 and attached coupon.
PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON
American Radio Relay League,
Hartford, Conn.
Enclosed find $1; please enter my trial subscription to QST for 9 months.
Name_____
Address_____

RADIO ELECTRICAL APPARATUS



New type radion receiving transformer has bakelite panels, two primary and one secondary 10 point switches. Oak cabinet. Price, $12.00.

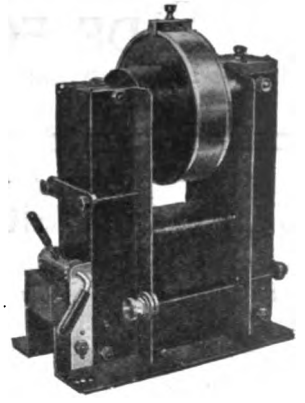
Our new Bulletin Y offers a distinctive line of radio and laboratory apparatus including transformers, spark gaps, oscillation transformers, variometers, variable condensers, etc., in fact the most complete line in America.

Bulletin R describes the Cambridge alternating current rectifier for
STORAGE BATTERY CHARGING
Send 3c. stamp for both bulletins

CLAPP-EASTHAM COMPANY
131 MAIN STREET CAMBRIDGE, MASS.
REMLER RADIO MFG. CO. 62 Post Street SAN FRANCISCO
Pacific Coast Representatives

1 K. V. A. 25,000 Volt Wireless Transformer

The Thordarson Wireless Transformer is more than a transformer. It is a machine of efficiency and reliability, a piece of wireless apparatus that every amateur can be justly proud of. A Thordarson Wireless Transformer will make a "Long Distance" amateur of you. Our "20-T" bulletin describes our complete wireless transmitting apparatus.

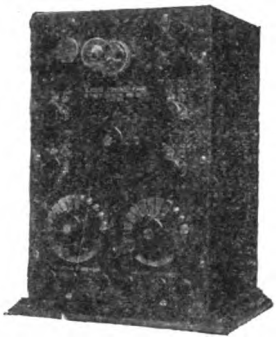


Thordarson Electric Mfg. Co.
501-515 So. Jefferson St. Chicago, Ill.

Regenerative Receivers, Amplifiers and Oscillators All Require
VACUUM TUBES
Experimenters who copy European stations with indoor loop antennas use the AudioTron Hi-Vacuum Tubular Detector-Amplifier-Oscillator.
Has proven its sensitiveness and reliability since 1915. No station is complete without it.
Send for descriptive bulletin describing the AudioTron and our new Bakelite Panel for ARC & Spark reception, new smooth running rheostats, knobs, levers, contacts, etc.
DEALERS: Write for proposition. Territory now being allotted.
AUDIOTRON SALES COMPANY
1940 LEAVENWORTH STREET SAN FRANCISCO

Digitized by Google

NEW TYPES OF AUDION APPARATUS



Audion Control Panel Type P-100—combining in a single compact set the Peerless De Forest Audion Detector, oscillator and audion amplifier, BUILT FOR THE AUDION AS ONLY THE MAKERS OF THE AUDION CAN BUILD IT. No other set like it has ever been built to sell for less than $150.00. Our Price without the bulb $65.00. Description of lower priced models sent on application.



The latest in Amplifier design sufficient to give amplifications up to 20 times. PANEL QUICKLY REMOVABLE MAKING ALL PARTS ACCESSIBLE, AND THE REPLACING OF THE NEW TYPE EN BLOC "B" BATTERIES BUT A MOMENT'S WORK. Workmanship of the highest grade. Price without the bulbs $69.50.

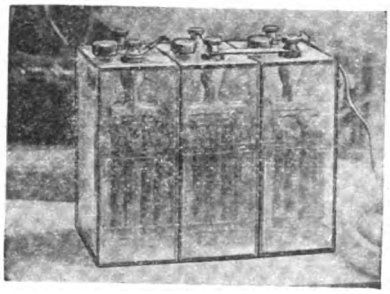
DE FOREST RADIO TEL. & TEL. CO.

1415 Sedgwick Avenue New York City

POROX STORAGE CELLS FOR

MODELS, ELECTRICAL, AND RADIO APPARATUS

Porox Storage Batteries are made up of separate 2-volt cells in PY-RA-LIN jars, designed for high efficiency, low weight, and long life. They are lighter, more powerful, last longer, and cost less than dry cells. Can be charged at home. Porox Cells are designed for the requirements of the



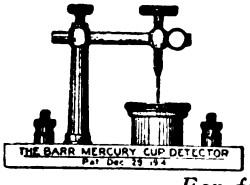
MODEL MAKER AND EXPERIMENTER

2 volts, 10 amp.-hrs., 3 x 1⅞ x 4½ ins. 3.75
2 volts, 15 amp.-hrs., 3 x 2⅝ x 4½ ins. 4.60
2 volts, 16 amp.-hrs., 3 x 1¾ x 6 ins... 4.00
2 volts, 25 amp.-hrs., 3 x 2⅝ x 6 ins... 5.20

Any number of cells put together for any required voltage. Batteries are also furnished in oak cases for ignition and lighting.

ALBERT MULLER,
8758 Queens Boulevard,
JAMAICA, LONG ISLAND, N. Y.

THE BARR
Mercury-Cup Wireless Detector



The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Co.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct

Instantly adjustable at a constant pressure.

For full information and price—write

The Barr Mercury-Cup Detector, Dept. C, The Wyoming, Washington, D. C.



DUCK'S No. 13 264 Pages Electrical and Wireless Catalog

JUST OFF THE PRESS

175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

The blue prints of many of the model engines described in Everyday Engineering are available. These can be had at a small charge. Everyday Engineering Magazine, 2 West 45th St., New York City.

Digitized by Google

STANDARDIZED EQUIPMENT AND MATERIALS

Short Range Antenna This Standard Antenna, with a simple tuner and crystal detector, will receive Arlington over 500 miles, and amateur or other stations in proportion to their power. Range greatly increased by Audion. Complete materials and instructions, $2.00 prepaid.

Long Range Antenna With a crystal receiver, this antenna will receive Arlington over 1,000 miles; other stations in proportion to their power. Can be used for long wave telephone or telegraph reception. Complete materials and instructions for erecting, $3.25 prepaid.

Super Range Antenna The type of antenna for long distance, long wave work, remarkably efficient, simple to erect, requires no masts. With one Audion, it will receive Lyons, France, over 5,000 miles. Complete materials and instructions for erecting, $4.65 prepaid.

NO MASTS REQUIRED AS HEIGHT NEED NOT EXCEED 30 FEET. INCREASED RANGE WITH GREATER HEIGHT. WIRE, INSULATORS, LEAD-IN CABLE, INSTRUMENT GROUND WIRE INCLUDED.

Standard Bakelite Panels The use of Standard Bakelite Panels makes possible interchangeable construction of apparatus. Instruments built on these panels can be added or temporarily removed without tearing up the set. Prices in the Introductory Bulletin.

H. F. Cable or Litz All inductances for receiving or Audion Transmitters must be wound with H.F. Cable for maximum efficiency. Resistance far lower than solid wire. Per 100 feet, 10 No. 38, $0.50; 20 No. 38, $0.85; 3x16, No. 38, $1.60.

SEND FOR INTRODUCTORY BULLETIN OF STANDARDIZED MATERIALS

Brass rods and tubes, magnet wire, Fahnestock binding posts, Bakelite panels, high tension cable, wood and machine screws, nuts, and supplies for Model, Electrical, Mechanical, Airplane, and Radio work.

This mark stands for integrity in Service, Prices and Quality.

G.A.

Immediate shipments, no disappointments for G. A. Customers.

157 E. 18th Street **The General Apparatus Company** New York City



TWO STEP AMPLIFIER

TYPE TRIODE-B

This amplifier is a compact unit of the resonance low frequency type, and provides a maximum of amplification.

Its compactness, simplicity and efficiency render it an attractive investment to the progressive radio experimenter.

IMMEDIATE DELIVERY

Particulars and price on application.

THE EATON OSCILLATOR

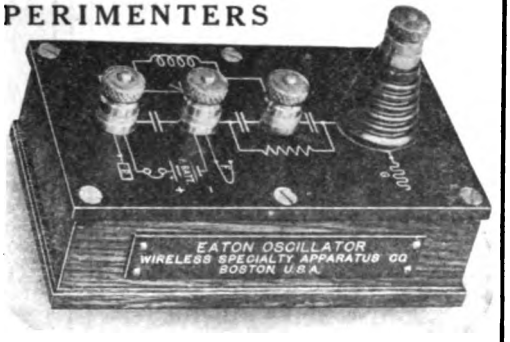
FOR EXPERIMENTERS

Designed to transform receiving circuits to receive arc and other undamped signals.

It will oscillate over a wave length range of 250-25,000 meters.

Requires no adjustments of any kind. Only one variable, the tuning condenser, is required.

The simplest and cheapest way of receiving undamped signals.



PRICE $14.90. Immediate Delivery.

WIRELESS SPECIALTY APPARATUS COMPANY

Engineers, Designers, Manufacturers BOSTON, MASS., U. S. A.

"ASK ANYONE WHO HAS USED IT"

SUBMARINED THREE TIMES and STILL IN USE

said an Englishman: "I've been submarined three times and put my Brandes Headset in my pocket each time. You bet I saved it. I wouldn't have any other make." (Name on Request).

Think of the help to wireless operators that the perfect sensitiveness and dependability of Brandes Headsets provided during the war. Life or death depended upon *hearing correctly*. They are made today just the same and give the same quality of service.

BRANDES WIRELESS HEADSET



"Superior", 2000 ohms, $7

TRIAL OFFER Brandes Wireless Headset sent to you on trial for 10 days. If, for any reason, you are dissatisfied, your money back without a question. Test it,—compare it with others, — for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

Send 4c for Catalogue M

C. BRANDES, INC. 32 Union Square, Room 822 New York

WIRELESS RECEIVER SPECIALISTS

M. B. Sleeper Is preparing for the G. A. Company a series of pamphlets on the construction of transmitting and receiving instruments, information Experimenters need on simple apparatus of new and highly efficient design. All detail drawings given.

1. INDUCTANCE TABLES: Simple, direct reading, for coils 3 to 10 ins. diameter by ¼-in. steps, 0.1 to 10 ins. long in 1/10-in. steps. Gives inductance of single layer, multi-layer, pancake and figure 8 coils.
2. DIRECTION FINDER: Detail drawings of simple unilateral Direction Finder of G. A. Standard Panel design, 200 to 2,500 meters.
3. AUDION TRANSMITTER: A high efficiency telephone or telegraph set that can be built at small cost of simple materials. Range over 10 miles.
4. SUPER RANGE RECEIVER: With one Audion, will give wonderful results on long wave undamped work, telephone or telegraph.

PRICE, 25c EACH. SPECIAL OFFER, 3 for 60c, 4 for 75c—YOU NEED THEM ALL, SEND AT ONCE

157 E. 18th St. **THE GENERAL APPARATUS COMPANY** New York City



VARIOMETER PARTS

Turned from birch. Set as illustrated consisting of stator (two parts) rotor, and form for winding coils. POSTPAID $2.50. Size of stator 5½" sq. Other sizes to order. Price $3.00.

The Wilcox Laboratories

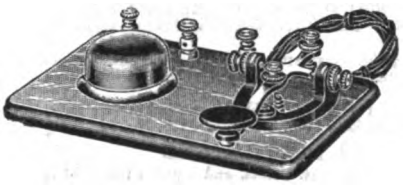
LANSING Dept. D MICHIGAN

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Wireless Receiving Ban Raised

MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No.		Price
342	Telegraph Practice Set, with Battery and Cord	$3.24

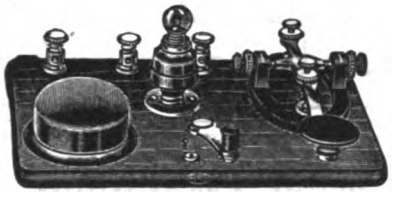
Weighs 4 lbs. packed.
Price does not include postage.

MESCO COMBINATION PRACTICE SET

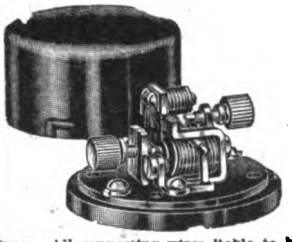
For Learning the Morse and Continental Visual and Audible Codes

This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord $4.65
Weighs 4 lbs. packed.
Price does not include postage.



MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a bayonet joint.

List No.		Price
55	Mesco Radio Buzzer	$2.65

We carry a large and complete line of Standard Wireless Material recognized by experts as such with competent experienced wireless attendants in charge

Send for the New Edition of Our Catalog K28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarms Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Manhattan Electrical Supply Co., Inc.

NEW YORK: 17 Park Place — BRANCHES: 110 W. 42nd St., 127 W. 125th St.
CHICAGO: 114 S. Wells St. — ST. LOUIS: 1106 Pine St. — San Francisco Office: 604 Mission St.

Genuine Armstrong Stocks and Dies



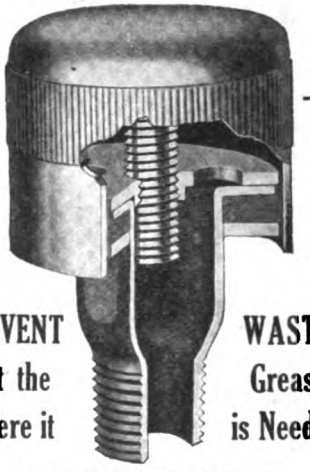
Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.

Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.

Send direct to us if your dealer cannot supply you.

Descriptive Catalog on Request

The Armstrong Manufacturing Co
761 Knowlton Street Bridgeport, Conn.



PREVENT WASTE
Put the Grease
where it is Needed

THE BRIDGEPORT
Center Thread Grease Cup

This cup will squirt more grease than any cup of the same size made.

Equip your machine, auto or boat with this new type of grease cup, one that does not leak, that cannot be cross-threaded and that forces the grease to the bearing points.

The cleanest Grease Cup made.

Send for Circular and Price List

THE GARRISON COMPANY
348 George St. Bridgeport, Conn.



Tubular Flashlight Style

Guaranteed **Triangle Flashlights** guaranteed to withstand a pressure of 200 pounds on the **Vulcanized Fibre Cases** used in the **Triangle Flashlights.**

	List Price	Our Price
Baby Tubular Complete 1¼"x5"	$1.35	$1.00 Postpaid
Baby Miner Complete 1¼"x5½"	1.50	1.15 "
Two Cell Tubular Complete 1½"x6½"	1.70	1.30 "
Two Cell Miner Complete 1½"x7"	2.00	1.45 "
Three Cell Tubular Complete 1½"x8½"	2.00	1.45 "
Three Cell Miner Complete 1½"x9"	2.25	1.60 "

22.5 Volts—15 Cells **Signal Corps, U. S. Army B-Batteries for Vacuum Tubes Type BA-2.** Worth $1.50. Our price 60c. Shipping weight one pound.
Same as above except 45 Volts—30 Cells. Worth $6.00. Our price $3.50. Shipping weight three pounds.
Aerial Wire compounded of copper and iron. Worth 45c lb. Our price 200 ft. for 70c. Shipping weight three pounds.

The Famous Mercury-Cup Wireless Detector, the most efficient crystal detector on the market. Tested by the U. S. Government and Marconi Wireless Telegraph Co. Increases the efficiency of every wireless receiving set by making the signal clear, sharp and distinct. Instantly adjustable at a constant pressure. Sells everywhere at $5.50. Our price is $4.50 postpaid.
Guaranteed **Victory** or **Domanco Electric Irons.** Six pound, 500 Watts. Worth $7.00. Our price is $4.65. Shipping weight 7 lbs.



Miner's Flashlight Style

Red Seal Batteries at 4 for $1.35. Shipping weight 8 lbs.
Guaranteed 200 Watts Blue Daylight Nitrogen Lamps. Worth $3.00. Our price $1.65 postpaid.
Guaranteed Thor Vacuum Cleaner for A. C. or D. C. with all the necessary attachments. Selling everywhere at $40.00. Our price $32.50 F. O. B. New York. Add enough postage for the above articles and three cents for insurance.

THE H. S. WIRELESS CO. 164 Ross St. Brooklyn, N. Y.

INDICATING CALIPERS



Here is a finely made tool incorporating features of rule, calipers, indicator and magnifier. Adjustment is provided for wear of parts. Easy movement is effected by ball bearings. A coiled spring draws points together. Tool can be set for desired dimension. It is a one hand tool, leaving other hand free for holding of the work.

Made in two capacities:
2" capacity, graduated in 100ths in.
3" capacity, graduated in 64ths in.
Price $6.50

Send for folder or inquire of your dealer.

Indicating Calipers Co.
508 East 19th St., New York

Digitized by Google

Baldwin Mica Diaphragm Telephones

In order to enable every wireless operator to use the well-known Baldwin phones, we have reduced the prices as follows:

NAVY TYPE "C"	$15.50 each,	F. O. B. New York
SMALLER TYPE "D"	16.50 each,	" " "
NEWEST TYPE MADE "E,"	17.50 each,	" " "

(More rugged and just as sensitive. This refers ONLY to Type E.)

Apply to your nearest local distributors. If unable to obtain same, forward your order with money order direct to us. If any operator desires a cheaper cost phone than the "BALDWIN" we can recommend the "Brownlie" adjustable phone, which is very sensitive. Price, $11.00, F.O.B. New York.

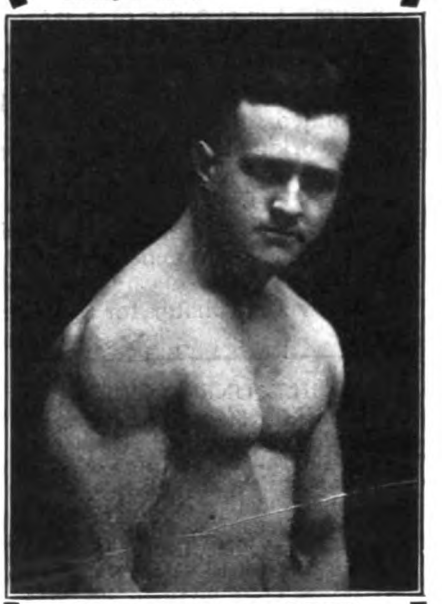
JOHN FIRTH & COMPANY, Inc.

81 New Street New York City

I Can Make You STRONG

I can show you how to develop every bit of strength that a real man should have. I can give you an abundance of vitality and a highly developed body and mind.

The Man who wishes to succeed in business must be endowed with an unusual amount of strength, endurance and vitality. I have found the way to develop these qualities in the shortest possible time. I have done it myself, with my own body, and I have done it for many other of the world's strongest men.



EARLE LIEDERMAN

The Acme of Physical Perfection

Let me take you in hand and make a real man of you. You will always bless the day that first you sent for my book. I can put pep into your actions, vigor into your step, and make your mind so clear and alert that you simply must go ahead in business and social life. There is no reason why you should go on through life all fagged out, more dead than alive. Let me change all this—let me make life worth living. Give me a chance to show you what I can do for you.

Send To-day for MY NEW BOOK

"Muscular Development"

It tells how I can help you. I will send this valuable book to you by return mail on receipt of only 10c to cover cost of mailing and wrapping. Use the coupon below. The book contains full particulars of my splendid offer, and is profusely illustrated with pictures of many of the world's strongest men whom I have trained. **Don't pass this by. Sit right down and fill in the coupon. Do it now, this minute, while it is on your mind.**

EARLE E. LIEDERMAN
Dept. 704, 203 Broadway, New York

Earle E. Liederman
Dept. 704, 203 B'way, N. Y. C.

Enclosed find 10c for which you are to send me at once your new illustrated book, "Muscular Development."

Name .....

Address .....

City .....

Quality Apparatus

Get This 40-Page Catalog of Radio Apparatus Mailed Postpaid



This forty-page book of Radio Apparatus shows nearly all the latest appliances both for receiving and sending wireless messages. It is written in non-technical terms so that it can be understood just as easily by the inexperienced person as by the wireless expert.

Prices are low when you consider the quality of the apparatus. Here is a sample of our prices:

6A9314—½ K. W. Meteor Wireless Transformer, 10,000 volt secondary **$13.95**

There are many bargains just like this. **Send for this book, 6044E, today.**

SEND TODAY!

Sears, Roebuck and Co., Chicago

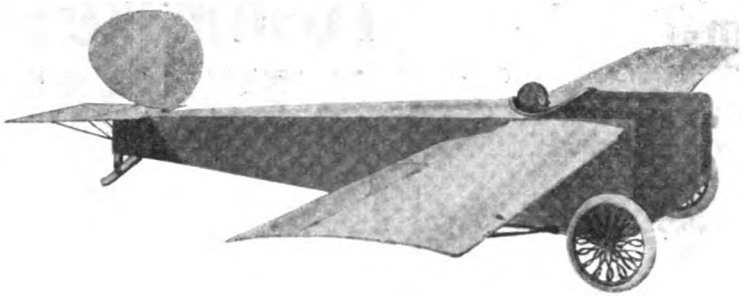
If Not a Subscriber Order Your November Issue of Everyday Engineering Magazine Now—Because

There will be more editorial matter as the magazine will be again increased in size, this means enlarging the regular departments and adding new ones.

Among the feature articles will be—A Modern Electrically Propelled Battleship, by Brewster S. Beach; Fitting and Adjusting Connecting Rod Bearings, by Victor W. Page; Building a Two-Passenger Seaplane, by Charles E. Muller; Dirigible Airship Frame Construction, by Victor W. Page; Features of the Still Engine, by T. O'Connor Sloane; Construction of Apparatus for the Modern Radio Station, by M. B. Sleeper; Problems of Vacuum Tube Circuits, by L. M. Clement; Why Tickler Coils Are Inefficient; A U. S. Navy Radio Compass; Where Does the Engine Power Go? The Construction of a Mechanical Vacuum Cleaner, by E. H. Williamson; Model Locomotive Design and Construction, by Henry Greenley of England, one of the World's most prominent model engineers; A High Speed Flash Steam Engine, by George Bender. The regular departments—Experimental Chemistry, Shop Practice, the Everyday Motorist, the Radio Department—will be continued. New departments—Aviation Progress Briefs, Everyday Science Notes, Electrical Progress Digest—will be added.

WHY NOT SUBSCRIBE AND BE SURE OF RECEIVING THE MAGAZINE REGULARLY, YOU CANNOT AFFORD TO MISS IT

Digitized by Google



BUILD THIS MONOPLANE

The plane for the pleasure flyer who wants all the thrills of flying without the expense of a larger plane. Single seater with a short fuselage making handling easy. Wings braced with solid struts, no wires to loosen, give way or break. Shock absorbing spring wheels built part of the body. Whole plane low for balance. Everything simplified for ease of assembly. You can build one yourself from our working drawings and instal a motorcycle, cycle car or other motor of 12 to 20 H.P. Spread 22 feet, length 14 feet, weight 200 pounds. High safety factor of 12 to 1. Simple fittings. Speed with 15 H.P., 30-50 m.p.h. Designed by aeronautical engineers for sporting use and general flights. Be the first in your town to have one flying. Three ways to own one—Complete for $1365, knock-down without motor for $365, or plans $2, and build it yourself.

BUILD ONE YOURSELF

You who like to make things and save money as well—send $2 for a full set of working drawings showing all details of the monoplane with building instructions. With the plans comes a price list of everything needed. Many money saving ideas given in the instructions. Price of plans refunded if you buy a knock-down plane later.

BUY IT KNOCKDOWN

Supplied knockdown without motor for you to assemble for $365. Everything supplied except motor, including propeller, wheels, fittings, counter-shaft, woodwork cut, wire, cloth, dope, etc., and a set of plans and full instructions, ready for you to put together and set in your motor. The ideal way to own one. Orders filled in rotation. Terms, $65 cash, balance C.O.D.

BE THE FIRST IN YOUR TOWN—SEND YOUR ORDER NOW!

GEORGE D. WHITE CO.

Aeroplane Manufacturers

113 E. 49th St. Dept. 5 Los Angeles, Cal.

Build and Fly a Model of the NC-4

Here's another new "IDEAL" Model Aeroplane—the celebrated Naval-Curtiss Seaplane—the first to cross the Atlantic Ocean—a strictly American 'plane every American boy will want to build! This Model is a dandy; 4½ feet across the planes and a true, scale-model duplicate of the real NC-4. Guaranteed to rise from the water and make a perfect flight under its own power. Get a set of "IDEAL" Accurate Scale Plans, including Building and Flying Instructions, and build this wonderful Model Aeroplane right away.

Plans and Instructions for building a 4½-ft. Model NC-4 50c

Other Plans and Instructions at the following prices, all postpaid:

DE HAVILLAND BATTLE PLANE,	**35c**
Curtiss Military Tractor,	25c
Bleriot Monoplane	25c
Nieuport Monoplane,	25c
Taube Monoplane,	25c
Cecil Peoli Racer,	25c

"IDEAL" Model Aeroplane Construction Outfits, containing all parts and materials needed to build these Model Aeroplanes are sold by leading Toy, Sporting Goods and Department stores. Ask for them at your store.

"IDEAL" Model Aeroplane Catalog, 48 pages, 5 cents postpaid

IDEAL AIRPLANE & SUPPLY COMPANY

Established in 1911

Cor. West Houston & Wooster Sts New York City



This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

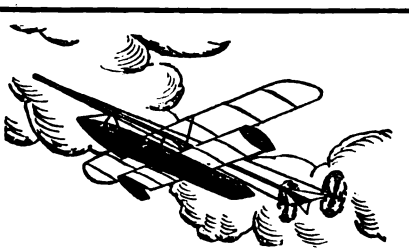
Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF 11 SCALE DRAWINGS OF BEST KNOWN MACHINES

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for OUR LATEST CATALOG.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.



MODELS THAT ACTUALLY FLY

Build your own flying boat from our superior working blueprints and materials. The ONLY Biplane Flying Boat on the market that will actually rise from the water and fly under its own power. Two sheet working blueprint one half actual size with full building and flying instructions. $1.00 postpaid in U. S.

Complete materials to build this wonderful flying boat with full building and flying instructions including two special hand carved propellers $5.00 postpaid in U. S. Canada 25c extra.

Blueprints of the following flying models one half actual size with full building and flying instructions 50c per copy postpaid in U. S. Complete set of four blueprints $2.00 postpaid.

BLERIOT RACER, 600-Foot flyer.

MANHATTAN RACER, 2000-Foot flyer.

MONTAUK FLYER, Flies 500 feet.

Send for Catalogue ready September 1st

HEC AEROPLANE CO.,

300 East 49th St. New York City

Address Special Dept.

Digitized by Google

YOUR OPPORTUNITY

Canceled Government Contracts

We have secured a large quantity of Small Motors, Generators and Charging Outfits. This material is new, still in original cases and carries the full factory guarantee.

This is Your Opportunity to buy new, guaranteed Electrical Apparatus of Standard Manufacture



Battery Charging Outfits

For use on 110 volt, A. C., 60 cycle, single phase current only.

60 watts, 8 volts, 10 amperes . **$48.50**

150 watts, 30 volts, 5 amperes . **$68.50**

150 watts, 15 volts, 10 amperes . **$68.50**

300 watts, 30 volts, 10 amperes . **$94.50**

All outfits complete with switchboard as cut shown.



1/2 H. P. INDUCTION MOTOR 110 or 220 volts, A. C. 60 cycle, single phase, 1750 R. P. M. **$32.50**

ALL MOTORS COMPLETE AS CUT

Mail $5.00 cash or Money Order. We will send C. O. D. subject to full examination.

MONEY BACK GUARANTEE



1/4 H. P. 110 volts A. C., 60 cycle, single phase 1750 R. P. M.

WASHING MACHINE MOTOR

Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Lathes Drill Presses, etc. **$18.50**

WRITE FOR CATALOGUE. BARGAINS IN MOTORS AND GENERATORS. SPECIAL QUANTITY PRICES

220 volts **POLYPHASE MOTORS** 1750 R.P.M. 60 cycle, 2 or 3 phase. Complete, pulley and base

1 H. P. $59.50 — 3 H. P. $ 84.50

2 H. P. $72.50 — 5 H. P. $102.50

NEW MOTORS

110-220 volts **REPULSION MOTORS** 1800 R.P.M. 60 cycle, single phase. Complete with pulley.

1/2 Hp. $44.50 — 1 Hp. $67.50

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON - West End - PITTSBURGH, PA.

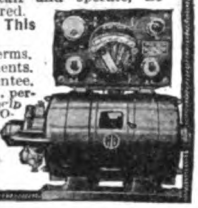
HB BATTERY CHARGING PAYS BIG PROFITS

Get Big Profits This Fall. $100 to $200 CLEAR Every Month.

Fall brings big demand for reliable HB Battery service. Get your HB 500 watt Charger NOW. Recharges 1 to 8 6-volt batteries. Cost 10c to 15c each, customer pays 75c to $1.50. No repairs, no burn outs or expensive renewals—steady, reliable service. Easy to install and operate, no mechanical knowledge required.

Small Cash Payment Puts This Money-Maker In Your Shop.

Balance on easy monthly terms. Profits easily carry payments. Absolute Money-Back Guarantee. Start NOW to build *your own*, big, permanent, profitable business. We help you. Tear out this ad and mail TO-DAY for information.



HOBART BROTHERS COMPANY
Box EE101 Troy, Ohio
Successful Mfrs. Since 1898



PHONOGRAPHS $4 UP FROM MANUFACTURER

24 different styles, **$4.00 up; $150 style, $40; $100 style, $35; $50 style, $13.**

Plays Victor, Columbia and Edison Records.

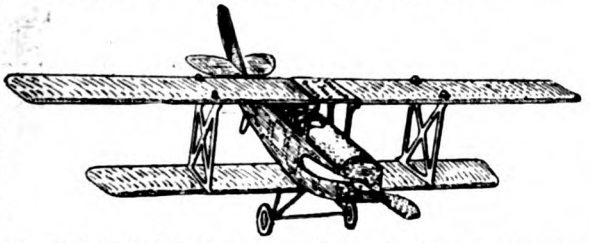
Mail Orders Filled Promptly. Send for Catalogue.

DEALERS WHOLESALE.

LUCKY 13 PRODUCTS CO., 3 East 12th St., New York.

You Make UmakeM Model Airplanes.

Send $3 quick for UmakeM Airplane Making Outfit No. 17



No. 17 UmakeM includes UmakeM tools, blueprints, aluminum, wood, rubber and everything for Making the Curtis J. N. 4. Model flying plane pictured here. To make as many more planes as you wish only inexpensive wood and raw materials are needed. It is Made from 1/8" flat UmakeM ply wood, cut out with UmakeM Scroll Saw and designed to fit together in an easy yet strong and compact manner.

You can saw out a wing or a fuselage in a jiffy. Several Duplicate parts can be cut at the same time and by the same operation, making replacements easy. No intricate fitting together of numberless small strips. Each main part is simply scrolled out of one large piece of ply wood. The wings fit into slots and are held safe and firm. You bend two pieces of wire, slip them through four holes, and the Chassis is ready for the axle. It's all Dead Easy.

When you are ordering UmakeM Airplane Set ask about our 40 other UmakeM outfits with which you can Make Money Making UmakeM Toys, UmakeM Furniture, Novelties, UmakeM Metal Working Lathes and other Popular UmakeM projects.

W. R. PRICE, Inc., 71 UmakeM Building, 127 5th Avenue, New York, N. Y.

DRAWING
Big Pay—Easy Pleasant Work

Draftsman earn $150.00 to $300.00 a month. The work is pleasant and the hours are short.

You can get this big pay too. All you need is the new 1919 edition of the Cyclopedia of Drawing and a little of your spare time. The cost is only 7 cents a day, and we give a year's consulting service free. See the FREE examination offer below.

Cyclopedia of DRAWING

4 big volumes each 5¼x8¼ in., bound in genuine American Morocco and trimmed in gold 1578 pages and more than 1000 illustrations plates, diagrams and blue prints.

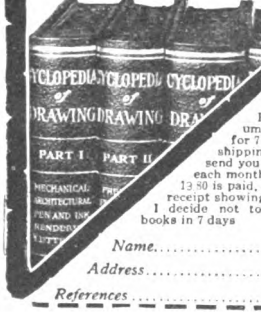
The only books that thoroughly cover Mechanical, Structural and Architectural Drafting in a non-technical way. You don't have to know anything about the subject to understand them. They begin at the beginning and tell you everything about Blue print Reading—Mechanical Drawing—Machine Design—Machine Drawing—Structural Drafting—Architectural Drawing and Lettering—Shades and Shadows—Perspective Drawing—Freehand Drawing—Pen and Ink Rendering—Typographical Drafting—Drawing Instruments and Their Uses and hundreds of other things connected with the work.

Use One WEEK FREE!

You can have these books for a whole week free without sending one cent. Just send the coupon below and all 4 volumes will come to you at once by express collect. Use them as if they were your own—go through them thoroughly and send them back at our expense if you don't want to keep them. If you do keep the books send us only $2.00. You can send the balance of our special introductory price — only $13.80 the same way—$2.00 each month.

Remember you don't take any chances. The risk is all ours and the benefits will all be yours—Send the coupon today

American Technical Society
Dept D-357 CHICAGO, U. S. A.



American Technical Society
Dept. D-357
CHICAGO, U. S. A.

Please send me the 4-volume Cyclopedia of Drawing for 7 days' Free Examination, shipping charges collect. I will send you $2.00 in 7 days and $2.00 each month until the special price of 13.80 is paid, and you will send me a receipt showing the books are mine. If I decide not to buy I will return the books in 7 days

Name.....

Address.....

References.....



THE MIDGET SLIDE RULE will solve any problem in addition, subtraction, multiplication division and proportion. A Log Log Scale gives any root or power of any number. Gives Logarithms Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six decimals. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book 16 pages, 12 illustrations, is sent with each rule. Diameter 4 in. Made in two models: Metal (white coated steel), **$1.00**; White Celluloid **$1.25**. Leather Case **50c** extra. Your money back if you are not satisfied. Send for Catalogue of Slide Rules. **Gilson Slide Rule Co., Niles, Mich.**

NATIONAL TRADE DENTAL SCHOOL

506 S. Wabash Ave., CHICAGO, ILL.

LEARN MECHANICAL DENTISTRY—DEMAND UNLIMITED

Earn $1200 to $4000 yearly in mechanical dentistry. A big and growing demand everywhere for mechanical dentists—like a gold mine, unexplored. Attend this school any time of the day or evening; be taught individually and learn by actual practice, without book study. Our System, the most complete in the world, is used exclusively in this school. We are constantly called upon to fill high-salaried positions. Why not qualify for one? Be fair to yourself; find out more about exceptional opportunity we offer. Visit the school or write for booklet B.

KLEAN E-Z-SUSPENSORY

FORM FITTING FOR ALL MEN

LINEN (MESH) **$1.50**



PRICES

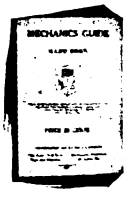
Balbriggan $1.25
Linen (Mesh) $1.50
Fine Glove Silk $2.00
Heavy Silk (Mesh) $2.50

ALL SIZES

One Extra Sack

At your dealers or sent postpaid on receipt of price.

A. R. CHISHOLM CO., New York, N. Y.
Suite 596 1328 BROADWAY



IMPORTANT TO MECHANICS

Learn more about the Machinists Trade. The Mechanics Guide Hand Book will do it. $2.00 worth of Practical Shop reference for 25 cents. A book for the Machinist, Toolmaker and Draftsman: it gives practical data on Gears, Tapes, Weight of Metals, Drills, Pipe Fitting, useful Multipliers, Decimals, Lettering; and how to read a Micrometer, also numerous other tables. Send 25 cents in stamps. Agents wanted.

LACLEDE BOOK CO.,
426 Odd Fellows Bldg., St. Louis, Mo.

COMPLETE CHEMICAL OUTFIT

Fifty (50) different chemicals and twenty (20) pieces of apparatus. Chemicals include Iodine, Mercury, Antimony, etc. Apparatus includes alcohol lamp, eight (8) test tubes, glass funnel, beaker, Erlenmeyer flask, etc. Best offer ever made. Not a plaything. Send $4.50. Shipped by express collect.

TECHNICAL EQUIPMENT COMPANY,
Dept. I-C.
22 East 17th St., New York City.

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

MAKE $30 next Saturday. Agents—Salesmen—District Managers—brand new invention selling like wildfire. Sell Speederator for Fords. So good it's used by 17 officials of Ford Motor Co. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—no special tools or holes to bore. Instant satisfaction. Listen: make money quick—sell ten to twelve a day easy. Mod-Master, Ill., sold four first afternoon, profit $12. Helton, Utah, makes over $300 every week. Dane, W. Va., $55 a week spare time only. Hurry, write quick for details and exclusive territory. Address Perrin Company, 1016 Hayward Bldg., Detroit, Mich.

AGENTS—Something different! Our Eradium (Luminous) Crucifix actually Shines in the Dark. Startling! Mysterious! Wonderful enthusiasm follows every demonstration. 150% profit on every sale. Sole manufacturers. The Pioneer Corporation, 1265 W. 63rd Street, Chicago.

American Made Toys

AMERICAN MADE TOYS WANTED. An opportunity for homeworkers on small scale and manufacturers on large scale. Unlimited quantities needed of Toy Soldiers, Army, Navy, Marines, Cannons, Machine Guns, Warships and other toys and novelties. Enormous demand and future in American Made Toys all over United States, Canada, Mexico and South America with over 50,000 10-cent stores and toy dealers. This new American industry stands out conspicuously. Factories are established, people trained, machineries made. Christmas Sets needed in millions this year. The great hit for 1919 without any competition. We are buyers of these goods all year, paying fixed prices. Attractive prices offered for painted goods. Experience or tools unnecessary. Hundred and more made complete per hour. Casting form outfits from $3.00 up. If you mean business, send for booklet and information free. TOY SOLDIER MANUFACTURING CO., 32 Union Square, New York.

Auctioneers

AUCTIONEERS. Make big money. Free Catalogue. Carpenter's Auction School, Kansas City.

Automobile Accessories

MORE Power, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

POWER of the FORD DOUBLED through leverage. The greatest satisfaction to CLIMB HILLS, PULL through MUD without using Ford Low. Victor "4 Speeds Forward" Auxiliary Transmission is mechanically simple, easily attached. Among 7 VITAL ADVANTAGES provides the missing "2nd" or "Intermediate" speed. Owners, Agents, why not learn the facts? Write NOW for complete line of "POWER-4-FORD" devices to increase Power, Ability, Economy & Speed of Ford Cars and Trucks. Convincing Trial Plan. T. Victor Manufacturers, 246 West 54th Street, New York.

Vulcanize Rubber without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

BATTERY CHARGING. Profit $100 to $250 Clear Monthly with HB Equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guarantees. Write HOBARTS, TROY, OHIO, Box EE.

Aviation

YOU MAKE UmakeM flying Model Airplanes. Outfit $3 00. See UmakeM Advertisement Page 59.

CELLULOID AIRPLANE travels twenty feet and returns. 15c. Richard Lavery, Asbury Park, N. J.

Blueprints

SEND 25c for each UmakeM Blueprint desired from following list: Bleriot Aeroplane (3); Curtis Aeroplane (2); 48" Workbench; 54" Workbench with drawers; Sewingstand; Bookracks; Stationary racks. Send 10c for one Toy design sheet or dollar for twelve. W. R. Price, Incorporated, Eighty-two UmakeM Building, Fifth Avenue, New York.

Books

BOOKS. Practical Mechanical, Auto, Aviation, Home Study Books. Easy payments. Send dime "tonight" for catalogs. Amsco, Department B-2, Aurora, Illinois.

BOOKS ON SEX. For men and women. Catalogue free. United Sales Co., Springfield, Ill.

BOOKS FOR MEN. Also "Classy" pictures. Catalogue free. United Sales Co., Springfield, Ill.

Business Opportunities

BUILD UP AN INCOME IN OIL—Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan NOW—It may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. "J," Houston, Texas.

I MADE $30 a week at home; French breadmaking. 15 years' experience; free booklet tells how to start without capital. Ashbrook, Marengo, Ohio.

MANUFACTURE TOYS. Dollar UmakeM outfit includes materials, tools, instructions to start. UmakeM Shops, UmakeM Building, Fifth Avenue, New York.

Boys

BOYS! You Make UmakeM flying Airplanes. See UmakeM Advertisement Page 59.

Chemicals

DYES—Set of 25 different colors representing various classes of dyes. Material sufficient for dyeing scores of skeins. Outfit includes 5 test-skeins of wool and cotton, 2 dyeing chemicals and spoon measure. Send $4.50.

ORGANIC OUTFIT—40 organic chemicals representing various groups (hydrocarbons, alcohols, acids, ketones, phenols, dyes, etc.) Send $6.50.

CHEMISTS—Lowest prices on chemicals, apparatus, minerals and equipment. Our Technical Bureau will design your laboratory free of charge. Consult us before buying. Appel "Laboratory Outfitter," Bausman Street, Knoxville, Pittsburgh, Penna.

PIGMENTS—25 different pigments used in manufacturing Paints, Varnishes, Rubber, Paper, etc. Send $4.00. Sets sent by express. Charges Collect. Technical Equipment Company, Dept. 2C, 22 East 17th St., N.Y.C.

CRUDE RUBBER: Experiment with pure uncompounded India Rubber. Make tire patching cements, water proof cloth, porous tire filler, rubber stamps, etc. First latex Para (highest grade India rubber) 4 oz., 50c; 8 oz., 80c; 1 lb., $1.25; 5 lbs., $5.00. Address, Bunsen Supply House, 14 S. Canal St., Akron, Ohio.

Fish

GOLD FISH. Imported Japanese, Chinese and American fish aquarium plants. We manufacture beautiful home aquariums. Descriptive circular free. Pioneer Goldfish Hatcheries, Racine, Wisconsin.

CATCH Fish, Every Trip! **Julian's Liquid Bait.** Price $1. George Julian, Albany Building, Boston.

Formulas

GUARANTEED Workable Formulas—$1.00 each: Auto Anti-Freeze Preparation; Greaseless Massage Cream; Making Ink in Tablet or Powder form; Wall Paper and Shade Cleaner; Soldering Alloy for Aluminum. Detailed method of preparation and sources of supply accompany all formulas. Industrial Methods Bureau, 1 West 34th Street, New York City.

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

500 FORMULAS including Resilvering Mirrors—Renewing Dry Batteries—Mechanics Soap—Luminous Paint. 25c. "Ideal" 5501—EG, North Robey, Chicago.

500 SUCCESSFUL money-making formulas and trade secrets. Postpaid, 25c. Charles Dynes, Winchester, Ind.

For the Shop

PREPARE for long dry prosperous evenings. Send Five Dollars for full set Blueprints and instructions to Make UmakeM Screw-Cutting Metal-Working Lathe. Castings later. Send Nine dollars for lumber, vise, blueprints and instructions to make 48" Workbench. W. R. Price, Incorporated, Eighty-two UmakeM Building, Fifth Avenue, New York.

For Inventors

YOU MAKE a UmakeM Lathe; then make your own Models. UmakeM Shops, UmakeM Building, Fifth Avenue, New York.

For Sale

100 6¾ ENVELOPES PRINTED to your order (2) colors, 75c prepaid. Write for Samples. Lincoln Novelty Co., Rochester, N. Y.

GENUINE INDIAN BASKETS—90 Styles. Catalogue. GILHAM, Highland Springs, California.

WILL SELL phonograph cabinets unvarnished. Do your own varnishing and installing motor. Saving 40 to 50%. Write for particulars. Bullock Mfg. Company, 4731 Madison, Chicago.

FOR SALE. Speedy slide crank engine in perfect condition. Write me. Prentice, 226 W. 78th St., N. Y. City.

Gummed Labels

FREE CATALOGUE containing ideas in package labels suitable for your business. Stock labels a specialty. Royal Label Co., 29 S. Seventh, Philadelphia.

Help Wanted

WRITE for newspapers and magazines. Big Pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

GOVERNMENT positions highly desirable; thousands appointed annually through frequent examinations everywhere; prepare immediately for Post Office Clerk, City or Rural Letter Carrier, Railway Mail Clerk, Washington Departmental Clerk, Stenographer-Typist, unexcelled correspondence instruction at $5. Request particulars concerning positions desired. Federal Civil Service School, 604 Kellogg, Washington, D. C.

U. S. GOVERNMENT wants Hundreds Railway Mail Clerks. Commence $90 month. Raise to $150. Fall examinations likely everywhere. Common education sufficient. Sample questions free. Write immediately. Franklin Institute. Dept. K99. Rochester, N. Y.

Machinery

WRITE UmakeM Shops, UmakeM Building, Fifth Avenue, New York, for everything to make Screwcutting and Milling Lathe. Blueprints only Five dollars.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS: $110.00 a month to start and expenses; travel if desired; unlimited advancement. No age limit. Three months home study. Situation arranged. Prepare for permanent position. Write for booklet CM-36. STANDARD BUSINESS TRAINING INSTITUTE, Buffalo, N. Y.

Manual Training Shop Equipment

SCHOOLS, CHURCHES. Neighborhood Clubs, prepare for long dry prosperous evenings. Send three dollars for UmakeM Flying Airplane outfit with Blueprints, instructions, airplanewood, tools, materials. Send two dollars for UmakeM outfit, tools, materials to make sixty toys. Send five dollars for UmakeM lathe-making blueprints, instructions; castings later. Address W. R. Price, Incorporated. Eighty-two UmakeM Building, Fifth Avenue, New York.

Miscellaneous

SELENIUM CELLS
Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up. Write for catalog. Selenium Laboratories, Good Ground, Long Island, N. Y.

METALS: Furnished in rods, tubing, sheets and wire of copper, steel, iron, brass, bronze, zinc, aluminum and nickel. Cut to any size and shape at reasonable prices. We handle very small orders as well as large ones and give them special attention. Write for quotations. Cut Metal Supply Co., 8530-12and Street, Richmond Hill, N. Y.

MAKE MONEY—Resilver Mirrors, Formula and Instructions 25 cts. (silver), several others free, worth $5. Sterling Novelty Co., 2945 N. Bailey St., Philadelphia, Pa.

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

ENGINES—Castings—Blue Prints—Gas and Steam. ⅛ H.P. up. Gears, Pulleys, etc. Complete circulars for stamp. Modern Model Engineering Co., Monadnock Block, Chicago.

BUSINESS WORTH WHILE. I start you silvering mirrors, plating tableware. Plans Free. Clarence Sprinkle, Dept. 80, Marion, Indiana.

Model Supplies

CRANK SHAFTS for model steam engines our specialty. Any type or number of throws to specification, also needle valves, blow torches and other parts. Quotations on receipt of specifications. Model Machine Shop Co., 415 East 71st St., New York City.

1" STEAM Gauge Parts $1, Water Gauge, Valve, Parts, Castings, $1. Bourdon tube length $1. Aitken, 1714 Brown, Philadelphia, Pa.

Motion Picture Plays & Supplies

$25-300 paid anyone for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

BARGAIN lists free. Motion Picture machines, film and supplies. National Equipment Company, Duluth, Minn.

Patents

PATENTS. Prompt, personal efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years actual experience, full information upon request. B. P. Fishburne, 322 McGill Building, Washington, D. C.

PATENTS promptly procured by personal expert service. Information on request. James M. Lyles, Washington, D. C.

INVENTIONS PATENTED; Trade-Marks Registered; Labels, Prints, Publications Copyrighted; prompt service; reasonable fees; plain advice; request detailed information before placing your business. Jaynes & Jaynes, 804 Kellogg, Washington, D. C.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" FREE. Franklin H. Hough, 510 Loan & Trust Building, Washington, D. C.

PATENTS—Herbert Jenner, patent attorney and mechanical expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

INVENTORS—Send sketch of your invention for advice regarding patent protection. Twenty Years' Experience. Hand-book on Patents sent Free. TALBERT & TALBERT. Patent Lawyers, 4821 Talbert Bldg., Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers. Washington, D. C.

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS — *Continued*

Patents

PATENTS. Over 70 years' practise; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., patent attorneys, 641 Woolworth Building, New York. 625 F Street, Washington. Tower Building, Chicago.

INVENTORS—Write for our free illustrated guide book, "How to Obtain a Patent." Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

JOHN M. McLACHLEN. Attorney at Law, Patents, Trade Marks, Copyrights. 410 McLachlen Building, Washington, D. C.

PATENTS. My fee payable in monthly installments. Send sketch for advice. Booklet free. Frank Fuller, Washington, D. C.

PATENT extraordinary, No. 1,297,578, Collapsible Flagpole, for home use; good advertising features, market for millions, investigate. Fred Lindstaedt, Fairmont, Minn.

Phonographs

BUILD YOUR OWN PHONOGRAPH. Particulars Free. DeSelO-PhonE, P. O. Box 72B, Attica, Indiana.

Photography

DO YOU TAKE PICTURES? Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 466 Pope Building, Boston, Mass.

Poultry

POULTRY PAPER—50c. year; 3 years, $1.00. Sample free. Rabbit Book, 25c, with paper one year 65c. Poultry Advocate, Dept. A-83, Syracuse, New York.

Printing

500 NEWMARKET BOND letterheads and 500 bond envelopes, printed, $3.00; prepaid to 6th zone. Echo Printery, Wauwautosa, Wis.

Salesman

GAS WATER HEATER Made Automatic $39. Attachments. Differential. Clinton, Iowa.

Songs and Music

WRITE THE WORDS FOR A SONG. We write music and guarantee publisher's acceptance. Submit poems on war, love or any subject. Chester Music Co., 920 So. Michigan Ave., Room 289, Chicago.

"MUSIC COMPOSED" to words. Bauer Bros. (formerly of Sousa's Band), Oshkosh, Wis.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

STAMPS sent on approval at 70% discount. Reference required. J. Emory Renoll, Dept. W, Hanover, Pa.

Telegraphy

TELEGRAPHY (both Morse and Wireless) **AND RAILWAY ACCOUNTING** taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School. Est. 45 years. Catalog free. Dodges Institute, 24th Street, Valparaiso, Ind.

Tricks

1,000 STAGE TRICKS with 500 illustrations. Catalogue 15c. Small Catalogue Free. Hornmann Magic Co., Station S, 304 West 34th St., New York.

Tricks

10 MYSTERIOUS TRICKS. Instructions how to make, and perform successfully, 25 cents, prepaid. L. Lasky, 1038 Wabash Ave., Youngstown, Ohio.

Used Correspondence Courses

$$$ SAVED. Used technical Correspondence courses at ¼ list price. Send for list. Courses bought. W. J. Benson, 2722 "M" Street, Philadelphia, Pa.

UmakeM Shops

UMAKEMISTS! The Publisher will accept your advertisements in this Classification if you desire to sell anything made from your UmakeM sets such as UmakeM Lathes, UmakeM Work benches, UmakeM furniture Novelties, UmakeM Model Airplanes, or UmakeM Toys. Organize UmakeM Membership in your community. UmakeM membership entitles holder to free advice and co-operation Making Money Making Merchandise. Address UmakeM Clubs, New York.

MAKE MONEY DOING GOOD. Start UmakeM Clubs Your Community. Address UmakeM Clubs, New York.

SEND DOLLAR for UmakeM Membership and get dollar UmakeM set free. Address UmakeM Clubs, New York.

MAKE MONEY DOING GOOD. All members need UmakeM outfits. We allow organizers good commissions for all UmakeM Merchandise bought by Members. Address UmakeM Clubs, New York.

SEND THREE DOLLARS for UmakeM Airplane set and Make Flying Model Airplanes. Big Demand. Address UmakeM Clubs, New York.

Wireless

WIRELESS parts valuable information, winding data, all 10c; magnet wire, half pound, 22-24-26c—28-32-36c; improved switch lever-knob with dozen switch points and screws 50c. Postpaid prices. Novotny Electric, Charlotte, N. C.

The Burgess BLUE BOOK

for all Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK Will Be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. *I guarantee satisfaction or will return your money* if you decide not to keep the book after using it for five days

BURGESS ENGINEERING CO., YORKE BURGESS, *Consulting Engineer*
753 East 42nd Street Chicago, Illinois

Write Everyday Engineering Magazine Service Dep't If You Need Information on Mechanical, Radio, Electrical or Automotive Matters

Readers of this magazine are invited to write for any information relative to procurement of supplies, tools, technical equipment, books, etc., they may need to carry on their studies or mechanical work more efficiently. Technical advice relative to all subjects within the scope of our magazine is available to all our subscribers and our corps of editors and contributing experts may render you valuable service if you avail yourself of this privilege.

All inquiries should be addressed to the SERVICE DEPARTMENT MANAGER and will receive prompt attention. The enclosure of a stamped, self-addressed envelope or postal card is a courtesy that will be appreciated and will insure prompt receipt of the desired information by the enquirer.

The Services of Our Staff of Experts Is Yours for the Asking

Digitized by Google

INVENTORS—That Machine or Apparatus You Can't Make Quite Perfect

Give us the idea—we can develop it for you. That is our business. For years we have been perfecting mechanical and electrical inventions. We have experts for model and special machine work. Also, we make a specialty of designing and building labor saving machinery. Get in touch with us—our charges are very moderate.

ELK MFG. CO.
1926A Broadway New York

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 507 431 S. Dearborn St. CHICAGO



Small Investors Wanted

To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.

For full particulars address
Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.

SPEED LATHE $7.00 COMPLETE
SWING 7 INCHES 24 INCH METAL BED

Head has a three speed cone. Spindle has No. 1 Morse taper shank centers. ⅝ hole through spindle. 3½ inch face plate is furnished. Tail stock has a screw feed spindle and No. 1 Morse taper center. Spur center is furnished for wood turning. Hand wheels are on all adjustments. Rest is adjustable to all positions. Lathe is complete at the above price. 30 inch bed if wanted.

M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

CHEMIST AMAZING DISCOVERY
25 Miles on One Gallon Gas
MOTOROL 25 to 50% more miles per gal. 25 to 35% more power.
Means Faster Ignition
One Dollar Postpaid — Uniform Combustion, No Carbon Deposits, Less Wear and Tear on motor
Agents Wanted — Higher Test of Gasoline
AUTO PRODUCTS CO. Dept. 66, 226 W. 138th St., N. Y.

Making Your Invention a Financial Success

How best to dispose of your invention
What kind of agreements to make for your protection
What kind of offers and mistakes to avoid
Valuable tables and other data

By M. G. Delaney, an experienced Inventor, in
The Inventor's Manual of Valuable Information
$1.50 per copy, postpaid
Additional information and Table of Contents will be mailed on request.
G. E. Perry Co., Publishers, 1328 Broadway, New York

Telegraph Pictures
BY ELECTRICITY



A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.
L. J. LEISHMAN CO. Dept. L, Ogden, Utah

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing Lists St. Louis

CELLULOID

SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

The Experimenter's Shop



SHOP TOOLS AND EQUIPMENT
Rough or Machined Castings
SUPPLIES
DESIGNS - MATERIAL - FITTINGS
for Model Yachts and Ships
Send Stamp for Catalog
DWIGHT S. SIMPSON, M.M.E.
14 Olive St. Saranac Lake, N. Y.

GENUINE DIAMONDS

½ CARAT, PURE WHITE 14K SOLID GOLD Ladies' or Men's Ring $33

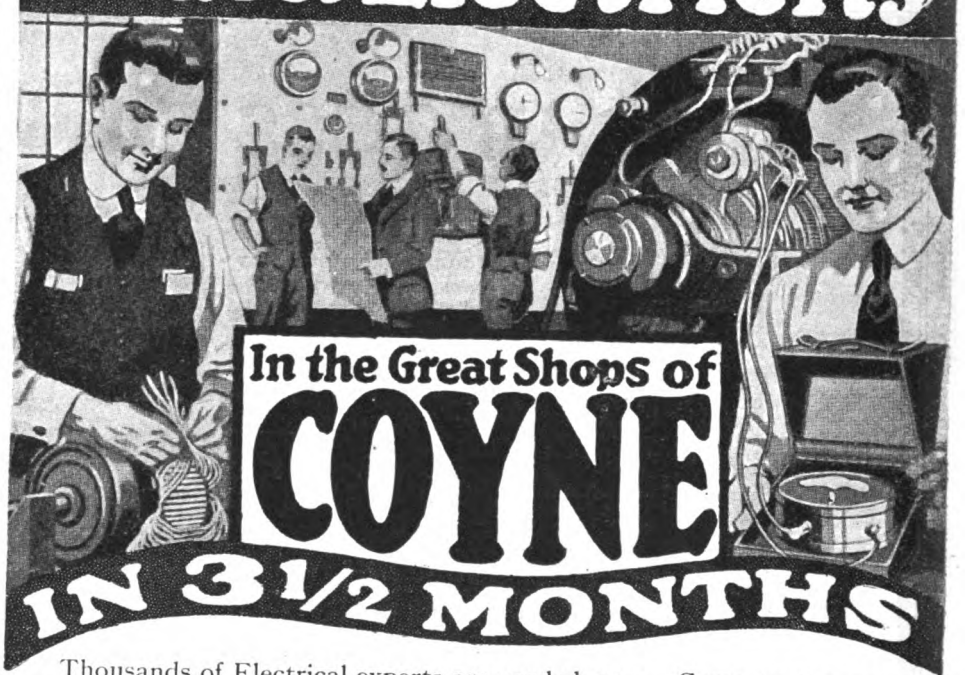
Wonderful value. Positively genuine diamond. Looks like $100 stone because of large spread. Remarkable color—brilliant, snappy. Accurately cut. Price astonishingly low. Biggest bargain you have ever seen. **Your money refunded if you can duplicate our offer at double our price.** Written legal guarantee covers weight, quality and value.

Order from this ad—You run no risk—everything exactly as represented. **You can wear any of our diamonds a year and return it and get your money back.** Sent on approval if desired. Absolute satisfaction guaranteed—always. 40 years' honorable dealings back up our statements. Order now—diamonds are a good, safe investment—constantly advancing—10% to 20% increase expected soon. Save money—**Order Today!**

Send for bargain catalog—Full of surprises. Thousands of diamonds, rings, watches and other jewelry offers at most remarkable cut prices. Get it—**it's free.**

B. GUTTER & SONS, Wholesale Jewelers
(Est. 1879), **170 Nassau St., Div. 20 NEW YORK**

Learn Electricity



Thousands of Electrical experts are needed now. Come to the great shops of Coyne and let us train you quickly by our sure practical way backed by 20 years of success.

Earn $125 to $300 a Month

Come to Coyne where experts train you on the actual apparatus. You work on everything from the simple bell to the mighty Generators, Electrical Locomotives and Power Plants. Everything to make you a Master Electrician. Look at the picture taken from life in our shops.

Become an Expert in 3½ Months

No need of taking 1 to 4 years to become an expert. We have proved this in thousands of cases. We are the only school teaching by the original Coyne methods, which means no books, no classes—all practical training.

Earn Your Way. Our employment department will help every ambitious man to earn a part of his expenses—without charge.

LEARN DRAFTING

The country needs hundreds of skilled Draftsmen in all lines at big salaries.

Coyne is the only school in the country that gives you the advantages of big shops full of construction and machinery. This makes our drafting courses practical, just like the job you'll have when you graduate. You can't get this in any other school.

WE TEACH ELECTRICITY, DRAFTING, MOTION PICTURE OPERATING AND PLUMBING

We teach all these professions in such a thorough, practical way that when you finish you can step right into a position of responsibility and big pay.

Fill out the coupon *now* and send it for our big free book of information. It tells what others are doing and have done, what you can do.

Be sure and check the trade that interests you. Do it now.

Bennett W. Cooke, Director
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 160 39-51 E. Illinois Street
CHICAGO, ILL.

COYNE SCHOOLS
Dept. 160 39-51 E. Illinois St.
CHICAGO, ILL.

Please send me that big free book. I'm interested in:

☐Electricity ☐Drafting ☐Plumbing
Motion Picture Operating

Name .....
Address .....

Digitized by Google

Earn $25 to $100 a Week

BECOME A PROFESSIONAL PHOTOGRAPHER





Big opportunities NOW. It takes only a short time to qualify for this fascinating profession. Three months' course covers all branches.

Motion Picture,—Commercial,—Portraiture

Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog.

N. Y. INSTITUTE of PHOTOGRAPHY
Dept. 20 141 W. 36th St., N. Y. City



SPECIAL KON-VER-TER SLIDE RULE

The original KON-VER-TER slide rule has over 8,000 graduations and over 1,800 letters and figures, will handle anything in Arithmetic, Algebra, Geometry or Trigonometry. Is 5.4 inches in diameter and in use all over the world, is much simpler to operate than others of similar construction. Eventually you will get the KON-VER-TER—get it now and save money. Plain Utility rules $1.00; Special De Luxe white ivory celluloid $2.50. Leatherette case 50c extra.

J. C. HAMILTON & CO.
Dept. F-7 Water St., Boston, U.S.A.

USE HB BALL BEARING ELECTRIC MOTORS

BETTER POWER AT LESS COST

HB Ball-Bearing Motors substantially save on operating costs, giving more economical, dependable, and better power than a gas engine. Trouble proof, absolutely reliable. Built for heavy service. Ideal for factory, garage, and machine shop, and lower power bills.

$20 Brings You Any HB Motor. Balance on Easy Terms. Sizes 1 to 15 h.p. A Size to SUIT Your Needs.



Write our Service Department your requirements. Get their advice—FREE—simply state what machinery you wish to run and the type of current available. We plan your power system for best results at least cost. Attach this ad to your letterhead and mail TODAY for full information. Ask also about HB Battery Chargers, Generators, etc.

HOBART BROTHERS COMPANY
Box EE103 Troy, Ohio
Successful Manufacturers Since 1898

Mathematics Made Easy



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.

Dept. U, L. J. LEISHMAN CO., Ogden, Utah

DRAFTING

Inventions and Ideas Developed!

Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE

A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit, and low price.

At Drug Stores or sent direct $1.00
Send for booklet of other styles and prices

J. C. SCHNOTER CO.
523 SIXTH AVE. *Dept. E* N. Y. CITY

Electrical Engineering

Bachelor of Science Degree in 3 Years

Theory and actual practice combined in laboratory and classroom under direction of experienced faculty of forty-two experts in their respective fields.

Fall Term Opens October 1st

Institute of Electrotechnics. Junior and Senior divisions. Entrance requirements 8th grade and 2 years high school respectively. Trains intensively for early graduation as an Electrotechnician. **Also one year Practical Electricity and one year Mechanical and Electrical Drafting Courses.** No special educational requirements. Fall Term Now Open.

"Earn While You Learn" if you like; one-half day school, one-half day paid employment. Reserve Officer's Training Corps. (Optional) Athletics. Students' Fraternity House. Glee Club. Room and board at cost.

Write NOW for latest bulletins and booklet "Succeed Through Electricity." Mention age, education and course of interest.

School of Engineering of Milwaukee
118-373 Broadway Milwaukee, Wis.



Boys! Win an Auto-Wheel

In This Interesting Contest

TO THE BOY who can think of the most interesting uses for the popular **AUTO-WHEEL COASTER**, for earning money and for play, we shall award one of our large models absolutely FREE. It's a mighty generous prize for a few minutes' work. And the following eleven valuable prizes will be given to those sending in the next best uses:

Camera, Camping Tent, Mess Kit, Scout Knife, Fleetwing Steering Sled, Compass, Ingersoll Watch, Axe, Bank, Electric Flashlight, Poncho.

INFORMATION ABOUT CONTEST

1. Any boy or girl not over 15 years may compete.
2. Contest will be judged by three men well-known in the Boy Scout organization.
3. Write to Business Idea Dept., Buffalo Sled Co., for pamphlet explaining the Contest, and colored catalog telling all about Auto-Wheel.
4. At end of letter write names of three Coaster Wagon Dealers in your town. If any carry the Auto-Wheel put an "x" after name.

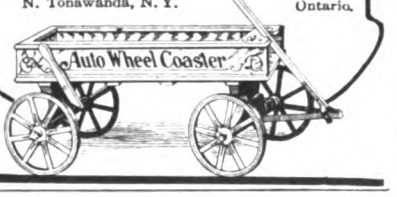
YOU CAN DO IT. Any live boy who knows how to get fun and earn money out of a good, strong coaster wagon, has a fine chance to get the Auto-Wheel as a prize. **Here are a few pointers:** The Auto-Wheel is a wagon for work or play. It's built for strength and speed. Has roller bearings, steel axles and tires, body white ash, maple gear.

If there's an Auto-Wheel dealer near you, he'll gladly let you see the Auto-Wheel Coaster in his store, and he'll give you some good ideas for your letter. CONTEST CLOSES NOVEMBER 30, 1919.

HERE'S YOUR CHANCE. GET BUSY.

Buffalo Sled Co.,
159 Schenck Street,
N. Tonawanda, N. Y.

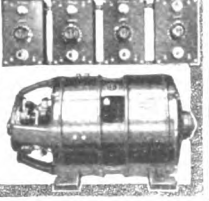
In Canada:
Preston,
Ontario.



Big Profits in Battery Charging with the HB 32-Battery Charger

Buy Ample Capacity to Handle Big Business This Fall. This fall brings bigger business in battery charging—and BIGGER PROFITS—than ever before. More cars driven, more batteries to charge. If you don't get those profits some other garage will. Get equipped NOW.

Small Cash Payment Puts This HB Outfit in Your Garage. Balance on easy monthly terms. Recharges 1 to 32 6-volt batteries at once, or equivalent in 12- or 24-volt batteries. Costs 10c. to 15c. each, customer pays 75c. to $1.50. No repairs, no expensive renewals, no mechanical skill needed to install or operate. Absolute Money-Back Guarantee. Do you want these BIG PROFITS? Tear out this ad and mail TODAY for information.



HOBART BROTHERS COMPANY
Box EE102, Troy, Ohio
Successful Manufacturers
Since 1893

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, **"Its Cause and Cure."** It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 900 Bogue Bldg., Indianapolis

SCIENTIFIC EVOLUTION "THERAPHONE"



High Power Scientific Receiver Earpiece is tuned to the ear. It can't confuse nor fatigue. Absorbs shocks, improves the Hearing and conserves time. For Busy, Deaf, Nervous, Privacy and Noises. Guaranteed to suit. (Check or C. O. D.—Export $2.20). No Agents.

The Evolution Phone Co., Inc.
48A Greenwich Ave., New York

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into positions just as soon as they are ready. Good salaries are offered to start with splendid chances for rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6061B. SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark **X.**

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BOOKKEEPER
MECHANICAL ENGINEER	Stenographer and Typist
Mechanical Draftsman	Cert. Pub. Accountant
Ship Draftsman	Traffic Management
Machine Shop Practice	Commercial Law
Toolmaker	GOOD ENGLISH
Gas Engineer	STATIONARY ENGINEER
CIVIL ENGINEER	CIVIL SERVICE
Surveying and Mapping	Railway Mail Clerk
MINE FOREM'N OR ENG'R	Textile Overseer or Supt.
ARCHITECT	AGRICULTURE
Architectural Draftsman	Navigator
PLUMBING AND HEATING	Poultry Raising
Sheet Metal Worker	Automobiles

Spanish
French
Italian

Present Occupation .....

Street and No. .....

City ..... State .....

Digitized by Google



18 cents a package

Camels are ***sold everywhere in*** *scientifically* ***sealed packages of*** *20 cigarettes;* ***or ten packages*** *(200 cigarettes)* ***in a glassine-paper-covered carton. We*** *strongly recommend* ***this carton*** *for the home* ***or office supply or*** *when you travel.*

Camel CIGARETTES

YOU'LL prefer Camel cigarettes expert blend of choice Turkish and choice Domestic tobaccos to either kind smoked straight. ***Your taste will prove that!***

Camels are so exceptional in flavor, in fragrance and in mellowness that you quickly realize their remarkable quality. It will be your constant delight to find Camels so ***full bodied*** though so mild and smooth. You may gratify your keenest desires to smoke liberally. Camels ***will not*** tire your taste.

Your enjoyment increases as you get to know Camels better. They return such generous cigarette satisfaction. Camels ***certainly fit your taste*** exactly as if they had ***been made for it.***

Camels are unlike any cigarette you ever smoked. For instance, they leave no unpleasant cigaretty aftertaste or cigaretty odor. In fact Camels are in a class by themselves! That's why we ask you to ***compare Camels with any cigarette in the world at any price!***

You will not look for or expect premiums, coupons or gifts. ***You'll prefer Camel quality!***

R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

CONTENTS

Vol. 8 November—December, 1919 No. 2—3

ELECTRIC FURNACES AND THEIR PRODUCTS.... 77
By Raymond Francis Yates

MAKING COPPER GAUZE MOTOR BRUSHES..... 80
By J. A. Weaver

THE EVERYDAY ENGINEERING CUP RACES..... 81

ADJUSTING AND FLYING MODEL AIRPLANES.... 82
By H. C. Ellis

FITTING AND ADJUSTING CONNECTING ROD BEARINGS 83

CONSTRUCTION OF A MECHANICAL VACUUM CLEANER 86
By E. H. Williamson, Jr.

BUILDING A TWO-PASSENGER SEAPLANE..... 89
By Charles E. Muller

WHERE THE POWER GOES..... 91

A BEGINNER WIRELESS SET FOR NAVY CODE PRACTICE 92

A SIMPLE APPARATUS FOR SIGNALLING UNDER WATER 93
By Laverne Yates

DIRIGIBLE AIRSHIP FRAME CONSTRUCTION..... 94
By Victor W. Pagé

AVIATION BRIEFS 96

A HIGH-SPEED FLASH STEAM ENGINE..... 97
By George Bender

METALLURGY FOR BEGINNERS..... 99
By E. Hurley

MODELS MADE BY OUR READERS..... 101

STANDARDIZED AUDION CONTROL PANELS..... 102
By M. B. Sleeper

WHY TICKLER COILS ARE INEFFICIENT FOR LONG UNDAMPED WAVES..... 104

THE RADIO DEPARTMENT..... 105

THE L. C. TABLE AND HOW TO USE IT..... 106

A NEW TRANSFORMER AND OIL CONDENSER.... 107

EXPERIMENTERS BACK TO OLD STATUS..... 108

THE U. S. NAVY RADIO COMPASS..... 109

THE PROBLEMS OF VACUUM TUBE CIRCUITS... 112
By L. M. Clement

CONSTRUCTIONAL DETAILS OF THE DOUBLE CONDENSER 114

STANDARDIZATION OF RECEIVER WAVE-LENGTH RANGES 115

DATA ON THE INTERNATIONAL RADIO OSCILLATION TRANSFORMER 117

THE STILL GAS AND STEAM ENGINE..... 118
By Prof. T. O'Conor Sloane

FIVE DIFFERENT KINDS OF ICE..... 120
By W. C. Dumas

THE WINNERS OF THE EVERYDAY ENGINEERING WORKSHOP CONTEST 121

WHO'S WHO IN THE A. S. E. E..... 123

ELECTRICAL PROGRESS DIGEST..... 124

AN APPARATUS FOR TESTING MAGNETIC PERMEABILITY 125
By William G. H. Finch

MOTORCYCLE LUBRICATION 126
By Andrew Jackson

WINTER CARE OF STORAGE BATTERIES..... 127

EVERYDAY SCIENCE NOTES..... 136
By Prof. T. O'Conor Sloane

ANTI-FREEZING SOLUTIONS FOR AUTOMOBILE RADIATORS 138
By Kenneth Alton

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street **New York City**

Editor RAYMOND F. YATES
Managing Editor VICTOR W. PAGÉ
Radio Editor M. B. SLEEPER

Contributing Editor
PROF. T. O'CONOR SLOANE

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Offices
E. M. CLEMENT, 320 Wayne Avenue, East Oakland, Calif.
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Southern Representative
H. W. ENGLISH, P. O. Box 339, Birmingham, Ala.

Published Monthly by
EVERYDAY MECHANICS COMPANY, Inc.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $1.50 a year in the United States and possessions. Canada, $1.75; Foreign, $2.00 a year.

Copyright, 1919, by Everyday Mechanics Co., Inc.

AN EXPLANATION

AS many of our readers probably know, both the November and December numbers of "Everyday" have been unavoidably delayed by a very disastrous printers' strike—disastrous both to the printers and publishers alike. It is claimed that the strike, which completely crippled the printing industry in New York City, cost the publishers about $50,000,000 and the printers $750,000 in lost salary.

THE printers demanded a 44-hour week with a flat increase of $14.00 per week on all wage scales. It would be impossible to even outline the developments that followed thereafter. Suffice it to say that the demands precipitated a strike which left the publishers of "Everyday" in an absolutely helpless way. Not a wheel of the printing industry was turning in New York City. We could not have paid the increase, even though it was agreeable to us, as the magazine is printed by contract with a large New York printer, who produces many other magazines besides "Everyday". We could have printed out of town at a tremendous expense, and with no end of trouble in moving tons of paper, type matter and cuts, to say nothing of the editorial staff. The strike caused a great increase of work in the lithographing establishments, and thereby cut off this avenue of possible retreat. Even then, it would have been necessary to typewrite the magazine at the cost of its appearance and amount of reading matter.

AT the very moment when it looked as if it would be necessary for us to take the magazine from New York, the printers appeared at their posts. It was then decided to put out a double number of the magazine, which would include the very best material that was to appear in the November and December numbers. Hence, the 96-page November-December number of "Everyday" which is now in your hands. This issue, however, will not be counted as two on subscriptions. Every subscription will be advanced one month.

WE take this opportunity to thank our many readers who have kept their faith in us and who have been forced to share our misfortunes.

RAYMOND FRANCIS YATES,
Editor.

Digitized by Google

HOLIDAY GIFT BOOKS

JUST PUBLISHED - - - - - - - AUTHORITATIVE - - - - - - - LIVE SUBJECTS

A BOOK FOR ALL AMATEUR AND PROFESSIONAL MECHANICS

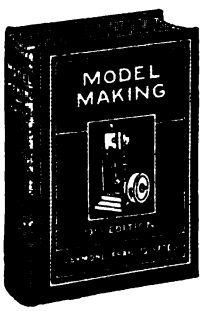
MODEL MAKING

INCLUDING

Workshop Practice, Design and Construction of Models

Edited by RAYMOND F. YATES
Editor of EVERYDAY ENGINEERING MAGAZINE

400 Pages ***Price $3.00*** 303 Illustrations



THIS book does NOT describe the construction of toys. Its pages are devoted to model engineering and the mechanical sciences associated with it. It contains descriptions with illustrations of the complete models made by some of the leading model engineers in this country. It is the only book published on this important subject.

This book will help you to become a better mechanic. It is full of suggestions for those who like to make things, amateur and professional alike. It has been prepared especially for men with mechanical hobbies. Some may be engineers, machinists, jewellers, pattern makers, office clerks or bank presidents. Men from various walks of life have a peculiar interest in model engineering. MODEL MAKING will be a help and an inspiration to such men. It tells them "how-to-do" and "how-to-make" things in simple, understandable terms. Not only this, it is full of good, clear working drawings and photographs of the models and apparatus described. Each model has been constructed and actually WORKS if it is made according to directions.

Among the chapters contained are:

I.—The Model Engineers' Workshop. II.—Lathes and Lathe Work. III.—Drills and Drilling. IV.—Soft and Hard Soldering. V.—Hardening and Tempering Steel. VI.—The Use of Abrasives. VII.—Pattern Making. VIII.—Electro-plating. IX.—A Model Slide Crank Steam Engine. X.—A Model Slide Crank Steam Engine. XI.—A Single Cylinder Engine. XII.—A Model Twin-Cylinder Marine Engine. XIII.—Flash Steam Plants. XIV.—A Flash Steam Plant for Large Model Airplanes. XV.—A Flash Steam Plant for Small Model Airplanes. XVI.—A Model Steam Turbine. XVII.—Design and Construction of Model Boilers. XVIII.—Model Boiler Fittings. XIX.—A Record-Breaking Model Hydroplane. XX.—A Model Lake Freighter. XXI.—A Sharpie-Type Model Boat. XXII.—A Model Submarine Chaser. XXIII.—A Model Submarine with Radio Control. XXIV.—A Model Crane. XXV.—An Electric Double-Drum Hoist. XXVI.—A Model Gasoline Engine. XXVII.—A Model Electric Locomotive. XXVIII.—A Model Steam Locomotive. XXIX.—A Model Gyroscope Railroad. XXX.—A Model Caterpillar Tank. XXXI.—A Model Siege Gun.

Practical-Complete-Easily Understood

A BOOK FOR EVERYONE INTERESTED IN ABRASIVES OR GRINDING

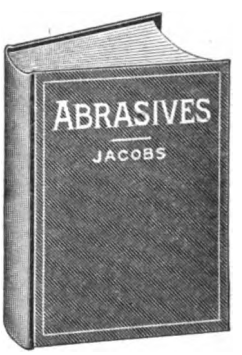
ABRASIVES AND ABRASIVE WHEELS

Their nature, manufacture and use

By **FRED B. JACOBS**

340 Pages ***Price $3.00*** 200 Illustrations

A practical handbook for engineers, shop foremen, foundrymen, mechanics and factory superintendents. Dealing with abrasives, their manufacture and practical use.



THE mechanical engineer, the man in the shop or factory or the student in engineering will find this volume of great value. It answers many perplexing questions and solves many important problems that arise in large factories and engineering establishments. The data is set forth in lucid terms, together with a multitude of illustrations; both half-tones and line drawings.

The subject of grits, grades and bonds, which is so perplexing to the average shopman, is thoroughly explained, together with other valuable data concerning the physical and chemical nature of abrasives in general.

Brief synopsis of chapters:

I.—Natural Abrasive Substances. II.—Artificial Abrasives. III.—The Manufacture of Grinding Wheels. IV.—Artificial Sharpening Stones. V.—Grits and Grades. VI.—Testing Wheels for Efficiency. VII.—Laboratory Tests. VIII.—Grinding Wheel vs. Grindstones. IX.—The Economic Advantage of Using Large Wheels. X.—Truing Devices for Grinding Wheels. XI.—Re-bushing Grinding Wheels. XII.—Suggestions to Follow in Ordering Grinding Wheels. XIII.—Design of Dust-collecting Systems. XIV.—Safeguarding Grinding Wheels. XV.—Abrasive Papers and Cloths. XVI.—Surface Grinding. XVII.—Cylindrical Grinding. XVIII.—Internal Grinding. XIX.—Special Grinding Operations. XX.—Cutter Sharpening. XXI.—Saw Sharpening.

The Only Book of its Kind

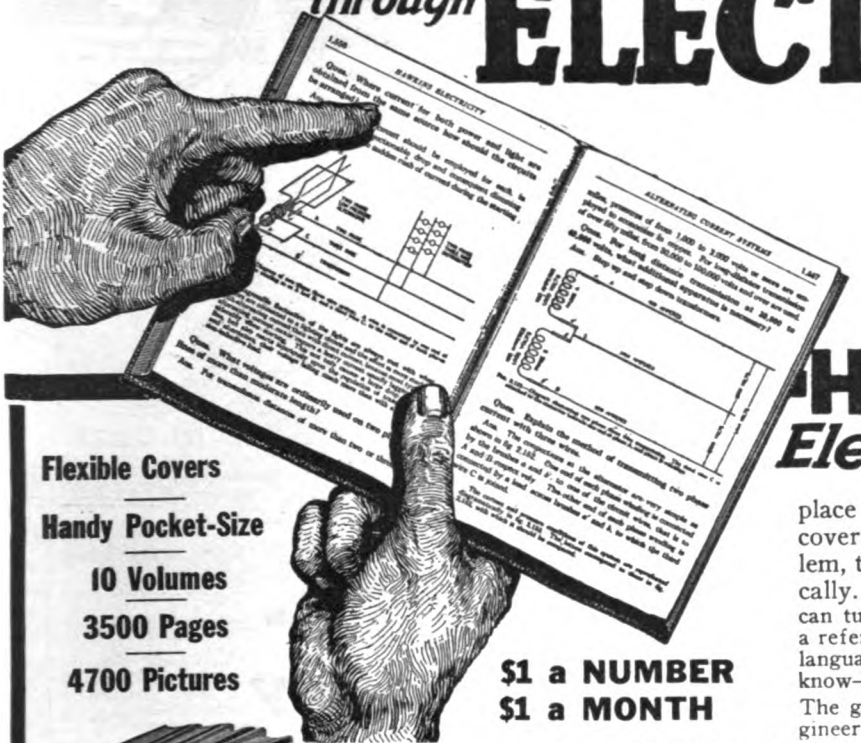
Any of these books sent prepaid on receipt of price, or a special circular of them sent on request.
FREE—Our new Catalog of Practical Books sent free on request.

THE NORMAN W. HENLEY PUBLISHING CO.

Dept. EE **2 West 45th Street, New York**

Digitized by Google

Get Bigger Pay through ELECTRICIT



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 31[illegible] pages, 379 illustrations Alternating current, wiring power stations—turbines: management, selection, location erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro-therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Employed by .....

Residence .....

Reference ..... Nov.-Dec.

SEND NO MONEY - USE THE COUPON

Digitized by Google



Face the Facts-

Training Brings Real Money

There are too many bookkeepers and clerks—not enough Expert Accountants. Training makes the difference. Only by training can you win the bigger job.

You—yourself—must decide whether tomorrow you will be a plodding bookkeeper or clerk or an independent executive. The worker market has plenty of $800 employees—but altogether too few qualified to handle the **$3,000, $5,000** and **$10,000** positions.

Why Accountancy Training Is So Valuable Today

New Income and Excess Profit taxes have brought home to literally thousands of firms the necessity of accurate records. American business is branching out in all directions—foreign and domestic—and with this tremendous expansion has come a keen appreciation of the importance of preventing waste and misdirected energies—of developing better methods of Cost Accounting. Positions are open today in every community for auditors, comptrollers, cost accountants, credit men, and public accountants at salaries ranging from $2,500 to $12,000, and even higher. Face the subject squarely. **Where men are scarcest**—there must trained experience demand highest salaries. Fit yourself for this most profitable of professions and tomorrow's success will take care of itself.

Applying the Success Formula

W. A. Thompson was once a bookkeeper—today he is Comptroller of the Allis Chalmers Mfg. Co. In less than 3 years through I. A. S. training he made the jump.

Arnold O. Link rose from Assistant Bookkeeper to Office Manager through the study of our course in Accountancy—**increasing his salary 500%.**

E. W. Brickell was a clerk when he began his I. A. S. training—today he is General Auditor of the Everwear Hosiery Company.

These stories are not the exceptions—if you will mail the coupon below for our book, "Stories of Success," you will find hundreds of similar examples. They prove, without a shadow of a doubt, that you **can** learn through the home study method—that I. A. S. trained men actually **are** holding big executive, auditing and cost positions.

Executive Positions Always Open to the Trained Accountant

Big business simply cannot get enough of men with trained accountancy experience. The accountant is executive timber. His work gives him a bird's-eye view of the whole business. The accountancy trained man dominates. No matter what your present position or education—if you have the gritty determination to make good—I. A. S. training will bridge the gap for you between your present position and high salaried independence—training that may be secured in spare time without giving up your present work.

Study at Home Under the Guidance of Experts

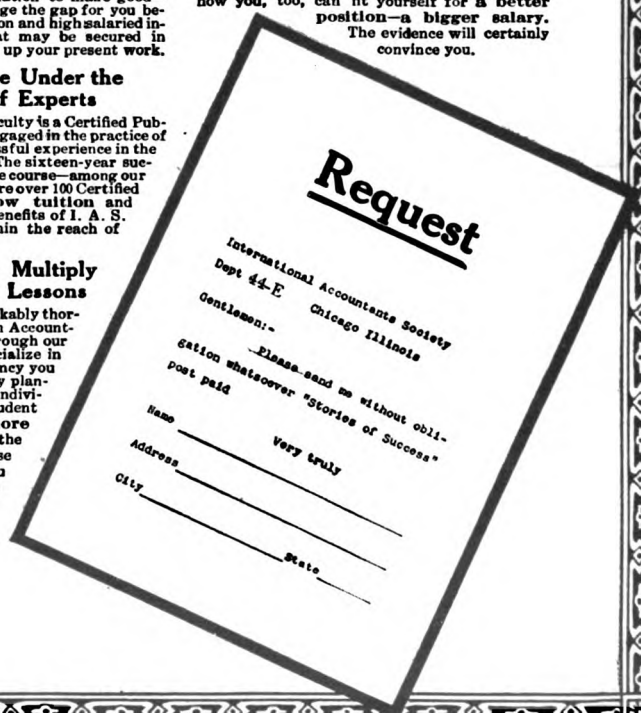
Every member of our faculty is a Certified Public Accountant actively engaged in the practice of his profession with successful experience in the teaching of Accounting. The sixteen-year successful record backs up the course—among our students and graduates are over 100 Certified Public Accountants. **Low tuition** and **easy terms** place the benefits of I. A. S. home study training within the reach of every ambitious man.

Elective Features Multiply the Value of the Lessons

In addition to a remarkably thorough practical training in Accountancy you are enabled through our elective feature to specialize in any branch of Accountancy you may prefer. Scientifically planned lessons fitted to the individual needs of each student enable you to save more than six months in the completion of your course—make it possible for you to cash in on the value of your training just that much sooner.

Two Big Books "Stories of Success" and "How to Learn Accounting"—FREE

Get these books—at once. They describe in a simple, straight-forward way the opportunities in higher accountancy today—show how hundreds of others have won better positions—tell how you, too, can fit yourself for a better position—a bigger salary. The evidence will certainly convince you.



INTERNATIONAL ACCOUNTANTS SOCIETY
a department of the Tanner-Gilman Schools Incorporated
DEPARTMENT 44-E, 2626 S. Michigan Ave., CHICAGO, ILL.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Short Cuts to Bigger Pay

Your last chance to procure one of these famous McGraw-Hill Home Study Courses at the old prices.

Here are three of the McGraw-Hill Home Study Courses that make promotion sure. Each represents practically a life time of study and practice. They are not correspondence courses. They are self-teachers. All the information you need is laid before you in plain language and plain illustrations.



Croft's Library of Practical Electricity

The only electrical library in existence that actually teaches electrical practice as experts know it. 3,000 pages and 2,100 illustrations taken from electrical work itself. 8 flexibly bound volumes, pocket-size. Easy to read and easy to understand, and the principles easily applied to work as it is done. For both the beginner and trained man, for reference or study. Price before February 28, 1920, $16. Afterwards $20, payable $2 in ten days and $3 per month.



Power Plant Library

The most used engineers' library ever published. Over 30,000 power plant men are using them as a means of passing examinations and becoming chief engineers. 8 volumes, durably bound in dark blue cloth. About 2,700 pages, 1,800 illustrations. If you are interested in any branch of power plant work you must have these books. They will enable you to pass the examination in any state. Price before February 28, 1920, $12. Afterwards $16, payable $2 per month.

Not one cent in advance

Merely check the library in which you are interested, fill out the coupon and return to us. We will ship the set of your choice for ten days' absolutely free examination. Return at our expense if you are not thoroughly pleased. Pay only the small monthly payments called for if you are satisfied the books will increase your earning power. But act now. Tomorrow may be too late to get the books at the old price.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York



Machine Shop Library

The practical side of machine shop work, written by such well known authorities as Colvin, Stanley, Lake, Goodrich, Haas, &c.. 3,000 pages, 2,000 illustrations. 9 volumes, dark red cloth, morocco grained. Suitable to the needs of every man connected in any way with the machine shop. Records of actual practice that show the way to more pay. Price before February 28, 1920, $16. Afterwards $20, payable $2 in ten days and $3 per month.

Save $4 by ordering NOW

An advance of $4 in the price of each set must be put into effect after February 28, 1920. Orders received by us after that date will be charged at the increased rate. No exceptions can be made. Even at the new prices these books are the best buy in engineering literature of the time.

FREE EXAMINATION COUPON

Add $4 to the price of each set after February 28, 1920

McGraw-Hill Book Co., Inc., 239 W. 39th St., N. Y.
Gentlemen: Send for ten days' free inspection the Library have checked below:

☐ Croft's Electricity, $16—payable $2 per month.
☐ Machine Shop Library, $16—payable $2 per month.
☐ Power Plant Library, $12—payable $1 per month.

If satisfactory I will send first payment in ten days and same amount each month until paid. If not wanted I return the books at your expense.

Signature .....
Residence address.....
City and State.....
Your employer.....
His address.....
Your occupation.....ED-11-

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

GOOD HOLIDAY BOOKS

PRACTICAL—COMPLETE—EASILY UNDERSTOOD

Wireless Telegraphy and Telephony Simply Explained.

By Alfred P. Morgan. This is undoubtedly one of the most complete and comprehensive treatises on the subject ever published, and a close study of its pages will enable one to master all the details of the wireless transmission of messages. The author has filled a long-felt want and has succeeded in furnishing a lucid, comprehensible explanation in simple language of the theory and practise of wireless telegraphy and telephony. Third edition. 154 pages. 156 engravings. **Price, $1.25**

Radio Time Signal Receiver.

By Austin C. Lescarboura. This new book, "A Radio Time Signal Receiver," tells you how to build a simple outfit designed expressly for the beginner. You can build the outfits in your own workshop and install them for jewelers either on a one-payment or a rental basis. The apparatus is of such simple design that it may be made by the average amateur mechanic possessing a few ordinary tools. 42 pages. Paper. **Price, 25 cents**

Switchboards.

By William Baxter, Jr. This book appeals to every engineer and electrician who wants to know the practical side of things. All sorts and conditions of dynamos, connections and circuits are shown by diagram and illustrate just how the switchboard should be connected. Includes direct and alternating current boards, also those for arc lighting, incandescent and power circuits. Special treatment on high voltage boards for power transmission. Second edition. 190 pages. Illustrated. **Price, $2.00**

Commutator Construction.

By Wm. Baxter, Jr. The business end of dynamo or motor of the direct current type is the commutator. This book goes into the designing, building and maintenance of commutators, shows how to locate troubles and how to remedy them; everyone who works with dynamos needs this. Fourth edition. **Price, 35 cents**

Arithmetic of Electricity.

By Prof. T. O'Conor Sloane. A practical treatise on electrical calculations of all kinds reduced to a series of rules, all of the simplest forms, and involving only ordinary arithmetic; each rule illustrated by one or more practical problems with detailed solution of each one. This book is classed among the most useful works published on the science of electricity, covering as it does the mathematics of electricity in a manner that will attract the attention of those who are not familiar with algebraical formulas. 160 pages. Twenty-first edition. Cloth. **Price, $1.00**

Dynamo Building for Amateurs, or How to Construct a Fifty Watt Dynamo.

By Albert J. Weed. A practical treatise showing in detail the construction of a small dynamo or motor, the entire machine work of which can be done on a small foot lathe. Dimensioned working drawings are given for each piece of machine work, and each operation is clearly described. This machine, when used as a dynamo, has an output of fifty watts; when used as a motor it will drive a small drill press of lathe. It can be used to drive a sewing machine on any and all ordinary work. The book is illustrated with more than sixty original engravings showing the actual construction of the different parts. **Price, Cloth, $1.00**

High Frequency Apparatus, Its Construction and Practical Application.

By Thomas Stanley Curtis. The most comprehensive and thorough work on this interesting subject ever produced. The book is essentially practical in its treatment and it constitutes an accurate record of the researches of its author over a period of several years, during which time dozens of coils were built and experimented with. 248 pages. Fully illustrated. **Price, $2.50**

Electric Wiring, Diagrams and Switchboards.

By Newton Harrison, with additions by Thomas Poppe. This is the only complete work issued showing and telling you what you should know about direct and alternating current wiring. It is a ready reference. The work is free from advanced technicalities and mathematics, arithmetic being used throughout. It is in every respect a handy, well-written, instructive, comprehensive volume on wiring for the wireman, foreman, contractor or electrician. Second revised edition. 303 pages, 130 illustrations. Cloth. **Price, $2.00**

Telephone Construction, Installation, Wiring, Operation and Maintenance.

By W. H. Radcliffe and H. C. Cushing. This book gives the principles of construction and operation of both the Bell and Independent instruments; approved mthods of installing and wiring them; the means of protecting them from lightning and abnormal currents; their connection together for operation as series or bridging stations; and rules for their inspection and maintenance. Line wiring and the wiring and operation of special telephone systems are also treated. 224 pages, 132 illustrations. Second revised edition. **Price, $1.25**

Electric Bells.

By M. B. Sleeper. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. Tools, bells, batteries, unusual circuits, burglar alarms, annunciators, systems, thermostats, circuit breakers, time alarms, and other apparatus used in bell circuits are described from the standpoints of their application, construction, and repair. The detailed instructions for building the apparatus will appeal to the experimenter particularly. The practical worker will find the chapters on Wiring Calculation of Wire Sizes and Magnet Windings, Upkeep of Systems and the Location of Faults of the greatest value in their work. 124 pages. Fully illustrated. **Price, 60 cents**

House Wiring.

By Thomas W. Poppe. Describing and illustrating up-to-date methods of installing electric light wiring. Intended for the electrician, helper and apprentice. Contains just the information needed for successful wiring of a building. Fully illustrated with diagrams and plans. It solves all wiring problems and contains nothing that conflicts with the rulings of the National Board of Fire Underwriters. Third edition revised and enlarged. 125 pages, fully illustrated, flexible cloth. **Price, 75 cents**

Electricity Simplified.

By Prof. T. O'Conor Sloane. The object of "Electricity Simplified" is to make the subject as plain as possible and to show what the modern conception of electricity is; to show how two plates of different metals immersed in acid can send a message around the globe; to explain how a bundle of copper wire rotated by a steam engine can be the agent in lighting our streets, to tell what the volt, ohm and ampere are, and what high and low tension mean; and to answer the questions that perpetually arise in the mind in this age of electricity. 172 pages. Illustrated. Thirteenth edition. Cloth. **Price, $1.00**

Construction of a Transatlantic Wireless Receiving Set.

By L. G. Pacent and T. S. Curtis. A work for the Radio student who desires to construct and operate apparatus that will permit of the reception of messages from the large stations in Europe with an aerial of amateur proportions. 36 pages. 23 illustrations, cloth. **Price, 35 cents**

Electric Toy Making, Dynamo Building and Electric Motor Construction.

This work treats of the making at home of electrical toys, electrical apparatus, motors, dynamos and instruments in general and is designed to bring within the reach of young and old the manufacture of genuine and useful electrical appliances. 210 pages, cloth. Fully illustrated. Twentieth edition, enlarged. **Price, $1.00**

Experimental High Frequency Apparatus, How to Make and Use It.

By Thomas Stanley Curtis. 69 pages, illustrated. **Price, 50 cents**

Wiring a House.

By Herbert Pratt. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules; in fact, just the information you need. Directions apply equally to a shop. Fourth edition. **Price, 35 cents**

Any of these books sent prepaid on receipt of price. FREE—Our new Catalog of Practical Books sent free on request.

THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. **2 West 45th Street, New York**

Digitized by Google

This Boy Knows. Do You?

This boy has had THE BOOK OF KNOWLEDGE in his home for a year and he can explain to you interestingly and correctly all the familiar things which he sees around him. His teacher will tell you that when she wants a quick and intelligent answer from her class, this boy always answers first. He understands many subjects of interest in the papers and magazines and in the conversation of his elders. *He has made a long start in the race for knowledge.*



Answers Every Question a Child Can Ask

Why is ice slippery?
Why is the sea never still?
Can a plant see?
What are eyebrows for?
Why does milk turn sour?
Why is snow white?
Do the stars really twinkle?
What makes the color of the sunset?
What makes knots in wood?
What makes an echo?
What makes shadows?
Why is it warm in summer?
What is camouflage?

The Book of Knowledge

The Children's Encyclopedia

10,000 Educational Pictures — **In Five Languages** (*English, French, Spanish, Italian, Portuguese*) — **350 Colored Plates**

Curiosity—The Great Teacher

Curiosity is the beginning of all knowledge. Do you know any subject about which your child has not asked you a dozen questions? Let him ask as many as he likes, and be sure to answer them correctly. That is the parent's most important and most easily neglected duty. If you discourage your child's curiosity you will injure his mind, and the bright boy or girl becomes stupid or indifferent. Through curiosity Columbus discovered America. THE BOOK OF KNOWLEDGE is the simplest and most natural method of helping the child to educate himself. *It answers every question a child can ask in plain and simple language.* So captivating is this great original work to the mind of a child that he absorbs with little effort the profound truths and great facts of the world of knowledge, while reading its delightful pages and looking at the thousands of striking educational pictures.

Your Child is Unique

Your child is like no other child in the world. He has his own peculiar taste and need for both physical and mental food. If you put a meal before him and let him choose what agrees with him best, he will thrive. THE BOOK OF KNOWLEDGE is the right kind of nourishing food for the child's mind during the growing years. Give your child this remarkable, original work, and watch carefully which of the 16 Great Departments interests him most, Nature, Science, History, Biography, Astronomy, Physiology, Art, Literature, Poetry, or Manual Training. It will prove *THE KEY* to his natural bent, and the kind of work or profession in which he will most easily succeed.

Your Child's Chance

In round numbers, what is your child's chance to become successful? If uneducated, he has one chance out of 150,000; with a common school education, 4 chances; with a high school education, 87 chances; with a college education, 800 chances, *with THE BOOK OF KNOWLEDGE in the home,* every chance. It is not a luxury, it is an absolute necessity. It is an *INVESTMENT* in your child's future which will pay dividends as long as he lives. In over *600,000* homes today the children are being educated with THE BOOK OF KNOWLEDGE. *Give your child his chance to compete with them.*

Satisfy Your Desire To Know By Mailing FREE COUPON Today

If you have a child to educate, *between four and sixteen years old,* send for the FREE sample-page BOOKLET TODAY. It contains 80 fascinating pictures and pages from THE BOOK OF KNOWLEDGE, some in natural colors. It will help you to decide this important matter without delay. Every day without it is a loss to your child.

Send for this BOOKLET TODAY. Mail the FREE COUPON NOW!

THE GROLIER SOCIETY
2 West 45th Street, New York

Please mail descriptive book containing specimen pages and illustrations from THE BOOK OF KNOWLEDGE, and explaining the use and meaning of the work for the mind of a child.

Name .....

Address .....

EDE 203

Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

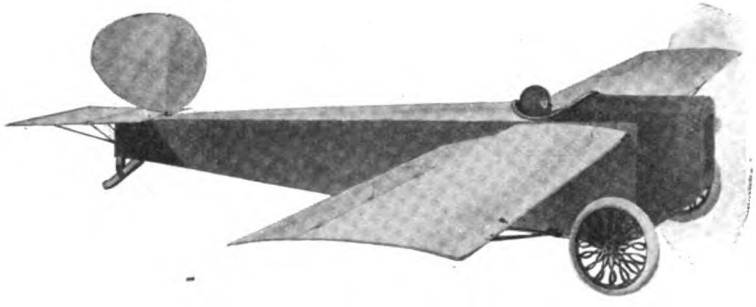
Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF II SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.



BUILD THIS MONOPLANE

The plane for the pleasure flyer who wants all the thrills of flying without the expense of a larger plane. Single seater with a short fuselage making handling easy. Wings braced with solid struts, no wires to loosen, give way or break. Shock absorbing spring wheels built part of the body. Whole plane low for balance. Everything simplified for ease of assembly. You can build one yourself from our working drawings and instal a motorcycle, cycle car or other motor of 12 to 20 H.P. Spread 22 feet, length 14 feet, weight 200 pounds. High safety factor of 12 to 1. Simple fittings. Speed with 15 H.P., 30-50 m.p.h. Designed by aeronautical engineers for sporting use and general flights. Be the first in your town to have one flying. Three ways to own one—Complete for $1365, knockdown without motor for $365, or plans $2, and build it yourself.

BUILD ONE YOURSELF
You who like to make things and save money as well—send $2 for a full set of working drawings showing all details of the monoplane with building instructions. With the plans comes a price list of everything needed. Many money saving ideas given in the instructions. Price of plans refunded if you buy a knockdown plane later.

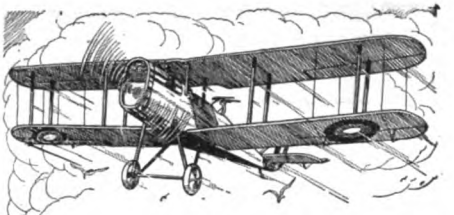
BUY IT KNOCKDOWN
Supplied knockdown without motor for you to assemble for $365. Everything supplied except motor, including propeller, wheels, fittings, countershaft, woodwork cut, wire, cloth, dope, etc., and a set of plans and full instructions, ready for you to put together and set in your motor. The ideal way to own one. Orders filled in rotation. Terms, $65 cash, balance C.O.D.

BE THE FIRST IN YOUR TOWN—SEND YOUR ORDER NOW!

GEORGE D. WHITE CO.

Aeroplane Manufacturers

113 E. 49th St. Dept. 5 Los Angeles, Cal.



Build and Fly An

IDEAL MODEL AEROPLANE

—an Accurate Scale-Duplicate of a Famous Plane

You can build a perfect Model of a famous Aeroplane, that will look exactly like the real one, and that will rise from the ground or water by its own power and fly in the air. Build one now; it's the greatest sport you ever had! You can learn a lot about Aeroplanes; how they are built; operated and controlled. Ideal Model Aeroplane Construction Outfits make building easy. They contain all parts, fittings, materials, plans drawn to scale and complete building and flying instructions. You put the parts together and build your Model like a real Aeroplane mechanic.

Pick Your Model from These Celebrated Aeroplanes

You can get a Complete Construction Outfit to build an absolute duplicate, scale-reduction Model of any of these well-known machines:

N C-4 (Naval-Curtiss Seaplane). The first 'plane to fly across the Atlantic Ocean. 4½ ft. Model. Shown below.
DeHAVILLAND Battle Plane (DeH-4). The fighting 'plane used by the American Aces. 3 ft. Model. Shown above.
Curtiss Military Tractor. The 'plane used to train our Aviators. 3 ft. Model.
Bleriot Monoplane. The first aeroplane to cross the English Channel. 3 ft. Model.
Nieuport Monoplane. A famous French 'plane used in the War. 3 ft. Model.
Taube Monoplane. The early German dove-like machine. 3 ft. Model.
Cecil Peoll Racer. A racing-type aeroplane with a record for distance flights.

Ideal Model Aeroplane Construction Outfits for building any of the above Aeroplanes are sold by Leading Toy, Sporting Goods and Department Stores. Ask for them at your store. Be sure you get IDEAL Model Aeroplanes because they are the only ones that are true copies of actual Aeroplanes.

Send for the Ideal Aeroplane Book

Tells all about Ideal Aeroplanes and Flying Toys; gives complete descriptions and prices; contains list of stores where you can get them. Get this 48 pg. book.

Sent Postpaid for 10c in stamps.

IDEAL AIRPLANE & SUPPLY CO.

Making Model Aeroplanes Since 1911

159-161 Wooster St.
Cor. W. Houston St., New York



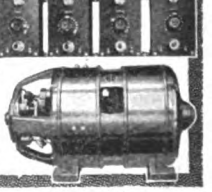
Battery Charging Your Biggest Money-Maker

$500.00 a Month Income with This 32 HB Battery Charger

Eureka Storage Battery Co., Houston, Texas, writes—"The first little machine we bought of you has given us the very best of service. With the new large machine, my income per month from charging is $500.00."

You, too, Can Make Big Profits with an HB 32 Battery Charger

Recharges 32-6 volt auto batteries, or equivalent in 12- or 24-volt batteries, at one time, for 10c to 15c each. Customer pays 75c to $1.50. Figure the profits yourself. No electrical knowledge needed. Uses no valuable floor space. Runs 24 hours a day.



Small investment puts this money-maker in your garage. Balance on easy monthly terms. Outfit easily pays for itself. Absolute Money-Back Guarantee. Write TODAY for full information. Send this ad.

HOBART BROTHERS COMPANY
Box EE113 Troy, Ohio
Successful Mfrs. since 1893

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 7499 431 S. Dearborn St. CHICAGO

Digitized by Google



MODELS THAT ACTUALLY FLY

Build your own flying boat from our superior working blueprints and materials. The ONLY Biplane Flying Boat on the market that will actually rise from the water and fly under its own power. Two sheet working blueprint one half actual size with full building and flying instructions. $1.00 postpaid in U. S.

Complete materials to build this wonderful flying boat with full building and flying instructions including two special hand carved propellers $5.00 postpaid in U. S. Canada 25c extra.

Blueprints of the following flying models one half actual size with full building and flying instructions 50c per copy postpaid in U. S. Complete set of four blueprints $2.00 postpaid.

BLERIOT RACER, 600-Foot flyer.
MANHATTAN RACER, 2000-Foot flyer.
MONTAUK FLYER, Flies 500 feet.

Send for Catalogue ready September 1st

HEC AEROPLANE CO.,
300 East 49th St. New York City
Address Special Dept.

CAN YOU DRAW DOTTED LINES AS FAST AS FULL ONES?
YOU CAN WITH A
BERGGREN PEN



The Berggren Pen draws any style of dotted line without blot or blur. Nothing complicated or bothersome, used like your regular pen. When you are ready to put in the dotted lines, fill your



Berggren Pen and carry on. The result is a perfect dotted line, made as fast as you move your hand.

Our pamphlet describes the pen and shows the styles of lines.

Berggren Drafting Pen and Six Wheels, $3.00

UNIVERSAL DRAFTING PEN CO.
BRIDGEPORT, CONN.

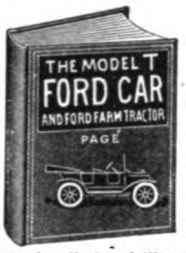
CHEMIST AMAZING DISCOVERY
25 Miles on One Gallon Gas
MOTOROL 25 to 50% more miles per gal. 25 to 35% more power.
Means Faster Ignition

One Dollar Postpaid
Agents Wanted
Uniform Combustion
No Carbon Deposits
Less Wear and Tear on motor
Higher Test of Gasoline
AUTO PRODUCTS CO. Dept. 68, 226 W. 130th St., N. Y.

Automobile Books
Worth Having

The Modern Gasoline Automobile, Its Design, Construction, Operation.

By Victor W. Pagé, M.S.A.E. This is the most complete, practical and up-to-date treatise on gasoline automobiles and their component parts ever published. In the new revised and enlarged 1920 edition, all phases of automobile construction, operation and maintenance are fully and completely described and in language anyone can understand. 1000 pages. 1000 illustrations. Price, $4.00



The Model T Ford Car, Its Construction, Operation and Repair, Including the Ford Farm Tractor.

By Victor W. Pagé. This is the most complete and practical instruction book ever published on the Ford Car. A high grade, cloth bound book, printed on the best paper, illustrated by specially made drawings and photographs. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and operating principle made clear to everyone. 310 pages, 106 illustrations. Price, $1.50

Automobile Welding with the Oxy-Acetylene Flame.

By M. Keith Dunham. Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone. 167 pages, fully illustrated Price, $1.50

Gasoline and Kerosene Carburetors, Construction, Installation and Adjustment.

By Capt. V. W. Pagé. All leading types of carburetors are described in detail, special attention being given to the forms devised to use the cheaper fuels such as kerosene. Carburetion troubles, fuel system troubles, carburetor repairs and installation, electric primers and economizers, hot spot manifolds and all modern carburetor developments are considered in a thorough manner. Methods of adjusting all types of carburetors are fully discussed as well as suggestions for securing maximum fuel economy and obtaining highest engine power. 250 pages, 89 illustrations. Price, $2.00

Automobile Repairing Made Easy.



By Victor W. Pagé. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism. Written in a thorough but non-technical manner. This book also contains Special Instructions on Electric Starting, Lighting and Ignition Systems, Tire Repairing and Rebuilding, Autogenous Welding, Brazing and Soldering, Heat Treatment of Steel, Latest Timing Practice, Eight and Twelve-Cylinder Motors, etc., etc. You will never "Get Stuck" on a Job if you own this book. 1,000 specially made engravings on 500 plates. 1,056 pages (5½ x 8). 11 folding plates. Price, $4.00

Questions and Answers Relating to Modern Automobile Construction, Driving and Repair.

By Victor W. Pagé. A self-educator on automobiling without an equal. This practical treatise consists of a series of thirty-seven lessons, covering with over 2,000 questions and their answers—the automobile, its construction, operation and repair. The subject matter is absolutely correct and explained in simple language. A popular work at a popular price. 5¼ x 7½. Cloth, 650 pages, 392 illustrations, 3 folding plates. Revised Edition just published. Price, $2.50

Starting, Lighting, and Ignition Systems.



By Victor W. Pagé. A practical treatise on modern starting and ignition system practice. This practical volume has been written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. It can be understood by anyone even without electrical knowledge. Nearly 500 pages. 297 specially made engravings. New edition. Price, $2.50

Any of these Books sent prepaid on receipt of price.

The N. W. Henley Pub. Co.
2 West 45th Street New York

Don't Be a Sickly Failure!



STRONGFORT
The Perfect Man

Are you dragging yourself about from day to day, always tired and dispirited; suffering from backache, indigestion, constipation; your biliousness showing in your face, your lack of energy in your eyes, your good-for-nothing physical condition in the hang-dog air with which you meet your fellowmen? Have you about given up hope—and has your wife given up all hope—that you will ever get ahead and amount to anything in the world?

Pull Yourself Together!

Brace up! There's a way out! You can be a man again! You can be full of life and energy and good health; you can trample under foot the sickly troubles that are pulling you down; you can change the watery fluid in your veins to sparkling red blood, that will nourish mind and body, overcome all your ills, and put you at the top of the heap.

No matter what brought you to your present condition; no matter how long you have sunk; you can be RE-BUILT into a MAN, with health and strength and mental and physical vigor and efficiency.

It's Never Too Late

Strongfortism doesn't know the meaning of the words "too late." No matter what your age or condition; no matter how long you have been mired in the slough of despondency or struggling under the handicap of physical irregularities, **Strongfortism can make a new man of you.** Strongfortism can improve every part of your system; strengthen your heart, lungs, liver, stomach; clear your brain; steady your nerves, rid you of that eternal languid, tired feeling, and start you on the path to success.

I Can Re-Create You

I KNOW that I can make you over, can improve you 100 per cent., because I have helped and am helping thousands of other men—some of them pretty far gone, too, before they took up Strongfortism. I have no pills, powders or patent medicine dope to offer you; no drugs of any kind. **EXPERIENCE** instead; the solid experience of a lifetime with myself and my pupils; the experience and study that have enabled me to dig out and apply to you the secret laws on which human health and happiness and vitality depend.

Send For My Free Book

"Promotion and Conservation of Health, Strength and Mental Energy" tells you all about Strongfortism; tells you how you can overcome your mental and physical ailments; how you can strengthen your vital organs; how to obtain symmetry of form and figure. It's forty-eight pages of talk straight from the shoulder, telling how you can get the most pleasure out of life, from a man who knows what he's talking about.

Mark the coupon below, showing what ailments you suffer from and send it with three 2c stamps to cover mailing expenses and I will send you the book free.

LIONEL STRONGFORT
Physical and Health Specialist
1094 Strongfort Institute Newark, N. J

CUT OUT AND MAIL THIS COUPON

Mr. Lionel Strongfort, Newark, N. J.

Dear Strongfort:—Please send me your book, **"Promotion and Conservation of Health, Strength and Mental Energy,"** for postage of which I enclose three 2 cent stamps to cover mailing expenses. I have marked (X) before the subject in which I am interested. 1094

..Colds	..Deformity	..Poor Memory
..Catarrh	..Insomnia	..Rheumatism
..Asthma	..Heartweakness	..Poor Circulation
..Obesity	..Short Wind	..Skin Disorders
..Headache	..Flat Feet	..Despondency
..Thinness	..Constipation	..Round Shoulders
..Rupture	..Biliousness	..Lung Troubles
..Flat Chest	..Torpid Liver	..Increased Height
..Neuritis	..Indigestion	..Muscular Development
..Neuralgia	..Nervousness	

Name .....
Age ..... Occupation .....
Street .....
City ..... State .....
Write Plainly

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

AGENTS—Something different! Our Radium (Luminous) Crucifix actually Shines in the Dark. Startling! Mysterious! Wonderful enthusiasm follows every demonstration. 150% profit on every sale. Sole manufacturers. The Pioneer Corporation, 1265 W. 63rd Street, Chicago.

GET OUR BIG MONEY MAKER monogramming Autos, etc., by transfer method. Catalogue and particulars free. Motorists Accessories Co., Mansfield, Ohio.

AGENTS. Signs for store and offices. Entirely new. $50-week easily made. Chicago Sign System 1-326 River St., Chicago.

American Made Toys

AMERICAN MADE TOYS WANTED. An opportunity for homeworkers on small scale and manufacturers on large scale. Unlimited quantities needed of Toy Soldiers, Army, Navy, Marines, Cannons, Machine Guns, Warships and other toys and novelties. Enormous demand and future in American Made Toys all over United States, Canada, Mexico and South America with over 50,000 10-cent stores and toy dealers. This new American industry stands out conspicuously. Factories are established, people trained, machineries made. Christmas Sets needed in millions this year. The great hit for 1919 without any competition. We are buyers of these goods all year, paying fixed prices. Attractive prices offered for painted goods. Experience or tools unnecessary. Hundred and more made complete per hour. Casting form outfits from $3.00 up. If you mean business, send for booklet and information free. TOY SOLDIER MANUFACTURING CO., 32 Union Square, New York.

Auctioneers

AUCTIONEERS. Make big money. Free Catalogue. Carpenter's Auction School, Kansas City.

Automobile Accessories

MORE Power, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

FORD SPEED and Power Specialties in stock; 4 Speed Forward Auxiliary Transmission, doubles the pulling power or increases speed 40%; 16 Overhead Valve Cylinder Head; speed carburetor; cam shaft; piston rings; light cast iron and aluminum pistons; crankshaft counter balances; high tension magnetos; underslung fixtures; front wheel roller bearings; speed, power bevel gears; foot accelerator; large steering wheels; racing bodies; radiators; complete racing cars $650—$1750 two weeks delivery. Victor H. Ford, Transmission Manufacturers, 250 W. 54th, New York.

BATTERY CHARGING. Profit $100 to $250 Clear Monthly with HB Equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guarantees. Write HOBARTS, TROY, OHIO, Box EE.

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

Automobile Schools

HAVE YOU A TRADE?—Why not learn the Automobile Business—actual practice under expert instructors qualifies you in a few weeks' time to repair or drive any make of car, truck or tractor. There are always plenty of good positions open for trained men. Write today for particulars to Buffalo Auto School, Dept. 84, Buffalo, N. Y.

Aviation

WANT TO EXCHANGE small airplane for motorcycle. Brubaker, 522 East 78th St., New York.

BUILD A STAR JUNIOR BIPLANE—Plan $2.00. Or send $3.75 for plan and book "Aeroplane Construction and Operation." Chicago Aero Works, Plan Dept., 326 River St., Chicago.

Blueprints

BLUEPRINTS of Model Boat Turbine 50c and U. S. Destroyer $1.00. Adams, 163 De L'Epee Ave., Montreal.

BLUEPRINTS: Small Steam Engines & Boilers, Gaso. Engines, ⅛—¼—½ H. P. 3 Sets, (13 Sheets) Postpaid $1.00. Circular on Castings for Slp. Modern Model Engineering Co., 384 Monadnock Blk., Chicago.

MODEL ELECTRIC MOTOR Blue Prints 25c. Complete working outfit $1.75. A. F. Cassel, 52 West 130th St., New York City.

Books

WHAT DID YOU DREAM? Ten Thousand Answers $1.25. Exclusive Sensational Novel "Genevieve de Brabant" $1.10. Voice Hindoo Mystic "senam" 33c. "Phenomena of Spirit" 33c. Catalogues 2c. Sovereign Company, 160 Sycamore, Buffalo, N. Y.

BOOK READERS—Write for free descriptive catalogue. Central Sales Co., 601 Ninth Ave., New York.

Business Opportunities

$1 DOES IT. Texas oil land making holders big money everyday. Bank references furnished. Investigate us thoroughly, that's all we ask. Results count. Our plan $1 down, balance monthly few months gives you Warranty Deed to land. May pay profits $200 or more monthly. Maps, reports, Established facts FREE. Address Sourlake Texas Oil Co., 835 DeMenil, St. Louis, Mo.

Business Opportunities

MONEY SAVED—All kinds used correspondence courses sold. (Also courses bought.) Write Lee Mountain, Pisgah, Ala.

Chemicals

CHEMICALS—50 different chemicals including Iodine, Mercury, Antimony, etc. Material sufficient for hundreds of experiments. Send $4.

LABORATORY APPARATUS—25 piece set. Includes Alcohol Lamp, Beaker, Erlenmeyer Flask, funnel, 10 test-tubes, Test-tube holder, etc. Send $3.

PIGMENTS—25 different pigments used in manufacturing Paints, Varnishes, Rubber, Paper, etc. Send $4. TECHNICAL EQUIPMENT COMPANY, Dept. 3CC. 22 East 17 Street, New York.

MICROSCOPES. Balances, Experimental Laboratories. Buy through our easy Payment Plan. No red tape. Write for Booklet 24-E. Chemical and apparatus supplied for all Chemistry articles appearing in Everyday Engineering. Perform their experiments with our equipment. Lions Scientific Institute, Bausman Street, Mt. Oliver, Pittsburgh, Penna.

CRUDE RUBBER: Experiment with pure uncompounded India Rubber. Make tire patching cements, water proof cloth, porous tire filler, rubber stamps, etc. First latex Para (highest grade India rubber) 4 oz., 50c; 8 oz., 80c; 1 lb., $1.25; 5 lbs., $5.00. Address, Bunsen Supply House, 14 S. Canal St., Akron, Ohio.

EXPERIMENTERS.—This Ad pays for itself because Everyday Engineering Readers are our regular customers. Our chemicals, apparatus, and supplies outfit their laboratories. Why not yours? Ask for free pricelist and free service card. Lions Scientific Institute, Mt. Oliver, Pittsburgh, Pa.

Drafting

MECHANICAL DRAFTING, all descriptions, Inventions and models developed, lowest rates, personal and prompt attention. F. L. Miller, 36 Jewett Ave., Cortland, N. Y.

Educational

CIVIL ENGINEERING one year. Students received any time. Technical Institute, Greenville, Ohio.

Electrical

"DANDITOY" Transformers, 2½—27½ volts only $2.98. Description sent. Eagleco, Darien, Connecticut.

100 INDUCTION MOTOR winding diagrams 1, 2, 3, phase star delta. 2 to 12 poles inclusive. Postpaid $5.00. E. Glass, 2108 South Broad Street, Philadelphia, Pennsylvania.

CHRISTMAS TREE Lighting Outfits; 8 light $2.75; 16 light, $5.50. Send for list. Eagleco, Darien, Connecticut.

Fish

GOLD FISH. Imported Japanese, Chinese and American fish aquarium plants. We manufacture beautiful home aquariums. Descriptive circular free. Pioneer Goldfish Hatcheries, Racine, Wisconsin.

Formulas

10,000 TESTED FORMULAS; Cost 1c for 25, before ordering send for catalogue "KK"—today. Goodnow, Highland Ave., South Sudbury, Mass.

370 FORMULAS, 10c. Fitzgerald, 15 West 65th St., New York.

GUARANTEED Workable Formulas—$1.00 each: Mechanics' Hand Paste; Bluing Steel Parts (heatless process); Carpet Cleaning Paste; Fire Extinguishing Compound. Detailed method of preparation and sources of supply accompany all formulas. Industrial Methods Bureau, 1 West 34th Street, New York City.

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

MANUFACTURING PROCESSES, Formulas, Technical Information. Interesting booklet free. Consulting Chemist, Little Falls, N. J.

For Advertisers

"THE TEN GREAT SECRETS of a Successful Letter"—A wonderful little book in 10 short chapters by Ad-Man Davison, highest-paid advertising writer in the world. Cloth-bound, postpaid $1. E. B. Davison, Publisher, Dept. E., 512 Fifth Avenue, New York.

For Sale

100 6¾ ENVELOPES PRINTED to your order (2) colors, 75c prepaid. Write for Samples. Lincoln Novelty Co., Rochester, N. Y.

GENUINE INDIAN BASKETS—90 Styles. Catalogue. GILHAM, Highland Springs, California.

FOR SALE—Knapp Type SS Dynamo 6 volts, 4 amp., slightly used, $7.00. Red Devil Water Motor, $3.90. Slightly used tools and electrical supplies. Send stamps for list and prices. J. Norlie, 2158 Knapp Street, St. Paul, Minn.

FOR SALE. Scott Boiler and Turbine in working order. Adams, 163 De L'Epee Ave., Montreal.

NO. 29 GOODELL LATHE Outfits $25.00 Speedy and Oscillating, castings and Small tools for sale. Enclose postal. Steam and Water Gauge Parts also valves all for $1.50. Aitken, 1714 Brown St., Philadelphia, Pa.

FOR SALE. Every issue Everyday Engineering ever published. In good condition. Also complete line of wireless instruments. Bard L. Frankhauser, 179 Marcy Avenue, Brooklyn, N. Y.

For Sale

CALIFORNIA FARMS FOR SALE. Write for list. E. R. Waite, Shawnee, Oklahoma.

Gummed Labels

FREE CATALOGUE containing ideas in package labels suitable for your business. Stock labels a specialty. Royal Label Co., 29 S. Seventh, Philadelphia.

Help Wanted

WRITE for newspapers and magazines. Big Pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

CENSUS CLERKS; Railway Mail Clerks; Mail Carriers wanted by Government. Thousands men—women needed. $1100 year. Common education sufficient. List positions free. Urgent. Write today. Franklin Institute, Dept. L-99, Rochester, N. Y.

WE WILL START YOU in the cleaning and dyeing business, little capital needed, big profits. Write for booklet, The Ben-Vonde System, Dept. B, Charlotte, N. C.

THOUSANDS U. S. GOVERNMENT Census and Railway Mail Positions now open. Men, Women, 18 up. $1100—$1700 year. Common education sufficient. Write immediately for list positions. Franklin Institute, Dept. M 99, Rochester, N. Y.

GOVERNMENT positions highly desirable; thousands appointed annually through frequent examinations everywhere; prepare immediately for Post Office Clerk, City or Rural Letter Carrier, Railway Mail Clerk, Washington Departmental Clerk, Stenographer-Typist, unexcelled correspondence instruction at $5. Request particulars concerning positions desired. Federal Civil Service School, 604 Kellogg, Washington, D. C.

2000 GOVERNMENT Railway Mail Clerks wanted. Men, women, 18 up. $1300 year to beginners. Write immediately for list of positions open. Franklin Institute, Dept. N 99, Rochester, N. Y.

Inventors

INVENTORS. In all matters concerning Patents, The National Institute of Inventors, 118 Fulton St., New York City, a co-operative society of 2500 will help you protect, develop and market your inventions. Annual dues $10.00. Booklet on request.

INVENTORS—We do experimental, Model, Tool, Die and Jig work. Light manufacturing. Miller & O'Brien Mfg. Co., Saint Paul, Minn.

INVENTIONS WANTED.. CASH OR ROYALTY for ideas. Adam Fisher Mfg. Co., 223, St. Louis, Mo.

Machinery

VIOLET RAY MACHINES. Complete. Working Drawings $1.00. All parts ready to assemble $10.00. Satisfaction Guaranteed. J. Barwick, 89 Britannia Ave., Hamilton, Ont., Canada.

CONCRETE BUILDING Block Machines and Moulds. Free Catalogue. 200 South Second Street, St. Louis, Mo.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS; $110.00 a month to start and expenses; travel if desired; unlimited advancement. No age limit. Three months home study. Situation arranged. Prepare for permanent position. Write for booklet CM-86. STANDARD BUSINESS TRAINING INSTITUTE, Buffalo, N. Y.

Miscellaneous

WE MAKE GOVERNORS to control Auto and Cycle engines when used as stationary. Write today for circulars. C. D. H., Box 582, Dept. E., Taft, Calif.

CREATING A SENSATION. The Mack Sennett Bathing Beauties now appearing on the stage in the principal cities of the United States. Three splendid photographs 25c. Descriptive literature free. Mutual Supply Co. Publishers, Bradford, Pa.

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

SPORTSMEN.—Trained beagles, rabbit, fox, coon, skunk, squirrel, and opossum dogs, bird dogs, pet and farm dogs, swine, rabbits, pigeons, pheasants, goats.—100 Varieties blooded stock. Circulars 10c. VIOLET HILL KENNELS, YORK, PA.

$1.00 PAID for Volume 1 Numbers 4 and 5, Everyday Engineering Magazine. George Walter, 2312 Hughes Street, Brooklyn, N. Y.

Model Supplies

MODEL VENTILATORS. Height from 1½ to 2¾ ins. Diameter at mouth 1 in., ¾ in. and ⅞ in. Price $2.00. Polished copper lacquered. Menne, 74 West 89th Street, New York.

BOYS build your own Electric Motor. Complete outfit $1.75. Blue Prints 25c. A. F. Cassel, 52 West 130th St., New York City.

Motion Picture Plays & Supplies

$25-300 paid anyone for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

BARGAIN lists free. Motion Picture machines, film and supplies. National Equipment Company, Duluth, Minn.

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS — *Continued*

Patents

PATENTS. Over 70 years' practise; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., patent attorneys, 641 Woolworth Building, New York. 625 F Street, Washington. Tower Building, Chicago.

INVENTORS—Send sketch of your invention for advice regarding patent protection. Twenty Years' Experience. Hand-book on Patents sent Free. TALBERT & TALBERT. Patent Lawyers, 483I Talbert Bldg., Washington, D. C.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" FREE. Franklin H. Hough, 510 Loan & Trust Building, Washington, D. C.

PATENTS. Prompt, personal efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years actual experience, full information upon request. B. P. Fishburne, 322 McGill Building, Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers. Washington, D. C.

INVENTIONS PATENTED; Trade-Marks Registered; Labels, Prints, Publications Copyrighted; prompt service; reasonable fees; plain advice; request detailed information before placing your business. Jaynes & Jaynes, 504 Kellogg, Washington, D. C.

INVENTORS—Write for our free illustrated guide book, "How to Obtain a Patent." Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS—Herbert Jenner, patent attorney and mechanical expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

M. H. LOUGHBRIDGE, Patent Attorney Consulting Engineer. The same high class service that is obtained by the large manufacturers. Charges moderate. Designs and Manufacturing specifications prepared. 1457 Broadway, New York.

PATENT RIGHTS on Automobile Snow Plow: new, superior, all metal. For clearing highways. Attractive commercial proposition. Harry Clark, Woodbury, Conn.

Photography

DO YOU TAKE PICTURES? Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 466 Pope Building, Boston, Mass.

LIKE PHOTOGRAPHS? Real pictures? State wants, send dime for sample. Our lists free, over 800 negatives from all parts of the world. Gulf Curio Co., Houston, Texas.

DEVELOPING AND PRINTING of the highest class. Send your next Film roll to us. Developing 15c per roll. Prints 3 to 5c. R. E. McIntyre, General Post Office, New York City.

YOUR PHOTO and 30c gets 25 gummed stamp size Photos. Your photo returned. Work guaranteed. Muscatine Agency, E-402, Muscatine, Iowa.

Printing

100 LETTERHEADS or Envelopes, 85c; 100 Business Cards, 35c, prepaid; samples free. Wellmann Printing Co., Huntington, West Virginia.

Radio

YOU ARE NOT MODERN unless you read "The Radioist." "The Radioist" is a monthly amateur radio magazine, as original as its name; containing many novel departments and sure to please either novice or expert as it contains live, peppy articles interesting to both. You can greatly improve your set by reading the latest advanced ideas in "The Radioist." Yearly subscription $2.00. Special three months' trial subscription, 50 cents. (Stamps not accepted.) Be progressive. Send your subscription, regular or trial, immediately and receive the "New Year Issue" which will be a rip-roaring success. Delay means you're missing such so act now and subscribe today INTERNATIONAL SOCIETY OF RADIOISTS, OMAHA.

Rubber Stamps

RUBBER STAMPS. If not delivered in 5 days return to your name and address, 50c. Stamp pads 25c. Order direct or send stamp for circular. Albert Porch, 7939 Bennett Ave., Chicago.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

STAMPS SENT on approval at 70% discount. Reference required. J. Emory Benoll, Dept. W., Hanover, Pa.

100 STAMPS 5c, 200—10c, Buckey, 412-B Bowen, Dayton, Ohio.

JAPAN'S Stamp Dealer. Stamps of all countries. Purchase and sale or exchange on approval sheets. $1.00—$20.00 every mail. 40—400 Stamps in exchange, registered desired. Nakade Stamp Company, 26 Sakaecho, Hamamatsu, Japan.

VICTORY stamp packet 35c. Catalog value $1.50 to $2.00. All Different. A. J. Hotz, 1324½ Maple Ave., Los Angeles, Calif. NO STAMPS ACCEPTED.

50,000 COINS, Medals, Paper Money, Antique Fire Arms, Swords, Indian Relics, Curios, Stamp Collections. List free. Antique Shop, 33 South 18th St., Philadelphia.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Telegraph

TELEGRAPHY (both Morse and Wireless) **AND RAILWAY ACCOUNTING** taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School. Est. 45 years. Catalog free. Dodges Institute, 24th Street, Valparaiso, Ind.

Tricks

1,000 STAGE TRICKS with 500 illustrations. Catalogue 15c. Small Catalogue Free. Hornmann Magic Co., Station S, 304 West 34th St., New York.

Typewriter Supplies

RIBNSAVER makes dried, pale ribbons like new for one cent. 50c postpaid. Order yours today. Ribnsaver Co., 186 N. La Salle St., Dept. 13, Chicago, Ill.

Wireless

THE AUDION. Its early history and development, Electron Theory and Trigger Action. Compiled by a Chief Electrician Radio man who was situated at the Naval Radio School as Instructor for two years, written by an old amateur for the Amateurs in words that they can understand. Also Blue Print Diagrams for hook ups for Receiving Damped signals using both air exhausted and gas Bulbs. Receiving undamped signals and regenerative circuits. Two step Amplifier using same (A) and (B) Batteries for both steps. Wireless Telephony with a Power Bulb. Working Blue Prints on how to build a "One to One" transformer for use with Audion Amplifier. All for TWO DOLLARS. Address T. O. McKENZIE, 104 Warburton Ave., Yonkers, N. Y.

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¼" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotoy Electric, Charlotte, N. C.

WIRELESS. 22.5 Volts—15 cells B. Batteries—Standard Signal Corps, U. S. Army for Vacuum Tubes Type BA-2. Fully GUARANTEED, worth $1.50—our price 90c postpaid. State your wants in Receiving and Sending Wireless apparatus. We will quote very reasonable prices. The H. S. Wireless Co., 164 Ross St., Brooklyn, N. Y.

HIGH PRICES

OF APPARATUS ARE A HANDICAP TO MANY — EXPERIMENTERS —

Why not sell some of the things you need no longer, and put the money into new equipment?

Or have you instruments to exchange?

Thousands of experimenters read Everyday Engineering, so many that a single classified advertisement will bring you results, and at such a small cost.

THINK—WHAT CAN YOU BUY, SELL, OR EXCHANGE? TELL THE OTHER EXPERIMENTERS IN A CLASSIFIED ADVERTISEMENT.

MODEL MAKING

By Raymond Francis Yates

A New Book for the Mechanic and Model Maker Which is on the Press

Orders received now will be given immediate attention when the book comes from the press.

Price, $3.00

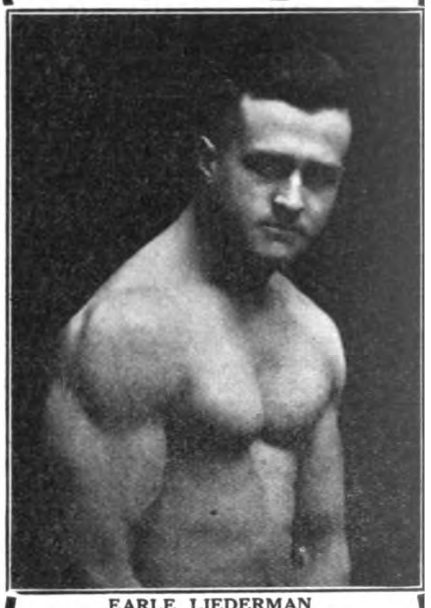
Bound in cloth with over three hundred half-tones and line cuts.

This is the first book of its kind to be published in this country and all those interested in model engineering should have a copy. The first eight chapters are devoted to such subjects as Silver Soldering, Heat Treatment of Steel, Lathe Work, Pattern Making, Grinding, etc. The remaining twenty-four chapters describe the construction of various models such as rapid fire naval guns, speed boats, model steam engines, turbines, etc.

This book must not be confused with those describing the construction of toys now on the market. It is a practical treatise on model engineering and construction.

NORMAN W. HENLEY PUBLISHING CO.
Dept. E.E., 2 West 45th St., New York

A Powerful Physique!



EARLE LIEDERMAN
The Acme of Physical Perfection.

A 48-inch chest and 16½ inch biceps!

HAVE THEM. HAVE YOU?

Hundreds of my pupils have obtained these measurements and many of my pupils have exceeded them.

Why not let me do the same for you?

My methods never fail to produce results quickly.

I BEGIN WHERE OTHERS LEAVE OFF.

I PRACTICE WHAT I PREACH.

MY NEW BOOK

"Muscular Development"

will explain all about my system and will interest you.

It is illustrated with 20 full-page photographs of myself and of some of the finest developed athletes whom I have trained. If you have not as yet read this book by all means get a copy.

Simply Tear Off Coupon Below and mail to me with 10c (stamps or coin) and you will receive your copy promptly.

EARLE E. LIEDERMAN
Dept. 705, 203 Broadway, New York City

TEAR OFF COUPON — DO IT NOW before you forget it.

EARLE E. LIEDERMAN,
Dept. 705, 203 Broadway, N. Y. City.

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write plainly.)

Name .....

Street .....

City ..... State .....

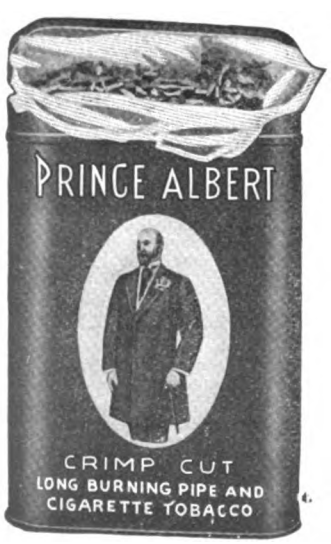
Eng. Nov., 1919

Digitized by Google



P. A. has such a joy'us way of making men glad about jimmy pipes!

Awaiting your say-so, you'll find toppy red bags, tidy red tins, handsome pound and half pound tin humidors—and—that classy, practical pound crystal glass humidor with sponge moistener top that keeps Prince Albert in such perfect condition!



To shoot it quick:—Prince Albert turns over a new leaf in your smoke-career! Shovels smoke-sorrows right out the attic airshaft and throws wide open the smoke-section-shutters! Talk about letting in a flood of smokesunshine! Bet your pet luckystone that the best you ever heard tell about can't hold a candle *with what Prince Albert will hand you* seven days out of every week! And, then, some-on-the-side!

Smoking Prince Albert is just about twins with having the top time of your life on each fire-up! *It gives you a new idea of how delightful a jimmy pipe or a home-rolled cigarette can be!* Such flavor and fragrance and coolness; such freedom from bite and parch! Prove out personally that Prince Albert's exclusive patented process *really does cut out bite and parch!*

Talk about ringing the bell every time you take *just one more little* smoke! You'll agree with your old fellow citizen, General Approval, that Prince Albert puts a man on the firing line with a pipe or cigarette, *and keeps him there;* that it sends all previous smoke setto records to the rear-ranks; that it just slams in one good time on top of another *so* fast, *so* happy-like, you realize that heretofore you've been hunting regular-man-sport with the wrong ammunition!

R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 8 NOVEMBER and DECEMBER 1919 NUMBERS 2 and 3

Electric Furnaces and Their Products

By Raymond Francis Yates

TWO centuries have passed since Sir Humphrey Davy "struck" the first electric arc. Barely a quarter of a century has passed since the first electric furnace capable of performing a serviceable day's work was put into operation. To-day the electric furnace has been applied to a multitude of industries. In some instances, as in the steel industry, it has taken the place of fuel-heated furnaces. In other cases it has made possible the creation of a new product which could not have been produced with the heat made available by any known process of combustion.

Wondrous changes are wrought within the glowing radiance of the electric furnace. Solid matter is made liquid, and liquid gaseous. Under the influence of a terrific heat chemical changes of combination and decomposition are brought about that would otherwise be impossible. For many years chemists dreamed of melting carbon. Moissian not only melted it; he boiled it! Nothing can withstand the continued application of the tremendous heat produced by the electric arc. In a sense, the electric furnace is probably one of the most destructive of earthly agencies. At least this is the belief of scientific men. No solid matter, regardless of its refractive properties, has been able to hold its identity within the electric furnace. There is no heat so terrible, so cruel and disruptive as that generated by the electric arc.

Electric furnaces are divided into three classes, *i.e.*, arc., resistance and induction. An electric arc is established when two electrodes of different potential are brought in contact and withdrawn. Thus, when two carbon electrodes are brought together to complete an electric circuit considerable heat is developed for the instant at the point of contact. This vaporizes a small amount of carbon which fills the space between the electrodes when they are separated. Current will continue to flow across this space, generating a terrific heat. The hot carbon vapor reduces the electrical resistance of the space between the arc from many thousand ohms to a few ohms. The quantity of heat generated will depnd entirely upon the current strength.

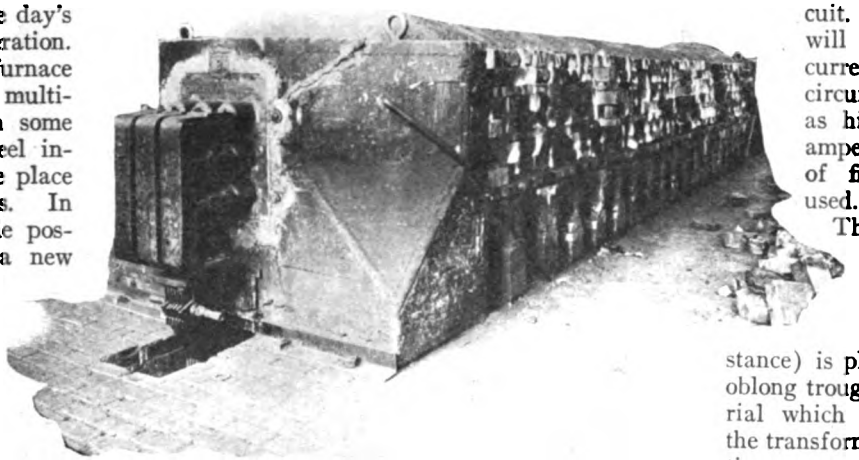


Photo Courtesy Acheson Graphite Co.

A resistance furnace used in the production of Acheson graphite. The highest temperature developed commercially is produced within the walls of this furnace

The electric furnace has fast grown to be a great and useful device in the industry of the world. Many wonders are wrought within its walls. In the blinding whiteness of its cruel, destructive heat chemical processes are brought about that could not be accomplished by any other known process. Through the medium of the electric furnace, Nature has been forced to yield some of her most guarded elements and compounds. This article, with the limited space it occupies, can be nothing more than a brief resumé of the great work that has been done in the field of electro-thermics.

Resistance furnaces bear no resemblance to those of the arc type. Heat is produced by interposing some resisting material in an electric circuit. The heat generated will be governed by the current strength of the circuit. A current strength as high as ten thousand amperes with a pressure of fifty volts has been used.

The main part of an induction furnace is a transformer. The charge (which must be a conducting substance) is placed in a circular or oblong trough of refractory material which encircles one leg of the transformer and thereby functions as a short-circuited secondary. The induction furnace is not used to any great extent in America.

Arc furnaces are divided into two classes. Where the arc is drawn between one or more electrodes and the metal charge, the furnace is said to be of the direct heating type. Furnaces where the charge is heated by radiation from an arc established between two electrodes within the furnace are said to be of the indirect heating type.

Carborundum was one of the first products of the high temperature electric furnace. Dr. Edward Goodrich Acheson was the man whose genius gave this wonderful commodity to an awaiting world. Chemically, Carborundum is known as silicon carbide, which is expressed by the formula SiC. Its production is brought about by the reaction between the element silicon (in the form of silica or sand) and carbon in the form of coke. This reaction takes place within the confines of what has become known as "Carborundum furnace," which is a resistance furnace of the most simple and rugged type. A large graphite electrode is placed at each end of a long trough-shaped structure made of fire bricks or

Digitized by Google

other highly refractory material. The resistance, which consists of ground coke, is interposed between the electrodes in the form of a round core. The charge is packed about this core and a refractory substance is placed between the charge and the furnace walls to prevent serious heat radiation and destruction of the walls by the exceedingly high temperature produced when the furnace is in operation.

A current strength of several thousand amperes is sent through the charge in the furnace under a pressure of from 80 to 110 volts. Under the influence of this great rush of current the core in the furnace soon reaches a tremendous temperature in the neighborhood of 2000 deg. C. The production of this temperature is accompanied by violent chemical decomposition and complete rearrangement of the elements within the charge. The more volatile substances succumb to the heat and the inflammable, gaseous products burn quietly at the furnace sides. In the interior of the furnace there is a fiery mass of blinding whiteness; in fact, the charge is brought to the point of incandescence. If it were not for the fact that it was smothered in a bed of refractory materials the charge would soon be consumed by the process of oxidation.

After thirty-six hours of operation the current is turned off and the furnace is allowed to cool. The sides are then taken away and a large core of still red-hot Carborundum crystals is bared to the atmosphere. As the cooling continues great masses of sharply pointed, iridescent crystals are in evidence. These are the crystals of Carborundum, second in hardness only to the diamond. Carborundum is the greatest artificial abrasive known and little can the layman appreciate the great value of this substance to industry. Carborundum is used in grinding steel rails and pearl buttons; it is used in grinding leather as well as glass. In fact, even the little wheels that buzz against our teeth in the dentist's chair are made of Carborundum.

It was while experimenting with the production of Carborundum that Acheson accidentally carried the temperature of his furnace too high. The result of this accident was the production of artificial graphite, a substance which has since done the world a wealth of good. If the temperature of Carborundum is carried too high the silicon is unable to withstand the increase and escapes in a volatile condition. This leaves the carbonaceous portion of the charge in the form of soft, unctuous graphite which is capable of withstanding the high temperature.

The graphite furnace is essentially the same type as the Carborundum furnace. In operation, however, the temperature of the graphite furnace is brought to a point considerably above that produced in the Carborundum furnace. As will be seen from the photograph, great copper bars carry the heavy current to the electrodes which are embedded in the concrete end blocks of the furnace. A number of large graphite rods form the electrodes.

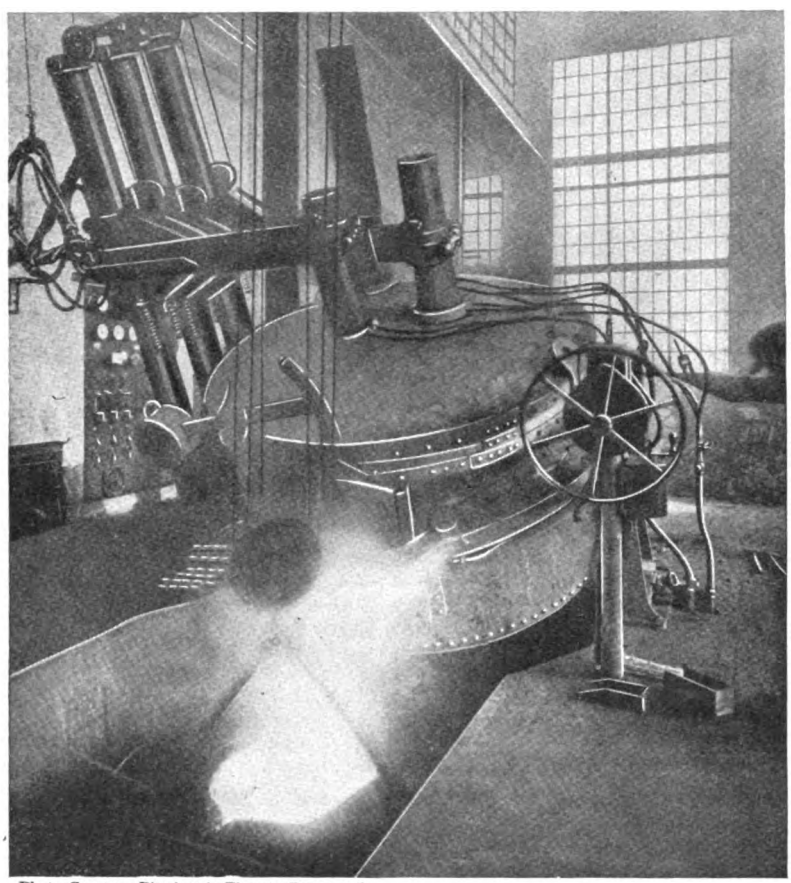


Photo Courtesy Pittsburgh Electric Furnace Co.

A small steel furnace pouring its charge

Silicon is another product that had its birthplace in the unconquerable heat of the electric furnace. The process of producing silicon electro-thermally is due to Mr. Frank Tone, a metallurgist of international fame. Unlike Carborundum or graphite, silicon is produced in a furnace of the arc type. The process is that of reduction. Carbon in the form of coke is placed in the furnace, together with silica. The reaction is one of substitution. The silica, unable to withstand the reducing action of the carbon, decomposes and thus liberates its silicon. The oxygen in turn combines with the carbon, producing carbon dioxide and mono-oxide. The silicon continuously runs forth from the spout of the furnace in a little fiery-red stream.

Aluminum was at one time a metallic rarity. Men gazed at small samples of it enviously through the glass cases in the museum. The furnace in which aluminum is produced does not in any way resemble the more conventional types. In fact, it is really an electrolytic cell maintained at a high temperature. The electrolyte is composed of a molten mass of cryolite and alumina. This molten mass is held in a large rectangular steel case heavily lined with carbon. Two large electrodes are introduced through the top of the device and these make contact with the charge. During the operation the alumina is decomposed into aluminum and oxygen. The aluminum collects at the bottom of the furnace in a fused condition. The aluminum furnace, or what is better known as the Hall furnace (named after its inventor) does not employ an arc in any way, the required heat being produced by the resistivity of the charge. The normal operating temperature of this furnace is in the neighborhood of 1,600 degrees Centigrade.

Calcium carbide was first produced by Wilson. Like many other discoveries of note, its first production was purely accidental. The Wilson carbide furnace is a very interesting but simple type. A large iron crucible mounted upon a truck and heavily lined with carbon forms the body of the furnace. Suspended above this are two graphite electrodes so arranged that they can be adjusted vertically. The charge in the furnace consists of powdered lime and coke. The arc is drawn between the molten mass of carbide and the two electrodes. The potential difference between the electrodes is 175 volts. The current strength is 3,500 amperes.

The chemical reaction which is brought about within the furnace between the powdered lime and coke follows: $CaO + C = Ca + CO_2$ and $Ca + 2C = CaC_2$. The molten carbide forms a pool at the bottom of the furnaces.

A great number of these electric furnaces are operated at Niagara

Digitized by Google

Falls, N. Y., which is the greatest electric furnace center in the world. This is because cheap electrical energy is available in great, but on the other hand, limited quantities.

It was in the year 1898 that Capt. Stassano produced the first real workable electric furnace for the production of steel. Today, there are hundreds of such furnaces in operation wherever cheap power is available for their operation. In fact, they have been developed to such a point of efficiency that they are being operated in many localities where power is not cheap. The production of steel from metallic ingredients is brought about in furnaces which greatly resemble the open hearth furnace in their action. A number of these are used for the fusion of pure materials in the proper proportion for making steel. These materials are pure pig iron, wrought iron or molten steel. Other furnaces are employed in melting together pig iron, steel scrap and ore. Furnaces of this type are always made with a basic lining to allow the removal of phosphorous and sulphur from the steel by limey slag.

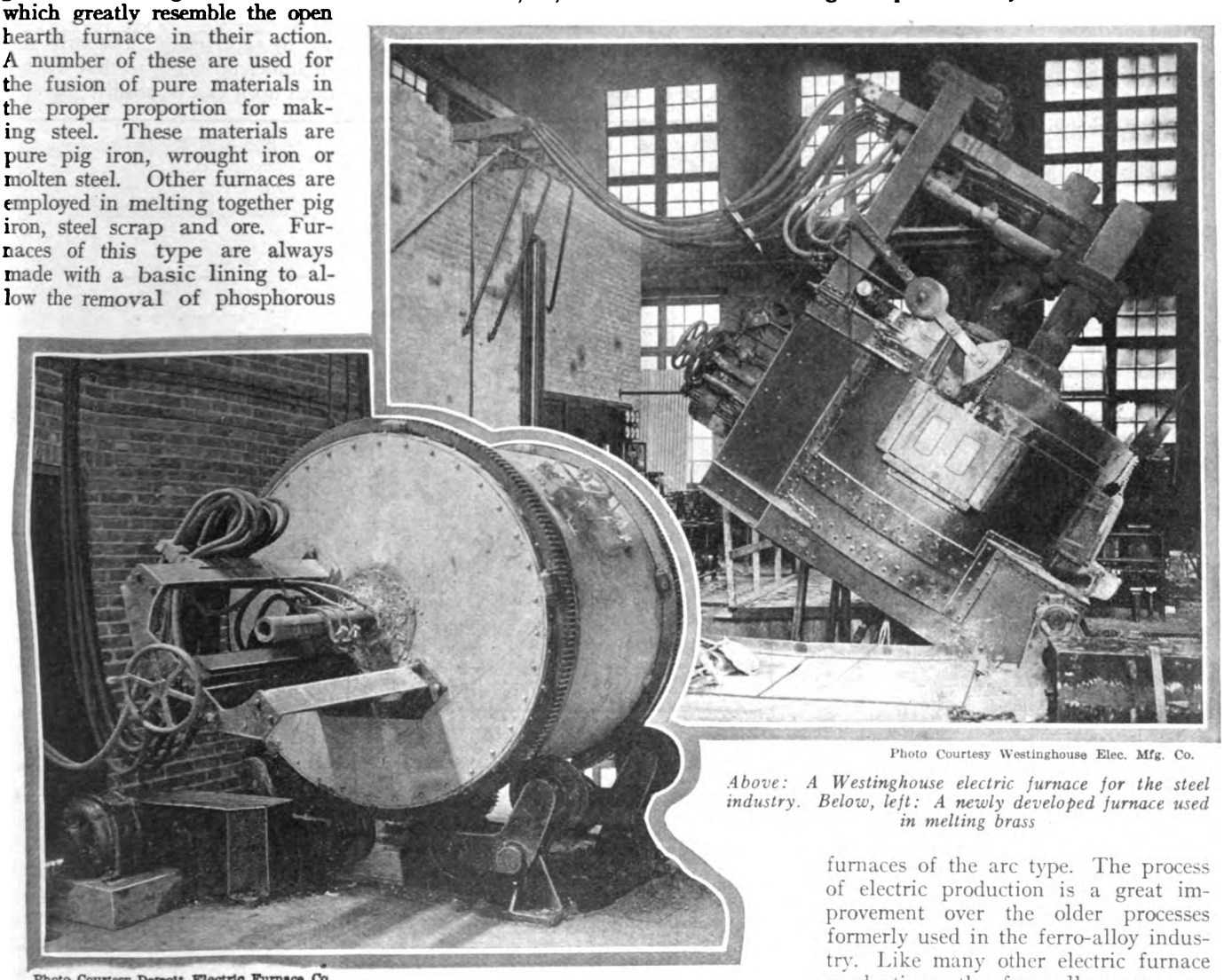


Photo Courtesy Detroit Electric Furnace Co.

Photo Courtesy Westinghouse Elec. Mfg. Co.

Above: A Westinghouse electric furnace for the steel industry. Below, left: A newly developed furnace used in melting brass

Steel furnaces of the arc, induction and resistance types have been developed. In America the Héroult furnace has gained considerable popularity. This furnace is of the series arc type. Two large electrodes pass through the roof and arcs are drawn between these and the metallic charge. In this way the current passes in the furnace through one electrode and out through the other. The Héroult furnace is encased in a steel shell lined with dolomite bricks and crushed dolomite. The roof is made up of silica bricks. The hearth of the Héroult furnace which is exposed to the molten charge, is made of burnt magnesite. To prevent excessive oxidation of the electrodes a water jacket is placed around them at the point where they enter the furnace. By the circulation of water through these jackets the temperature of the electrodes is kept fairly low. When the charge is ready to pour the furnace is tipped by mechanical means.

The electrode regulation of the Héroult furnace is entirely automatic. If the arc becomes too long, the electrode is lowered, or, if the arc becomes too short, the electrode is raised. This happens without the attention of the furnace attendant.

There are a number of different types of electric furnaces in America. They all have their advantages and disadvantages like many other things. It would require more space than is allowable to completely describe the outstanding features of the various steel furnaces in use. They range all the way from one ton capacity to the great giants that are able to accommodate twenty tons as one charge.

A few years ago carbon disulphide was produced by passing sulphur vapor over red hot charcoal. Thanks to the ingenuity and resourcefulness of one R. E. Taylor this product is now being produced abundantly and cheaply with the aid of the electric furnace. It is one of the many products that has been cheapened through the medium of the electric furnace.

A great quantity of ferro-alloys are used annually in the steel industry for deoxidizing steel to produce sound ingots. These alloys include ferro-silicon, ferro-chrome and ferro-manganese. Such alloys are now produced in great quantities by means of electric furnaces of the arc type. The process of electric production is a great improvement over the older processes formerly used in the ferro-alloy industry. Like many other electric furnace productions, the ferro-alloys are produced in enormous quantities at Niagara Falls.

Phosphorous is produced within the electric furnace by heating phosphoric acid with some form of carbon. The resulting vapor is distilled and condensed outside of the furnace. Owing to the fact that the process of producing phosphorous must be carried on without the presence of air this operation is nicely adapted to the electric furnace.

Within the last few years a furnace has been developed in which brass can be successfully melted. This has been

Digitized by Google

the aim of metallurgists for some time. Mr. H. W. Gillett of the United States Bureau of Mines must receive the credit for having designed one of the most successful electric furnaces for the melting of brass.

A furnace used for melting brass must of necessity have many unique features owing to the peculiarity of the service which it is required to render. The speed of production depends largely upon the rate at which heat can be produced within the furnace without serious injury to the refractories from the metal under treatment.

One of the most important items of cost in melting copper alloys which contain large percentages of zinc and lead is the loss of metal through vaporization and oxidation. It is quite impossible to entirely eliminate this loss, but on the other hand, it is possible to reduce it to a minimum by melting the alloy in a tightly closed furnace chamber in the presence of a neutral or reducing atmosphere. In the ordinary fuel heated furnace there must be a constant draft.

The rocking electric furnace for the melting of brass which is shown in one of the photographs accompanying this article is really one of the greatest triumphs of electro-metallurgy. The furnace shown consists essentially of a cylindrical steel shell lined with refractory substances and mounted on rollers and ring gears in such a way that it is free to move within an arc of 200 degrees. The rocking motion during operation is produced by a small motor through the proper reducing gears. The sourc of heat in this particular furnace is an electric arc drawn between two graphite electrodes placed axially within the furnace. These electrodes are regulated by wheels. The arc is produced in the exact center of the furnace.

When the furnace is charged the electrodes are withdrawn and only their tips are flush with the inner walls of the furnace. This is to prevent them from being broken by the heavy pieces of metal that are dumped into the furnace. During the first few minutes of operation the furnace remains still since rocking it at this state would probably break the electrodes. After the heat has been applied for some time and the metal becomes soft the rocking motion is started, first through a small arc and gradually increased until the metal becomes completely molten. During this rocking motion the molten metal washes the inner lining of the furnace to within a few inches of the charging door. Two complete oscillations are made per minute. As the molten metal washes over the refractory lining any excess heat which the lining may have is directly absorbed by the metal and put to a useful purpose.

Making Copper Gauze Motor Brushes

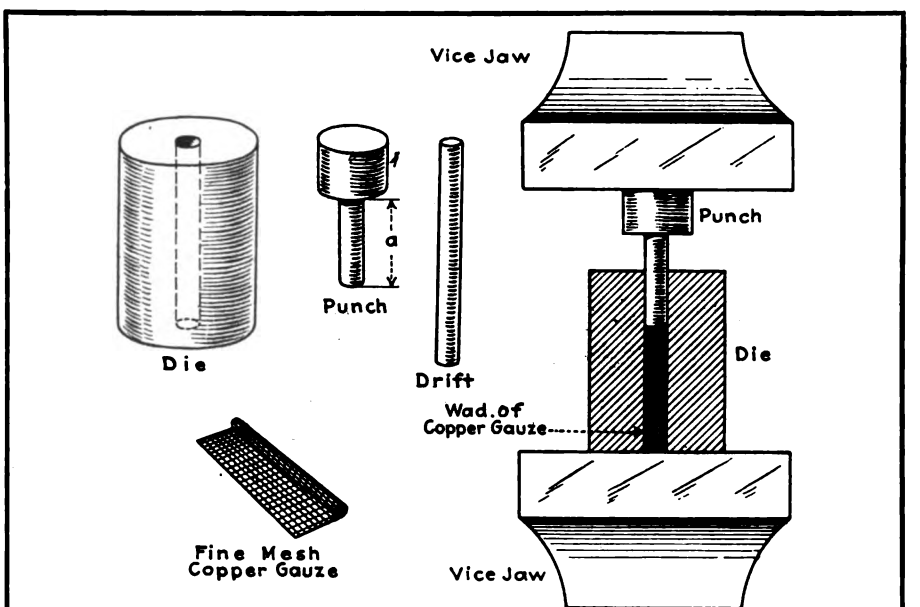
By J. A. Weaver

COPPER guaze brushes are widely used on the smaller sizes of motors and dynamos, especially low voltage machines where the high resistance of a carbon brush is not suitable. No doubt most experimenters think it is beyond their means to make their own brushes and it should be interesting to learn how easy it can be accomplished with the aid of a simple home-made device.

First, it is necessary to make a die in which the brushes are formed. There are several types that can be employed, but, as it would require considerable trouble to make a split die without proper shop facilities, the simple one piece die illustrated in the drawings was selected, as it can be easily made with the aid of a small lathe, and serves the purpose admirably. Cold rolled steel shafting will do for the material. A piece of shafting of suitable diameter should be cut about twice as long as the length of the brush desired, and its ends faced off square. Next, a hole the same size and shape as the cross section of the brush to be made is formed in the center of the shafting. This should extend through its entire length. In the case of a round brush, this is a simple matter. Then a punch or follower should be made with an easy sliding fit for the die. The length of the portion A from the shoulder to the end of the punch should equal the length of the die minus the length of the finished brush. The ends of this punch should be faced off square. A drift the same size as the punch, but a little longer than the die, should be provided for ejecting the finished brush. These parts and the method of using the same are clearly shown in the drawings.

The copper gauze used, especially for the smaller sizes of brushes, should be of as fine a mesh as can be obtained and the experimenter should experience little trouble in obtaining a suitable grade from any hardware or supply house. A strip of gauze is cut with a width about twice as great as the length of the finished brush, although the exact width necessary to use in order to make a finished brush of a certain length depends upon the pressure applied in forming and can only be determined by experiment. The strip should be of sufficient length so that when it is wadded up it can be readily forced into the die. After the wad is pushed in the die the punch should be started in behind it. Then the outfit should be placed between the jaws of a vise and pressure steadily applied until the shoulder of the punch rests against the face of the die. The wad will then be fully compressed. Then the punch should be removed and the brush ejected by means of the drift. When the diameter of the punch is very small and there is danger of it buckling under the pressure necessary to compress the gauze then it can be driven in by light blows from a hammer. It is well to keep the punch and die well lubricated.

In compressing the copper gauze, it will be found that a tremendous pressure can be exerted by means of the vice. It must be remembered that a vice is really a combination of the screw and lever.



The copper gauze brush is better, for small machines, than carbon on a flat metal brush

Digitized by Google

The Everyday Engineering Cup Races

Speed Boat Contest at Central Park Causes Lively Competition

ON the 21st of September, the EVERYDAY ENGINEERING MAGAZINE cup races were run off at Central Park. A large, enthusiastic crowd of spectators were present and everyone thoroughly enjoyed the event which was not without its exciting, as well as amusing, moments.

Mr. Raymond Francis Yates, Editor of EVERYDAY ENGINEERING, framed the racing rules to which the model boat owners adhered to closely. The rules were as simple as possible. The boats were raced separately around a circular course 300 feet in circumference. Each boat had to make three laps. The owners were each given a half an hour to make their boats cover the required distance. The boat that made the three laps with the lowest total of seconds was the winner. Thus, a boat making three laps with 15 seconds for the first, 12 seconds for the second and 11 seconds for the third, which would produce a total of 38 seconds, would win over a boat that made the three laps at 15 seconds a lap, giving a total of 45 seconds.



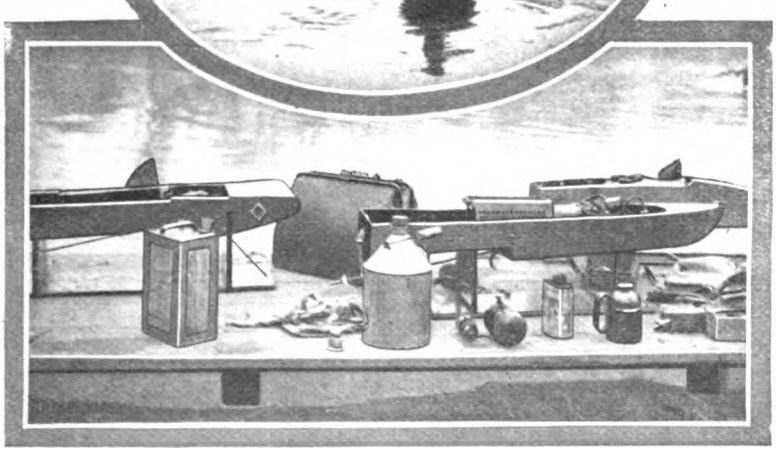




Part of the crowd. From left to right seated: Mr. J. Berg, Commodore C. P. M. Y. C.; H. Griffiths, Secretary; R. F. Yates and M. B. Sleeper

Some of the entries. Mr. Fischer, who is in the center, under a sudden impulse of enthusiasm and excitement, jumped into the water without waiting to put on his waders





Some of the boats and running equipment. The center oval shows an exciting moment during the races. Mr. Rapp's boat stalled on the third lap with 24 seconds to finish

The rules stated that it was not necessary to make three continuous laps. Time could elapse between the laps, providing they were all run off within the half hour allowed. None of the boats that entered the race ran for three continuous laps without an interval of time in between.

Mr. J. Fawcett Rapp's speed hydroplane "Elmara V" won the race. Her time was 15 seconds, 17 seconds and 24 seconds, for the first, second and third laps, respectively. This gave "Elmara V" a total of 56 seconds. The boat was not making her usual speed and the time by no means represents the best she can do. It seems that just at the time the owners of the model power boats want them to perform their very best, they slack off and make a very poor showing.

Mr. Harry Johnson's boat "Ex Calibur" came very near winning the cup. She had covered two continuous laps at a speed of 15 seconds per lap, and at the beginning of the third lap she burst into a marvelous speed. Mr. Yates, who was the official timekeeper, had timed her for six seconds for three-quarters of the third lap. At the very moment when it looked as if the third lap was to be made in record time, a small piece of wood fouled her propeller and stalled the engine. Further efforts were made to coax "Ex Calibur" into making the third lap, but she suffered such severe strain owing to her accident, that this could not be done within the time allowed.

"Whiz Bang," a boat owned by Mr. Clarence Johnson, refused to function properly after many attempts to make her do so. "Bo-Bo," a neat little craft owned and operated by Matthew Bolles, had a cranky power plant and although her owner made a desperate effort to put her into running order, she only made one lap successfully. (*Contd. to page* 132)

Digitized by Google

Adjusting and Flying Model Airplanes

By H. C. Ellis

A great deal of success in flying models depends, as in full-sized machines, in thoroughly understanding the principles under which they operate. It takes practice to acquire the feel and balance of the machines; so is the case in flying model aeroplanes; their principles of operation should be well understood to secure good results. It is practice that helps in everything; building and flying model airplanes is no exception to the rule. Once you understand the principles of model flying you will never lose interest, it is so fascinating and its possibilities so varied and interesting. Almost every time you fly a model you learn something new, and every success or failure teaches its lesson to the observant experimenter.

Take care to see that everything is constructed exactly as indicated, if building from plans. See that all planes are true and parallel to one another, all rudders and stabilizing surfaces straight. Holding the model balanced in the right hand throw it steadily horizontally against the wind. Adjust as explained below until it will glide on a level keel to the ground.

To test the model, first wind its motor up about half the number of revolutions ordinarily used and then launch from the hand against the wind, being careful to observe its action, so as to adjust it accordingly.

If, after leaving the hand, the model exhibits a tendency to dive, it shows that it is head heavy; that is to say, there is not enough lift in front. This is easily corrected by sliding the main plane forward to increase the lift in front.

If, on the other hand, the model climbs too much, it shows that it is tail heavy, in which case just the reverse procedure is used—i. e., shifting the main plane back to increase the lift in the back. Putting a small weight either in the front or back, as the case requires, will help, but is not advisable if shifting the plane will give the required balance.

If the model tips over sideways, either to the right or left, it is probably due to the torque or twisting tendency of the propeller or faulty alignment of the main planes, tailplane or rudder, or, in the case of a double propeller machine, one propeller being wound up more than the other. This last cannot be the fault if a double winder is used, as both propellers are turned the same number of revolutions.

To correct this tipping and swerving sideways it is only necessary to increase the angle of the main plane on the side that the model tips over or swerves. This is done by bending the rear corner of the low wing down and bending the rear corner of the opposite wing upward a bit. This corresponds to warping the planes in a large machine. Adjust rudder to turn machine to the other side. If these few simple rules and instructions are studied and followed out you will soon grasp the principles of model flight and there should be no limit but the reader's mechanical skill to the varied and interesting models one can construct and fly with perfect success.

TWENTY-FOUR-CYLINDER LIBERTY ENGINE

As a result of experimental work at McCook field, a 24-cylinder engine, built largely of Liberty 12 engine parts, has been successfully completed. But few changes were necessary, these being in the crank case and connecting rod construction. The figures given were furnished by the Army Air Service:

Horse Power (Normal)

Liberty 24... 673 Liberty 12... 400

Pounds Per H. P. (Dry)

Liberty 24...1.97 Liberty 12...2.11

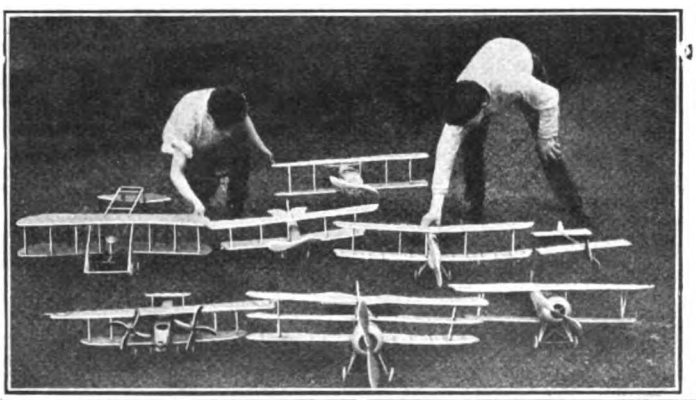
Gas Consumption (Pounds) Per H. P. an Hour

Liberty 24...0.55 Liberty 12...0.51

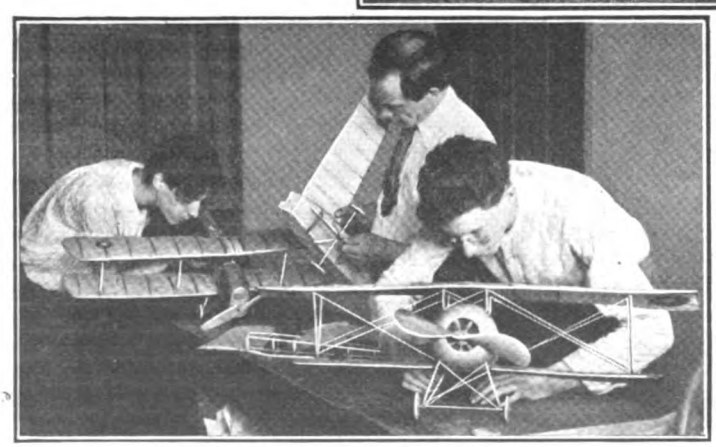
An engine of this power, if run at the normal speed, would permit the use of a comparatively large slow-speed propeller without gear reduction, thus increasing propeller efficiency.

The first air delivery of late mail for outgoing ocean liners was ingeniously accomplished recently when the pilot of a flying boat dropped a pouch on the White Star liner *Adriatic*. The feat was successful despite adverse weather conditions and a heavy sea and the ship was reached an hour and a half after it had left port.

The manufacture of scale models for instruction purposes is an industry of some importance. Below, workmen are shown putting finishing touches on miniature D. H. 4 and Nieuport airplanes



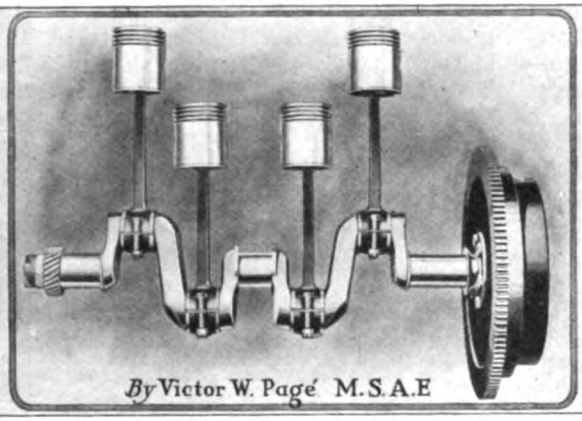
Practically all leading airplanes have been reproduced in model form. In the group at the left, there is an early Wright, a Handley-Page, Sopwith triplane, D. H. 4., Nieuport biplane and others





Digitized by Google

FITTING AND ADJUSTING CONNECTING ROD BEARINGS



By Victor W. Page M.S.A.E

THE experienced motorist will always seek the cause for any strange noise in the car motor. A most common noise is "knocking," a sharp metallic clank easily noticed by even the untrained ear. The causes are: Running with spark lever too far advanced with engine at full load, too rich mixture, carbon deposits, loose valve tappets or loose bearings at crankshaft, either at the main bearings where the shaft revolves in the crankcase or at the connecting rod journals. Sometimes loose wrist-pin bearings cause noise. If a motor has a tendency to heat up abnormally and knocks only after it has been run a while, this is usually caused by excessive deposits of carbon. Loose valve operating mechanism causes a clicking noise and is not so sharp as the knocking caused by loose bearings.

A loose connecting rod bearing makes a clattering noise that increases with the speed and is especially noticeable if the cylinders are short circuited in turn. The knock occurs twice each revolution of the crank shaft. With the bottom of the crank case removed as shown at Fig. 1, it is very easy to determine which bearings are loose.

There is nothing so important as the proper taking up of motor bearings when necessary. It has been noted that many automobile motors have been seriously damaged through carelessness of operators in doing this work. Bearings should not be allowed to run loose for any length of time. When the pounding is first noticed time should be taken to properly take up the bearing. If the bearing is allowed to pound it will not only flatten the crank pin (under which condition it is impossible to fit a new bearing to operate satisfactorily without trueing the shaft), but it is destructive to the entire engine.

Connecting Rod Big Ends

Fitting and adjusting rod bearings, especially those at the crank pin end, is one of the operations that must be performed several times a year if a car is used to any extent. The common form of connecting rods in general use is known as the marine type and is clearly shown at Fig. 2. In this one or two bolts are employed at each side and the cap must be removed entirely before the bearing can be taken off of the crank pin. The tightness of the brasses around the crank pin can never be determined solely by the adjustment of the bolts, as while it is important that these should be drawn up as tightly as possible the bearing should fit the shaft without undue binding, even if the brasses must be scraped to insure a proper fit. The marine form of connecting rod usually has a number of liners or shims interposed between the top and lower portions of the rod end and these may be reduced in number when necessary to bring the brasses closer together.

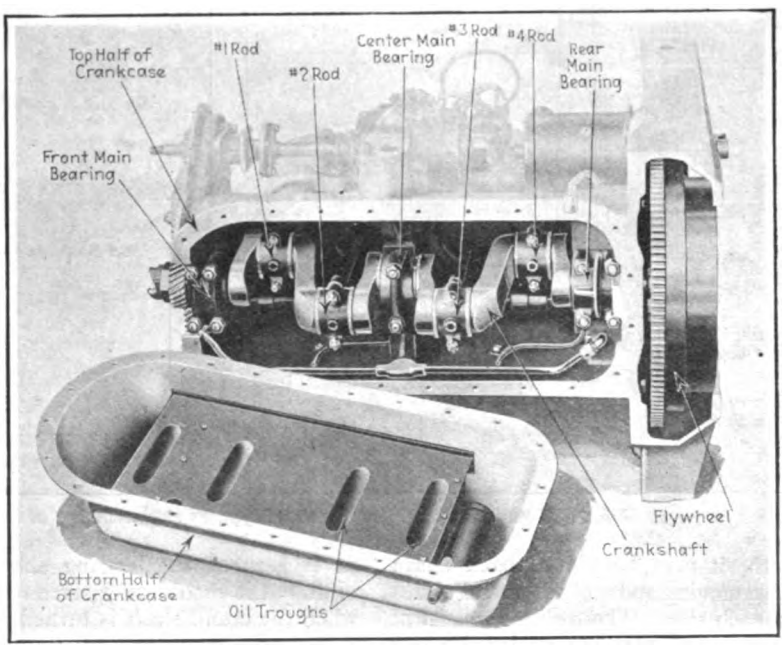


Fig. 1. Bottom half removed from four-cylinder automobile engine to expose connecting rods

On the new eight and twelve cylinder V type engines which are fitted on several models of modern cars, the connecting rod design is different from that ordinarily used, as it is always necessary to have two rods working from the same crank pin. The construction follows very closely that used in motorcycle engines of the two-cylinder V form. Two methods of connecting rod arrangement are shown at Fig. 2. In the example at the top of the illustration, one connecting rod has a forked end which encircles the main crank pin bushing. These ends are of the usual marine type, straddling the big end of the other rod which is free to oscillate on the crank pin bushing. Care must be taken to fit rod A in such a manner that it will be clamped tightly around the end of the main crank pin bushing so that member will move in unison with rod A. The method outlined in the other view uses a master or main rod of the conventional pattern, excepting that a slotted boss is forged on one side of the connecting rod to take the lower end of the short rod which hinges on a suitable bearing pin. The crank pin bearing works in connection with main rod just as in a four-cylinder engine, and the point to be watched for wear is at the hinge where the short rod fastens to the main member. The same method of fitting brasses to be described in connection with the conventional forms of bearings apply just as well to the special type, though somewhat greater care will

Digitized by Google

be necessary in fitting the yoke or forked end rod construction than is required with the simpler bearing subject to wear only at its inner periphery. If the depreciation is at all pronounced, bearings in rods of the "scissors" or forked type should be replaced with new ones.

To Tighten Big End Bearings

When the bearings have become loose from wear but are not damaged from lack of oil or from actual cutting and the bearing surface is smooth it is only necessary to tighten it. After removing the nuts (a special socket wrench may be obtained to fit these nuts) and taking the bearing cap off, the condition of the bearing may be determined. If

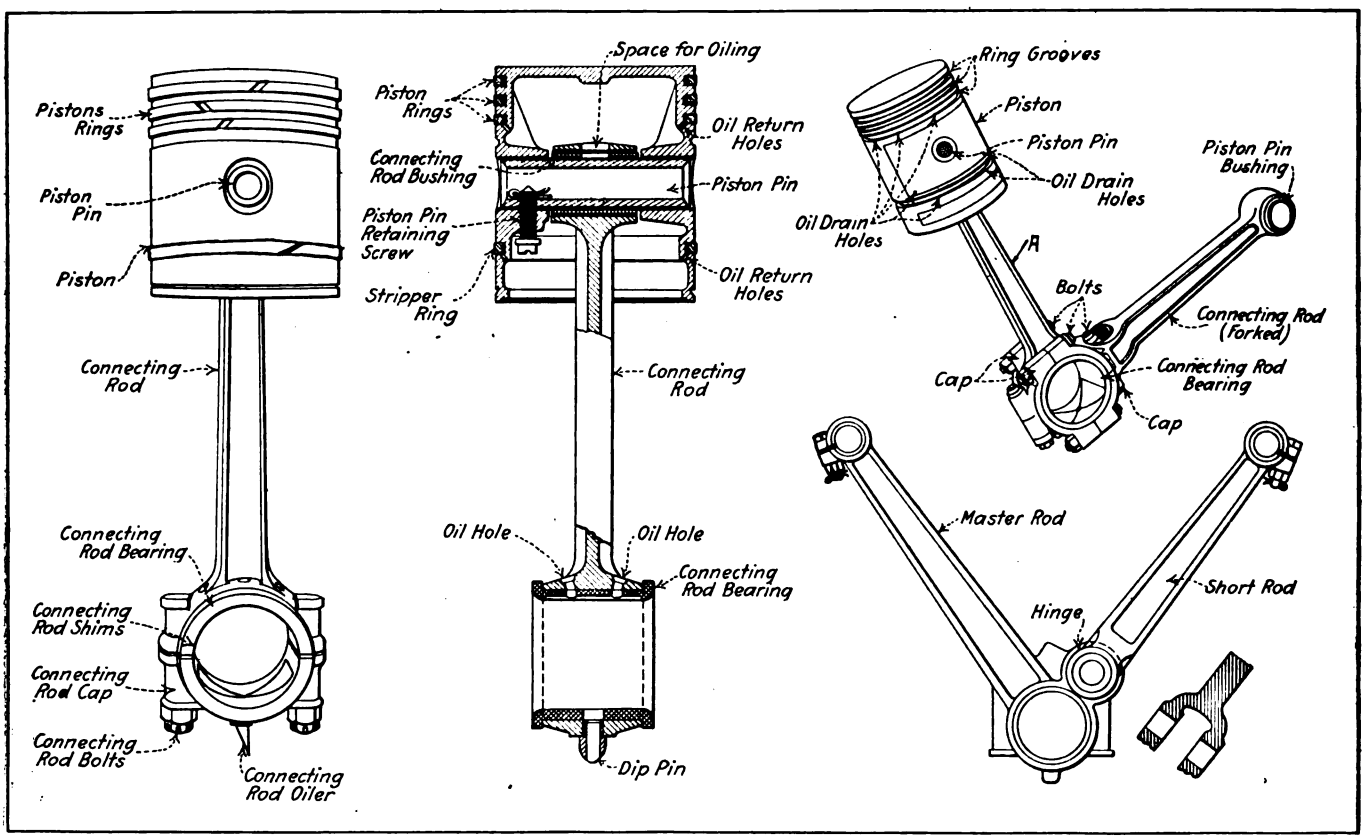


Fig. 2. Connecting rods for the usual type of engine shown at left and for V type outlined at right

smooth, it may be placed back again after removing some of the metal shims from each side. These shims consist of a number of thin pieces of metal which may be separated until the desired thickness is secured. Good judgment should be used as to the thickness taken off and also that the same amount is removed from each side. Be sure to place the caps back the same way they came off. Serious consequences might result if bearing caps were changed or turned around.

After bearing has been set up and nuts drawn up tight, take a hammer and a block of wood and pound the lower part against the shaft. Be careful not to hammer directly against any of the parts or bolts, or injure the small pipe in lower cap, but use the wood against the metal. This will have a tendency to press out slight inequalities and will loosen the bearing slightly. The motor should then be turned over by the crank or fly wheel if that member is exposed. By rocking it back and forth over center you can determine if bearing is too tight by the resistance it offers, or if too loose it can be detected by working the connecting rod back and forth. When trying a bearing the bolts should always be drawn up tightly. If bearing is found too tight replace enough shims to make it right.

Never loosen up a bearing by loosening the nuts—if bearing is too tight insert another layer of shims until the proper fit is obtained. When the proper fit is secured the bearing should not bind, but it should offer some resistance when the crank shaft is turned. When the bearing is properly fitted put in new cotter pins that fit the holes snugly. Do not back up the nut to line up the cotter pin hole. If it is not in line when nut has been tightened securely remove the nut and file the face slightly. Before engine is run, thoroughly oil all bearings. Put a fresh supply of oil in the crank case and run motor slowly and watch it carefully for a few hours, or until satisfied that the bearings have been properly fitted and do not overheat.

Wrist Pin End of Rod

A connecting rod is a double end proposition as there is a small bearing bushing at the upper end in some types. In others, the wrist pin is clamped to the rod. The bushings are usually of the solid form and no compensation is possible for depreciation except renewal. A few engines have a split bushing that can be clamped around the wrist pin by a suitable bolt in the upper rod end. Even though the bearing is much less in area than at the big end, it has a rocking or oscillating motion and does not wear out as soon as the lower ones. While wrist pins are usually made of very tough steel, case-hardened with the object of wearing out an easily renewable bronze bushing in the upper end of the connecting rod rather than the wrist pin, it sometimes happens that these members will be worn so that even the replacement of a new bushing in the connecting rod will not reduce the lost motion and attendant noise due to a loose wrist pin. The only remedy is to fit new wrist pins to the piston. Where the connecting rod is clamped to the wrist pin and that member oscillates in the piston bosses the wear will usually be on bronze bushings which are pressed into the piston bosses. These are easily renewed and after running a reamer through them of the proper size no difficulty should be experienced in replacing either the old or a new wrist pin depending upon the condition of that member. Where the wrist pin oscillates directly in the bosses of an iron or aluminum piston and these wear, the only remedy is

Digitized by Google

reaming out the worn bosses and fitting over-size wrist pins.

Fitting New Brasses

In fitting new brasses there are two conditions to be avoided, these being outlined at Fig. 2, C and D. In the case shown at C the light edges of the bushings are in contact, but the connecting rod and its cap do not meet. When the retaining nuts are tightened the entire strain is taken on the comparatively small area of the edges of the bushings which are not strong enough to withstand the strains existing and which flatten out quickly, permitting the bearing to run loose. In the example outlined at D the edges of solidly in their proper position and that they are not raised by any burrs or particles of dirt under the head which will flatten out after the engine has been run for a time and allow the bolts to slack off. Similarly, care should be taken that there is no foreign matter under the brasses and the box in which they seat or that no burrs exist on the edges. To guard against this the bolts should be struck with a hammer several times after they are tightened up, and the connecting rod can be hit sharply several times under the cap with a wooden mallet or lead hammer. It is important to rivet the brasses in place to prevent movement as lubrication may be interfered with if the bushing turns

BELT GLUE

A GLUE for belts can be prepared as follows: Soak 50 parts by weight of gelatine in water, pour off the excess of water and heat on the water bath. With good stirring, add, first, 5 parts by weight of glycerine, then 10 parts by weight of turpentine and 5 parts by weight of linseed oil varnish and thin with water as required. The ends of the belts to be glued are cut off obliquely and warmed; then the hot glue is applied, and the united parts are subjected to strong pressure, allowing them to dry thus for twenty-four hours before the belts are used.

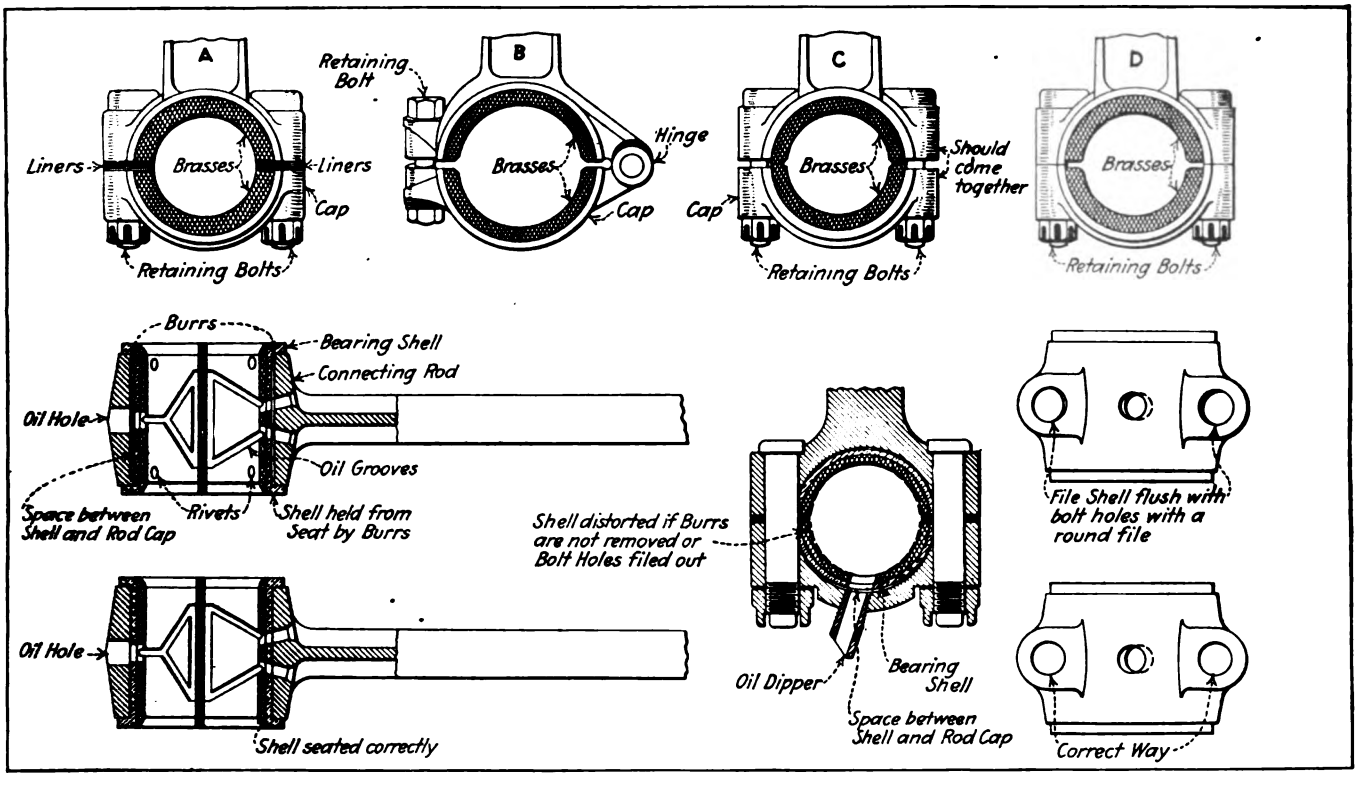


Fig. 3. Diagrams outlining precautions to be taken in fitting brasses to connecting rod big ends

the brasses do not touch when the connecting rod cap is drawn in place. This is not good practice, because the brasses soon become loose in their retaining member. In the case outlined it is necessary to file off the faces of the rod and cap until these meet, and to insure contact of the edges of the brasses as well. In event of the brasses coming together before the cap and rod make contact, as shown at C, the bearing halves should be reduced at the edges until both the caps and brasses meet against the surfaces of the liners as shown at A, Fig. 3.

Before assembling on the shaft it is sometimes necessary to fit the bearings by scraping. It is apparent that if the crank pins are not round no amount of scraping will insure a true bearing. A point to observe is to make sure that the heads of the bolts are imbedded round and breaks the correct register between the oil hole in the cap and brasses.

Care should be taken in screwing on the retaining nuts to insure that they will remain in place and not slack off. Spring washers should not be used on either connecting rod ends or main bearing bolts, because these sometimes snap in two pieces and leave the nut slack. The best method of locking is to use well-fitting split pins and castellated nuts.

(To be continued)

AMONG THE ALLOYS for bearings is the following:—Cadmium, 45 per cent.; zinc, 45 per cent.; antimony, 10 per cent. This has a very low coefficient of friction and casts well.

An easy test for carburetor adjustment may be made by pressing down on the air valve while the engine is running throttled down. A slight pressure should not change the engine speed, but a greater pressure will stall it if the mixture is correct. If the engine stalls with a slight pressure, the mixture is too lean.

In the absence of any reliable horsepower rating for motorcycle engines, and having instanced the unsuitability of existing formulas in determining the horsepower of such high-speed engines, the *Motorcycle* (English) recommends that 100 cubic centimeters be regarded as one horsepower. Thus the popular 350 cubic centimeter and 500 cubic centimeter cycle power plants would be rated at 3½ and 5 horsepower respectively. This simple rating can also be successfully applied to small cars.

Digitized by Google

Construction of a Mechanical Vacuum Cleaner

By E. H. Williamson, Jr.

PART I.

THE vacuum cleaner has become a household necessity in the comparatively few years which have elapsed since it was first introduced. Starting with the type which consisted of a heavy vertical case containing one or more suction pumps, operated by an electric motor, where the cleaning was done by attaching lengths of air hose to the stationary pump, there has been a constant improvement in the way of increased portability and reduced weight, and the present style of domestic cleaner leaves little to be desired. The modern cleaner consists of a small exhaust fan connected directly on the shaft of an electric motor. This is enclosed in an aluminum case provided with a broad nozzle, in which is a revolving bristle brush, and a slot of narrow width, which travels close to the carpet or other surface to be cleaned. The dust, etc., is stirred up by the brush, and sucked into the slot, and so through the fan into a long bag of silk or other close woven fabric. For those whose residences are provided with electric current, a cleaner of this sort leaves little to be desired, but some still lack this convenience, and it is for their benefit that the following description of a mechanically operated cleaner is given. To bring the construction of the machine within the scope of the average home workshop or den, the machine is built largely of white pine which is light, and easily worked, and can be obtained from the scrap heap of any pattern shop. The majority of the metal work can be done with an ordinary bench vise and bench drill or even a breast drill, while if the reader possesses a wood lathe or engine lathe, the whole machine can be easily constructed at home.

The photographs shown are pictures of the cleaner made by the writer, and are used as illustrations for construction in preference to line drawings except in four or five cases. As the fan, which by its rotation produces the vacuum, is the most important part of the machine, and probably the most difficult part to construct, we will consider it first. Figure No. 1 shows the fan (A) removed from the case together with one side of the fan box. It consists of a round disc of 1/32-in. sheet brass, 5 inches in diameter. This is cut from stock, either on a metal working lathe, or by marking a centre and scribing a circle of the required size. The disc is then cut out along the line with heavy tinners' shears, the rough edges being smoothed off with a file so that a true circle is formed. The disc must be perfectly flat, and if bent in cutting, must be hammered out level. A 3/8-in. hole is now drilled in the exact centre of the disc, a smaller hole,



The finished vacuum cleaner in use

say 1/8-in., being drilled first as a guide.

The hub on which the disc revolves is shown in Fig. 2, and is 1 in. long and 1/2 in. outside diameter with an 1 1/4-in. flange at one end. The writer was fortunate enough to find a portion of an old "floor push," such as is used

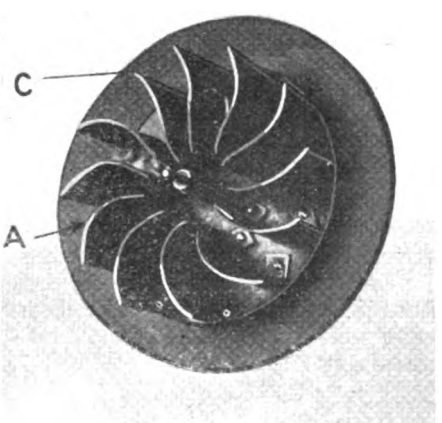


Fig. 1.

to operate an electric bell or buzzer from the dining room to the kitchen, which was just the right size for this, when the hole through the centre was bored out to 3/8 of an inch. To assemble, a piece of round iron rod, a trifle less than 3/8 in., was set vertically in a vise and the disc set upon it, together with the hub so that the flange of the latter rested on the disc. The hub and disc were sweated together with solder to anchor them, and then removed from the bar and permanently connected with three 8-32 round head iron machine screws driven through flange and disc, the screw heads being on the flange side. An 8-32 brass nut is then run on each of the protruding ends of the screws and screwed up tight, and then sweated with solder. The balance of the screw is cut off flush with the nut. The fan has twelve vanes or blades, which are cut from a sheet of No. 22 brass, 1 3/4 in. wide.

Each blade is 2 1/4 in. long and is shaped as shown in Fig. 3. Having cut the twelve pieces, they are stacked up with the edges even and clamped together in a vise. All the edges are now trued up with a file and the rounded corner filed to shape. The pack is now reversed in the vise, and the two lugs are formed by making cross cuts with a hack saw to the required depth, and cutting away the surplus metal either by chipping with a sharp cold chisel and filing, or by filing alone.

The stack is now removed from the vise, separated and each blade is then clamped and the lugs bent over at right angles, even with the bottom of the blade. Care should be taken, however, not to bend them so sharply as to crack the brass. A circle 4 in. diameter is now marked on paper for a pattern, and each blade is bent in a curve, corresponding to an arc of the circle, the lugs being on the inside of the curve. The iron bar is again set upright in the vise, and after the circumference of the disc has been spaced off into twelve equal parts with a pair of dividers, and radial lines drawn from each point to the centre, the disc with its hub is set on the bar, and the blades set in place, one by one, using the lines as guides and taking care to have all blades equally distant from the centre. The easiest method is to first solder each blade in place, holding it with pliers, and then fasten it permanently with a 4-36 machine screw through each lug and the disc.

It is very important that the fan should be equally balanced on its centre, as under the high speed of rotation, any eccentricity would soon cause it to shake itself to pieces. Slight inequalities in weight may be compensated for by a drop or two of solder on the light

Digitized by Google

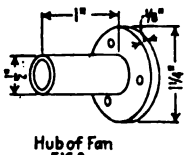
side of the fan. The spindle of the fan is a piece of round steel rod 4¾ in. long, and in order to reduce friction, each end of the shaft is cut down to 5/32 in. for a space of ½ in., the diameter of the part between being 11/32 in. It is best to have the spindle made up at a machine shop, unless one is an expert with a machine lathe.

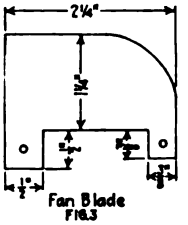
The fan is now set on the spindle so that the end of the hub is ¼ in. from one end of the shaft proper, and is secured in place with an 8-32 iron machine screw, driven through both hub and shaft, and locked with a nut on the farther side. Fig. 4 shows the construction of the fan box from which the fan has been removed. The circular shell (D) is made from a block of pine, 2 in. thick and 12 in. square, both sides of which have been planed. An 8-in. circle is marked on one side and a circular block of that size is cut out with a band saw. The block is then screwed to the face plate of a wood lathe, and the outer circumference turned down to 7½ in., while the centre of the block is cut out to 6 in. inside diameter, making the sides of the shell ¾ in. thick by 2 in. deep.

The circular cover (C) shown in Fig. 1 should also be turned, from ⅜-in. stuff, the diameter being 7½ in. with a 7/16 in. hole in the centre for the fan shaft. The cover for the other side of the box is not circular but comes to a square edge on one side, tapering from the full diameter of 7½ in. to a width of 5 in. on the square portion.

This cover must be centered on the lathe, however, and a 3½ in. hole turned out, to give access to the air duct which is attached to this side. The cross bar which supports the inside fan bearing may be seen crossing this hole, and consists of a piece of ⅛-in. strap iron, ½ in. wide and 7½ in. long, which is screwed to the edges of the shell being set in shallow notches to allow the cover to be screwed flat on the edge of the shell. The bearing proper (E) is a piece of brass ¼ in. thick, ½ in. wide and 1 in. long, which is bored to receive the gudgeon of the spindle, and screwed to the cross bar, which is correspondingly bored. The block (F), which forms the outlet from the fan box, is part of the piece left over when the 8-in. block was sawed out, and is used because the curve corresponds closely to that of the shell.

It is 4 in. long by 3 in. deep and 2 in. thick and is both nailed and glued to the side of the shell, in the position shown. When in place a 1½ in. circular opening is driven through both





block and shell, and to avoid splitting either it is best to drill a smaller hole first and then enlarge it to the required size with a sharp gouge.

The hole should be a true circle for at least one inch in depth, so as to make an air-tight fit with the metal neck of the dust bag.

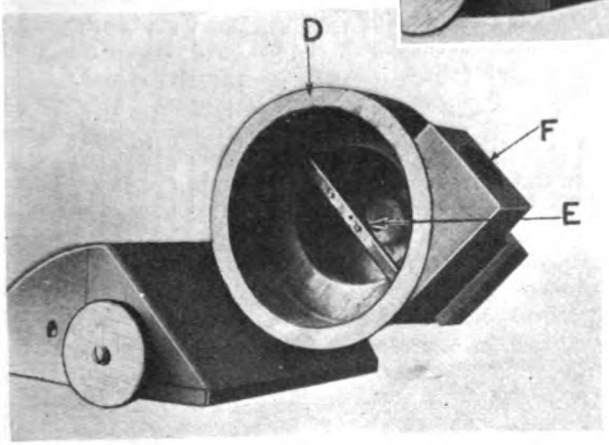


Fig. 4

The photograph, Fig. 5, shows the arrangement of gears by which the fan is driven. A cast-iron pinion (⅞ in. diameter, ⅜ in. face, 20 pitch, bore ⅜ in.) is reamed out a trifle and driven on the end of the fan spindle to a point ¼ in. from the end. It should fit tightly on the spindle. The gear (G) which drives this pinion is 3½ in. diameter and the same face and pitch as the latter. It revolves on a spindle 1½ in. long with a ⅛-in. gudgeon at each end, ⅜ in. long. The diameter of the spindle will be ½ in., as stock gears of this size are usually so bored, and the gear will have a ½-in. hub on one side, making the bore ⅞ in. through.

The gear (G) is driven on the spindle to a point ½ in. below the end and a 1in. pinion of the same face and pitch as the others is set on this projecting end, against the side of the gear (G), to which it is fastened with a couple of 8-32 round head machine screws. The bearings for the gears are made as follows: Two pieces of 3-in. pine (GG) are gotten out, 3½ in. long and 2¼ in. high. These are screwed to the wooden cover (C) in an upright position, parallel with each other, the inner sides being 4½ in. apart. Two 6-in. lengths of ½ in. by ⅛ in. strap iron are now prepared and drilled for No. 8 wood screws at points ⅜ in. from each end. Two pieces of 3/16-in. brass, 1½ in. long by ½ in. wide, are prepared and drilled ¼ in. from each end, to allow a 4-36 machine screw to pass through. One of these pieces is now screwed at the centre of each 6-in. strap. One has a 5/32-in. hole bored in the center of the brass and through the iron. This is the bearing for the fan spindle and is set in place on the two blocks, in notches cut in the wood so that the iron is flush with the top, and screwed firmly in place with 1-in. No. 8 wood screws. The bearing must be adjusted in position so that the fan revolves freely, the shaft being in the centre of the hole in the wooden cover, and the hole in the bearing being reamed out a little if necessary, so the gudgeon does not bind. The bearing for the gear (G) is prepared the same way as the other, except that the hole in the brass is for a ⅛-in. gudgeon.

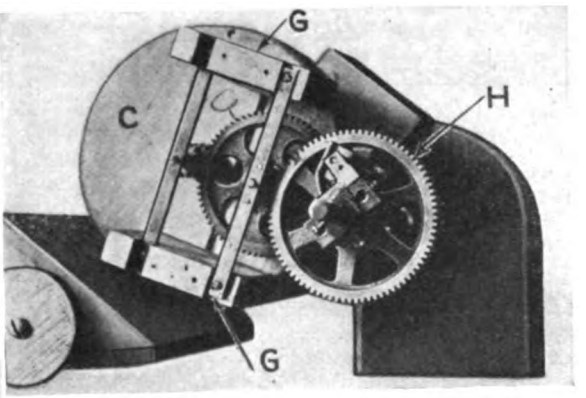


Fig. 5

The bearing for the bottom end of the spindle of (G) is a brass plate, ⅛ in. thick and 2 ins. long by 1 in. wide, which is screwed to the face of the wooden cover, the wood being bored out to accommodate the end of the lower gudgeon.

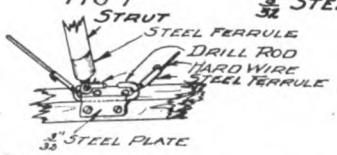
To avoid the expense of unnecessary machine work, the spindle of the gear (G) may be made as follows: A piece of ½ in. round iron rod, 1½ ins. long, with a smooth surface is prepared and the ends filed square. Take a center punch and make a dent in the exact center of each end, and start the hole with a No. 40 drill. Next take a ⅛ in. drill and bore a hole to a depth of ¾ in., keeping the drill square with end.

Digitized by Google

METAL FITTINGS

WRIGHT INTERPLANE STRUT SOCKETS

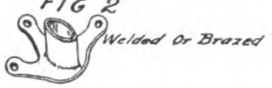
FIG-1



BRAZED I. S. SOCKET

STEEL PLATE OVAL TUBING

FIG 2



CAST ALUM. ALLOY

FIG. 3



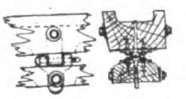
STRAP STEEL

FIG. 4



CONTROL HINGE

FIG. 5



EYE BOLT STRUT SOCKET

FIG. 6

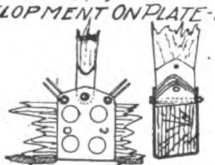


SIMPLIFIED - STRUT SOCKET

Designed For SEA PLANE

FIG. 7

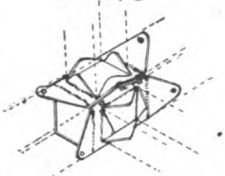
DEVELOPMENT ON PLATE-5



HARD WOOD BLOCKS (Glued and Nailed) TO WING BEAMS TO PREVENT SLIPPING OF FITTINGS

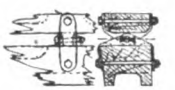
SHEET STEEL FUSELAGE SOCKET

FIG. 8



CONTROL HINGE

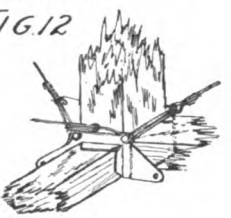
FIG. 9.



IDEAL S.S. STRUT SOCKET

SHEET STEEL

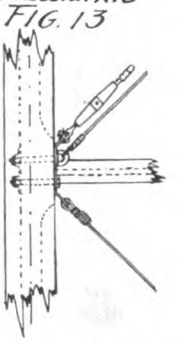
FIG. 12



DRIFT WIRE ANCHORAGE

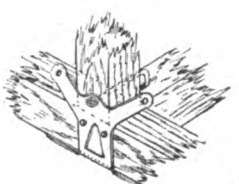
COMPRESSION RIB

FIG. 13



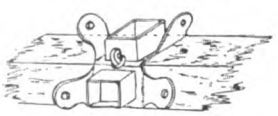
FUSELAGE SOCKET

FIG. 11



FUSELAGE STRUT SOCKET

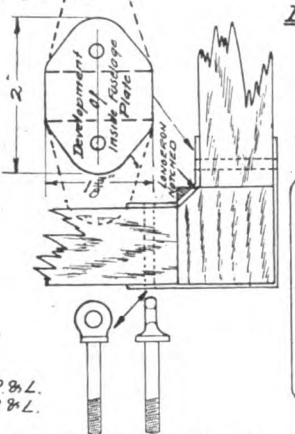
FIG. 10



FUSELAGE FITTING

Designed For SEA PLANE

FIG. 15



LANDING GEAR COMB'N FITTING

FIG. 14

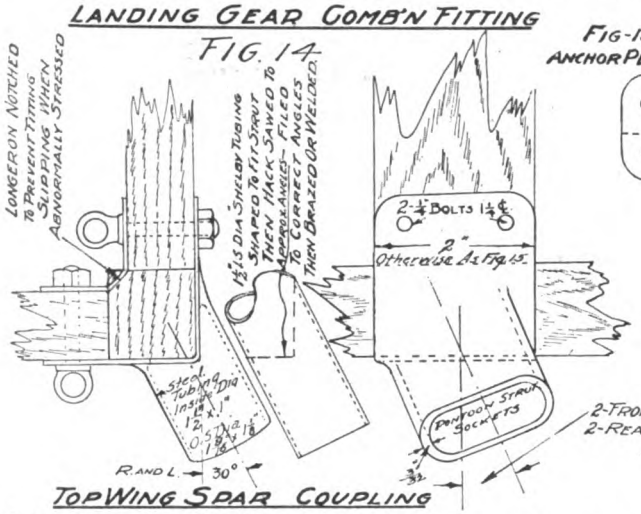
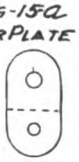
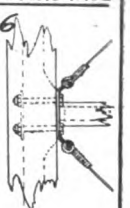


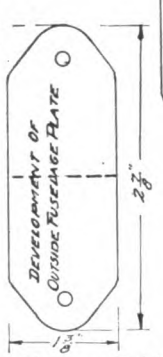
FIG-15a ANCHOR PLATE



DRIFT WIRE ANCHORAGE

FIG 16



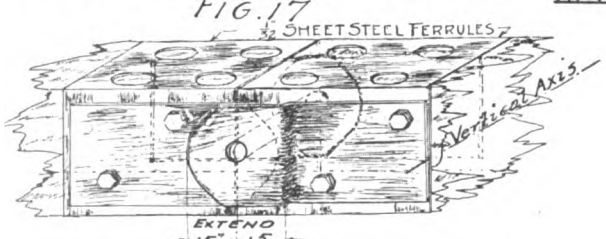


EYE-BOLT FOR ABOVE FITTING

FIG. 19

TOP WING SPAR COUPLING AND CABANE STRUT ANCHORAGE

FIG. 17



4-⅜ CRS. PLATES 2" × 5½" F.T.W. SPAR
4- " " " 1½ × 5½" R.T.W.
WING SPAR COUPLING PLATES

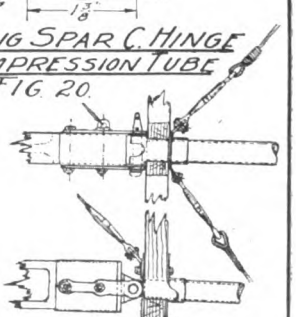
WING SPAR HINGE

FIG. 18



LOWER WING SPAR C. HINGE WITH COMPRESSION TUBE

FIG. 20.



HORN FOR ALL CONTROL SURFACES

FIG. 21 (DETAILS PLATE 5)

PLATE FOUR

C.E. MULLER 9-16-19

Sheet of details for metal fittings of two-passenger seaplane

Digitized by Google

Building A Two-Passenger Seaplane

By Charles E. Muller

Consulting Aeronautical Engineer

PART 4—METAL FITTING DETAILS AND DEVELOPMENT

THE essential considerations on the designing or in the adoption of interplane, landing gear or fuselage fittings, are efficiency, facilities of manufacturing and the attachment to vital components without weakening those members. Figs. 1, 2, 3, 6 and 7 graphically depict the evolution of strut fittings from the crude aluminum alloy (Fig. 3) castings to the present day tendency of one piece die stamping, similar to Fig. 7. This latter method will ultimately become the standard practice. Considering the engineering value in design that may be suggested by the history of the various methods of fitting construction, it is considered pertinent to describe the origin and special considerations attached to their use.

Early Wright Fitting Simple.

Fig. 1 is undoubtedly the first practical strut fitting. They were used on the early Wright machines due to the necessity of a flexible attachment to permit the warping of the wings for lateral stability of the Wright machine up to 1912. These fittings were crude possibly, but very serviceable. They not only permitted a ball and socket strut movement but were also used as flying, landing and drift wire anchorages. These will be described more fully in proper sequence. Fig. 2 represents the Curtiss early type and a natural introduction by a bicycle and motor cycle expert. The cast aluminum alloy fitting was employed by many amateurs and some factories during 1911. Strap steel fittings, such as shown at Fig. 5, were much in evidence at Nassau Boulevard and at Mineola, L. I., up to 1912.

The 14 cylinder Gnome Tractor biplane designed and built by the author in 1911 in New York City was, it is believed, the first machine to use all steel fittings. These were made of mild sheet steel plates with "Shelby Steel Tubing" brazed to the plates, the brazing material forming a fillet inside and outside of the joint. The fuselage fitting, Fig. 15, was given a severe try out on this machine, proving very satisfactory. The notching of the longerons to prevent the fitting from sliding originated with this design and has proven entirely practical. Owing to a bad landing in a side wind the landing gear was badly damaged but not one of the fittings failed. Although some of the landing gear strut sockets were damaged they were straightened out and used again.

Pierced Spars Not Desirable.

Fig. 8 shows a one-piece sheet steel fitting riveted parallel to the longeron between the horizontal and the vertical fuselage struts. Fig. 10 is a bent steel plate with rectangular tubing welded on for sockets and held in position by an eye bolt which surely disqualifies it. Any fitting that pierces the wing beams or longerons, thus impairing the strength, should be eliminated if possible. Hard wood blocks glued on these components and wrapped tightly with linen tape, cemented with thick orange shellac or hot glue has never failed to strengthen a pierced member when this construction was unavoidable within the knowledge of the writer.

A method extensively employed is to imbed the fitting bolts half their diameter into the spars. Extra thickness is given the spar at the weakened point or hard wood blocks are attached by marine glue, brads and doped linen, compensating for material displaced. The Curtiss method at the present time is to use a die stamped one piece plate fitting with integral lugs for truss wires and to hold the interplane strut end fitting that has an eye shank welded to a stamped socket. This plate is bolted on the wing spars with four bolts imbedded as described above.

The illustration at Fig. 11 is that of a very simple one piece stamping with a 90° knee bolt (3/16 in. drill rod) that holds the vertical and horizontal longeron struts in place, and also may be used to tighten the cross sectional wires. The fore and aft diagonal wires are also anchored on this knee bolt but require turnbuckles. The objections to this method are that in a short time the wires stretch, some more than others, also that it is necessary to pierce the longerons with wood screws or bolts to hold this style fitting from slipping. In the event of a bad landing it is almost impossible to true up the fuselage without replacing the wires. For this reason it is inadvisable to adopt this method for commercial machines. It was used on the Hanriot monoplane and also on some of the war machines. Its advantages are rapid production, quick repairs and economy, and as the life of an airplane at the front was variously estimated at from 6 to 40 hours, a little distortion of the body was compensated for by the controls when possible rather than rebuilding the entire machine.

The diagram at Fig. 12 appears to be an excellent fuselage fitting meeting the general demands consistently. The horizontal strut is held by a socket formed by punching and turning the tabs outward, the vertical strut is held in position by the bolts that hold the wire clips for the wire anchorages. These bolts also serve to clamp the fitting to the longeron preventing slippage and are obviously adjustable.

Best for Amateur Production.

The fitting at Fig. 15 is undoubtedly the most suitable for the amateur with limited facilities, as the plates can be roughly shaped by a cold chisel and finished off with a file. By drilling a number clamped together or punching them through the holes in one that serves as a template the work will not only be expedited but be of a more uniform character. Satisfactory eye bolts may be purchased or high grade steel bolts with an anchor plate as shown in Fig. 15-A for the brace wires or the inside plate of this fitting may be extended as shown by dotted lines for this purpose.

That at Fig. 14 is a combination of Fig. 15 with a piece of Shelby seamless steel tubing formed over a hard wood block to dimension taken from Plate Two, landing gear strut end section, Fig. Y-2. This tubing may be purchased through any dealer of automobile or bicycle tubing. These bolts also serve the purpose of securing the fuselage struts in position.

Control Hinges Simple.

Figs. 5 and 6 are representative of the control hinges and are so simple that they require no further explanation. A very simple hinge may be made by using a 20 gauge plate fashioned like a strap hinge (Fig. 25), but instead of doubling the ends carry one thickness above and one below the attachment using 2⅛ inch bolts for clamping. These simple control hinge fittings were used very extensively and satisfactorily in the early days, even on the large Farman machines.

The fittings at Figs. 13 and 16 are simply anchor plates for the brace wires for staying the wing panels, which are technically called internal drift wires. Fig. 17 represents the simplest form of wing spar coupling in which 20 gauge steel ferrules are formed and butt joint welded, lightened as much as possible by drilling or punching and driven on the inside ends of the wing spars. Fish plates are made and bolted through the wing

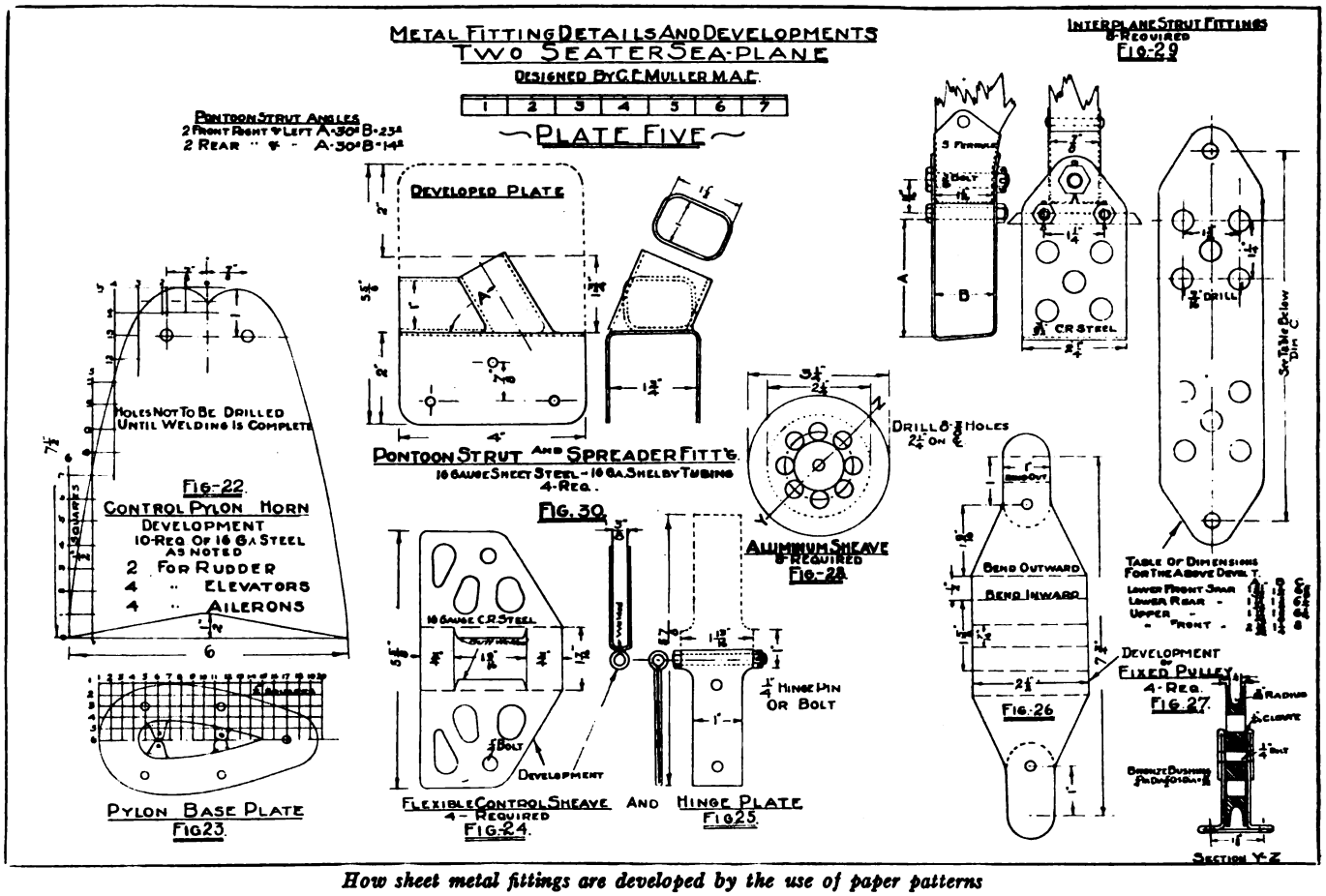
Digitized by Google

spars. By offsetting one plate on each spar they will assemble easier. These fish plates are best placed above and below the spar, permitting an eye bolt to answer for locking this joint and also serving the additional purpose of handling the airplane or seaplane by a hoisting cable suspended at the center of gravity. Fig. 18 represents a practical coupling made of an eye plate extending on both vertical sides of the wing spar with a lug plate brazed to the eye plates. They not only space these plates but also give additional strength.

A ⅜ in. pin, Fig. 20, is usually secured by a No. 10 wire or cotton pin.

of stress applied, the problem is easily solved by good common sense. On a machine of this type it is well to carry the safety factor high, at least 12, and safer to err on a little over weight. Even steel has its cross grain and defects, also it is affected by temperature and by the strain produced by bending and other operations. In very high grade steel these internal strains are neutralized by a heat treatment. Avoid very sharp bends, scratches or cuts. Sheet steel should never be bent over a sharp corner. A radius equal to at least twice the thickness of the material should be used at all bends. Heating to a cherry red with a blow torch will

may be butt welded by the oxy-acetylene process. Fig. 24 depicts the flexible pulley necessary for the aileron control wires which will be explained in another instalment. If a paper pattern be cut out to full size of the development then bent as shown, it will instruct more graphically than a thousand words. This method will also suggest at once that used with other fittings. The aluminum sheave may be made from a casting or from rolled bar stock. I believe that fiber board would make an excellent substitute barring its weight, and even hard wood has been used by experimenters for pulleys.



How sheet metal fittings are developed by the use of paper patterns

Fig. 20 is the Curtiss method used on the JN4 A, B, D, and H. It is a very practical and efficient fitting, but requires much skill in its fabrication. The prominent feature is the steel tubing compression strut extending from wing spar to wing spar, taking the direct compression stress of the lower wings.

Laying Out Fitting Blanks.

A careful analysis of Plate 5 will show the method of laying out sheet steel fittings, which is a very simple matter. There are many calculations necessary for stress allowance, but I feel that with a little elementary knowledge of the tensile strength of the steel used and the appreciation of the kind

absolutely prevent accidental fracture, faciliate the work and insure keeping the full strength of the material.

The development at Fig. 23 shows the Control Pylons before forming. These are usually of various lenghts in commercial airplanes due to the movement of control surfaces required which varies, but this one is made universal; the difference in movement will be compensated by changing the leverage at the controls to give the necessary movement. A little study of the squares in the diagram will suggest to the amateur mechanic the method used to lay out these curves which need not be rigidly followed.

The base plate tabs are bent while cherry red to shape; riveted to Pylon to hold it in shape, then brazed or it

TENSILE STRENGTH OF STEEL

Grades of Steel	Tension Ultimate Strength lbs. per sq. in.	Compression
Extra Soft.....	45,000	16,000
Soft	50,000	18,000-20,000
Medium	60,000	22,000-40,000
Hard	70,000	
STEEL CASTINGS:		
Soft	60,000	16,000
Medium	72,000	18,000-20,000
Hard	70,000 up	
Steel Forging...	75 to 90,000	18,000
Spring Steel.....	101,000 to 135,000	
Tempered	130,000 to 200,000	
Vanadium alloy, annealed	54,000 to 96,000	
Oil tempered....	125,000 to 250,000	

Editor's Note.—The next instalment of this series will describe fully the construction of the fuselage and will show two forms, one suited for the 3-cylinder radial motor and one adapted to a modified, popular 4-cylinder car motor.

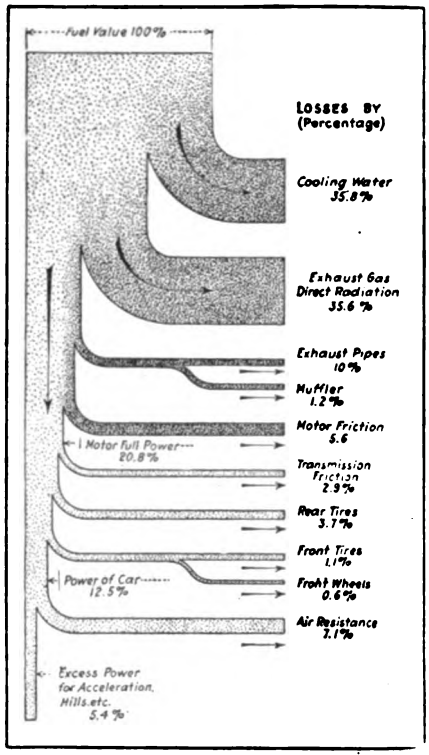
Digitized by Google

Where the Power Goes

THE cost of motoring would be decreased by a substantial amount if it were possible to utilize the full heat value of the gasoline put in the fuel tank and lose none of the potential power contained therein. A motorist receives a return of but 20 per cent as engine power of the total 100 per cent heat value of the fuel at the tank. If it were burned under a steam boiler and steam used to drive the automobile he would obtain even less because the heat efficiency of a steam boiler and engine is less than that of an internal combustion power plant. The chart and plan view of the typical automobile chassis herewith give a good idea of how the heat obtained from the exploded gas is dissipated and how there are further losses even after a relatively small proportion is converted into useful power.

The greater part of the loss takes place in the conversion of heat to power in the engine cylinders. There is an absorption of 35.8 per cent in the water cooling system and 37.8 per cent is lost through the heat of the exhaust gases and direct radiation from exhaust manifold, pipe leading to silencer and the muffler itself. Of the power delivered by the engine a certain amount is needed to overcome frictional resistance at various points as indicated, the tires and wheel bearings taking some power and the power transmission system also taking toll of the energy passing through it. These losses are unavoidable and skillful designing is necessary to secure even the efficiency of heat utilization outlined which is much greater in the modern automobile than it was in the early forms.

The figures given will vary with the type and mechanical condition of the automobile mechanism. Some cars, in which lubrication is neglected or showing considerable wear at essential points, will take a higher friction toll than the approximation given. A poor carburetor adjustment will lessen the efficiency of the engine and result in loss of potential heat units. Even such a common thing as insufficiently inflated tires will increase the power loss at that point.



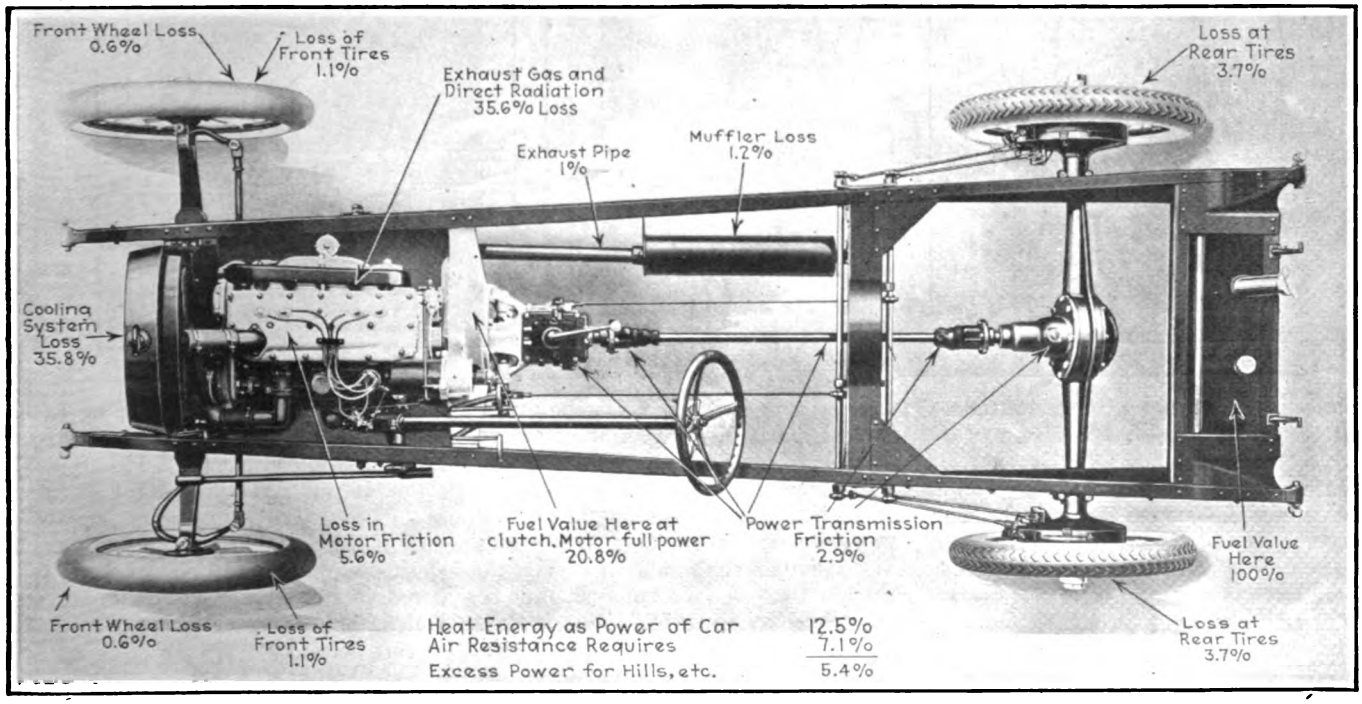
Graphic diagram showing how heat energy in fuel is used in automobile

EXTINGUISHING SMALL GASOLINE FIRES

While pure sawdust gives excellent results in putting out a small gasoline fire, a mixture of 10 pounds of bicarbonate of soda with 12 pounds of clean sawdust is the best medium to have on hand. Have the sawdust dry and free from chips. The action is that the sawdust forms an air-tight blanket as it floats on the burning liquid, and at the same time the heat of the flame generates carbonic acid gas. This gas, together with the sawdust, keeps the oxygen in the air away from the flame and quickly smothers it.

It is essential to have the engine warmed thoroughly before starting to adjust the carburetor, the motor should be run so it is hot when the finishing touches are given. An engine adjusted while cold will not develop full power, and an entirely different fuel needle valve setting will be necessary after it heats as usually the gasoline supply can be reduced, this resulting in increase of power and gasoline economy.

When you have the time study your starting and lighting system carefully, using your instruction book as a guide. Gradually the uses of the parts and the paths of the currents will become clear to you. Give it the care it needs and you will get better service and have less trouble in the end.



Plan view of five passenger four-cylinder automobile showing how heat units obtained by combustion of fuel in engine cylinders are utilized and what proportion is actually employed in driving the car when it is run at a rate of 40 miles per hour on the high gear

Digitized by Google

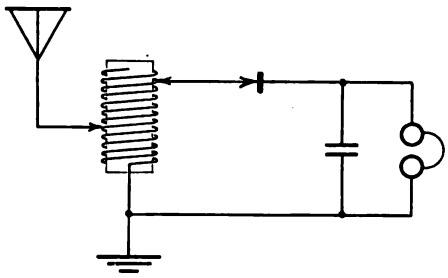


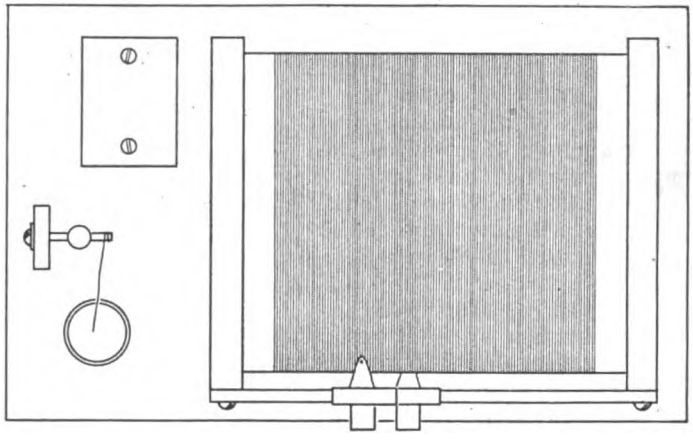
THE JUNIOR EXPERIMENTER

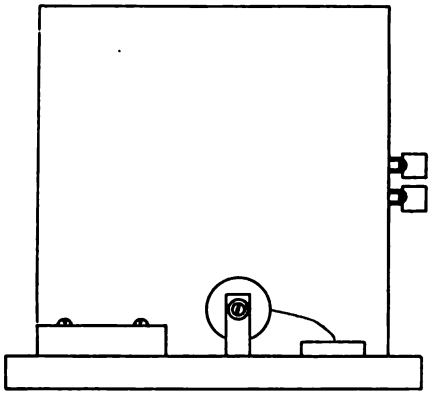
A Beginner's Set for Navy Code Practice

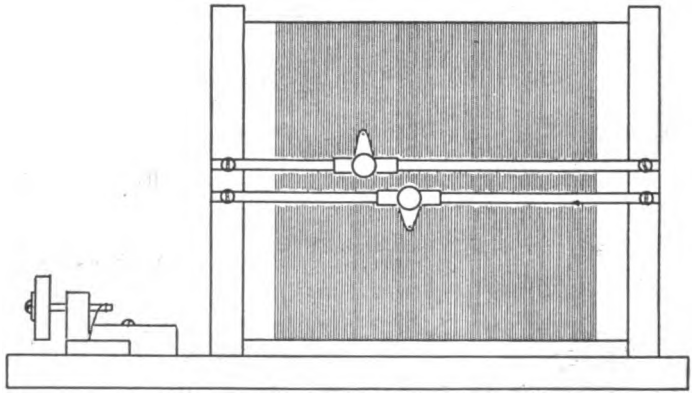
This Receiver, With a Small Antenna, Will Tune Above 1,500 Meters, the Wavelength Used for Navy Practice

ON October 5th the Naval radio station at 44 Whitehall Street, New York City, started a nightly transmitting program, following the 9 P. M. press news, to give radio experimenters a chance to practice receiving at slow speed. The set described in this article, used with a standard short or long range antenna, will copy the signals at a distance of several hundred miles. It is also a good set for general receiving work, and is simple enough for any beginner to operate.









The tuning coil, mounted at the right of the base, is made up of a tube 6 ins. long and 5 ins. in diameter, wound for 5 ins. with No. 24 S. S. C. wire. Two methods can be used for mounting the tube—either holes can be drilled with an extension bit in the 6 x 6 in. end pieces, or wooden discs, fitted into the ends of the tube, may be fastened with brass screws to the end pieces.

Slider rods of 3/16 x 3/16 in. brass are secured to the end pieces by means of small brass wood screws. The sliders are square brass tubes, 1 in. long. A piece of spring brass, for a contact, is soldered to each one. On the top is soldered a flat head machine screw, to take the adjusting knob.

The wiring diagram shows that one end of the winding is brought out for connection to the ground, one slider rod to the antenna, and the other to the detector. Connections should be soldered if possible.

Under the small wooden block, beside the tuner, a fixed condenser is mounted. This consists of 15 sheets of tin foil, 2 x 1 in., separated by paraffined paper sheets. Alternate tin foil sheets are connected together, and leads brought out to shunt the phones. If care is used not to overheat the tin foil, it can be soldered. The completed condenser is set into a place cut out in the under side of the block and sealed with paraffin or sealing wax.

Any type of detector may be used, though the one illustrated here is about the easiest to construct. A 1½ in. 8-32 screw is put through a tight fit in a brass post. For convenience, a simple disc of bakelite is used as a handle. A short piece of No. 30 copper wire, soldered to the screw, acts as a contact. Galena or ferron will give good results in this detector.

Telephones of 1,000 or 2,000 ohms complete the set.

(*Continued on page* 116)

Digitized by Google

A Simple Apparatus for Signalling Under Water

By Laverne Yates

THE oscillator and microphone described in this article can be used for transmitting signals under water up to a distance of forty feet. Both the transmitting and receiving stations can be put together with a few odds and ends that are generally found around the amateur's laboratory or workshop.

We will first confine our attention to the oscillator. An examination of the drawing shows that it consists primarily of two 20-ohm magnets mounted in a tin receptacle. In the writer's case, the receptacle was a tin can in which mechanic's soap is sold. The can should be cleaned out nicely and wiped dry to prevent it from rusting. A pair of 20-ohm magnets are then mounted on the cover as illustrated. Owing to the depth of the can, it will be necessary to place a wooden block between the magnets and the cover. The holding screws pass through the wooden block and screw into the ends of the pole pieces. The magnets should be so mounted that the opposite end of the pole pieces come within ⅛ in. of the bottom of the can. If more powerful magnets can be obtained, so much the better. However, magnets with too high resistance should not be used.

The magnets are connected in series in the usual manner and one of the free terminals is soldered to the inside of the can. The other terminal passes through the can to the outside. The hole through which the wire passes must be made perfectly water tight. To do this, a brass bushing is first soldered in place. In this a circular piece of fibre is forced with a hole in it just large enough to permit the passage of the wire. After the wire is drawn through, both sides of the fibre bushing should be smeared with white lead.

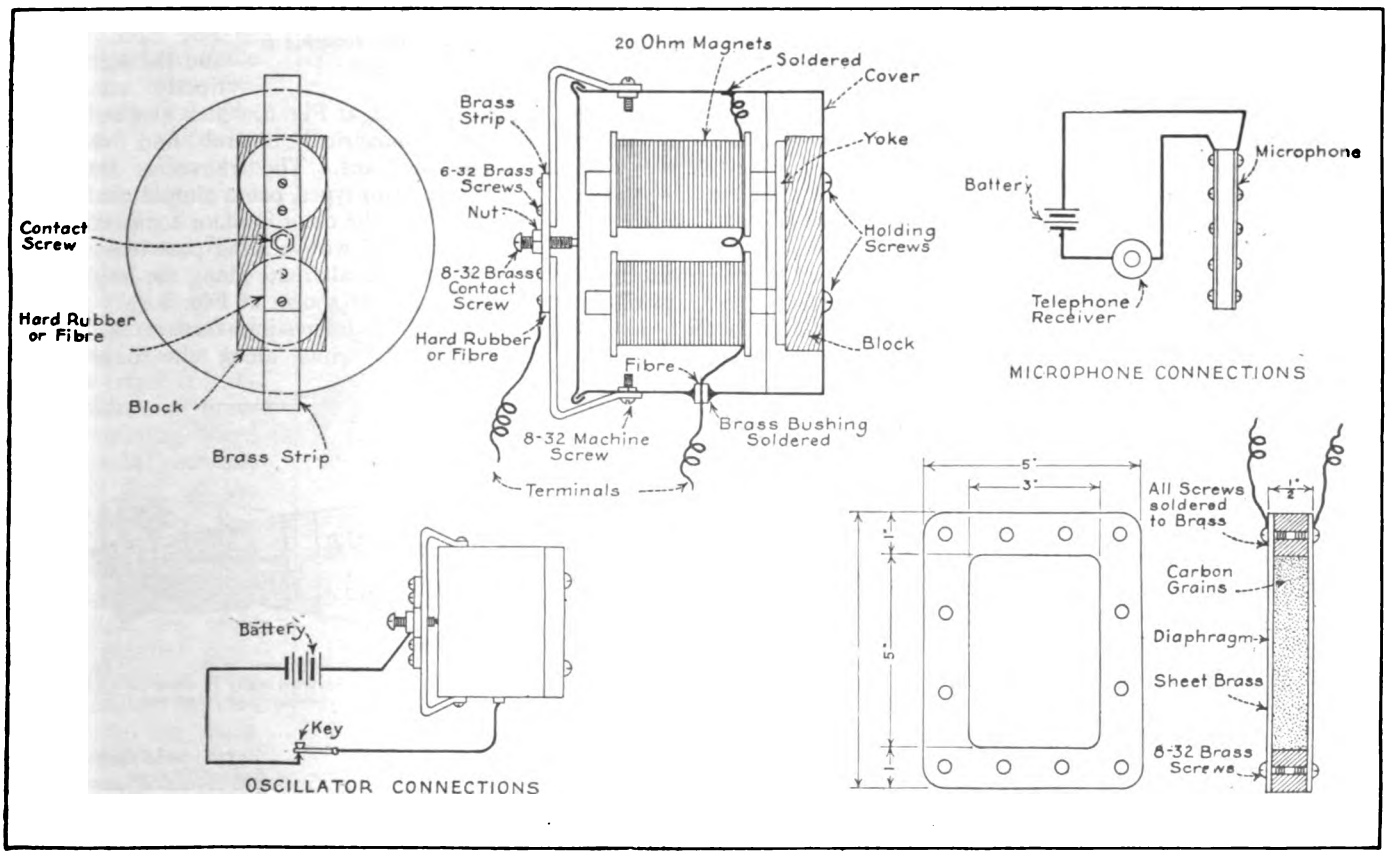
A strip of heavy sheet brass about ½ in. wide is then bent and attached to the bottom of the can as shown in the sketch. The screws which hold the strip in place should be covered with a drop of solder to prevent water leakage. The remainder of the work on this particular part is clearly shown in the drawings and the author does not feel it necessary to give it further description.

Before the cover is finally put in place, it should be smeared on the inside where it comes in contact with the can with white lead. After it is in place, the outside should also be painted with white lead and allowed to dry. This will make the can water tight.

The oscillator for the transmitter must be used in connection with a telegraph key and three dry cells. The connections of the device are shown at the bottom of the drawing.

The microphone or receptor is a very simple piece of work. The main frame is cut from a piece of fibre 5 in. x 7 in. The center of this piece is then cut out so that it will form a frame, with inside dimensions of 5 x 3, outside dimensions 5 x 7. Holes are then drilled around the edge of this frame with a 28 drill and tapped out to receive an 8-32 brass screw. A piece of 20 gauge sheet brass is used to cover one side of the frame and holes must be drilled in this piece to correspond with those in the fibre frame. A thin film of white lead is smeared around the frame before the brass sheet is put in place. After the screws are tightened properly a drop of solder can be placed on each one to make the device as nearly water tight as possible. The diaphram should be cut from thin sheet brass. Holes are drilled in it to correspond with those drilled in the frame. To save a lot of work in doing this, the writer placed the two pieces of sheet brass together and clamped them with the frame in the vise. All the holes were then drilled together. Before the diaphragm is put in place, the microphone is laid flat on the bench and filled with carbon grains. These can be made by crushing an old battery carbon. The pieces should be a little smaller than a pea. The microphone should be filled flush with the carbon

(*Continued on page* 132)



Digitized by Google

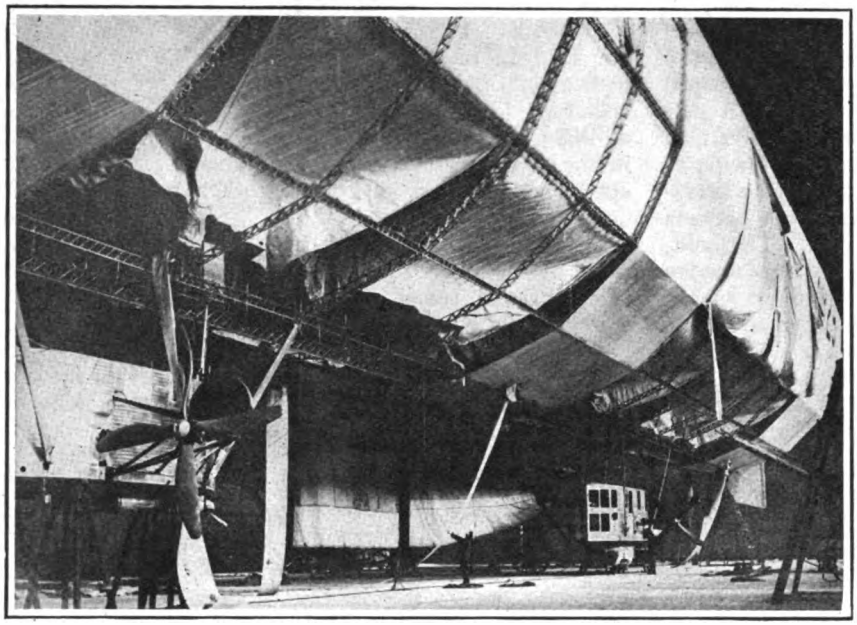
Dirigible Airship Frame Construction

Details of the Hull Structure Showing How a Combination of Engineering Ability and Metallurgical Knowledge Made the Rigid Airship Possible.

By Victor W. Pagé, M. S. A. E.

TO design and construct a frame structure nearly 700 feet long and 80 feet in diameter that will be sufficiently light to form the basis of the modern dirigible airship and at the same time secure the requisite strength to carry a heavy load of passengers and freight and withstand the vibration of powerful engines and buffeting of the elements is a task of no mean proportions. Its successful achievement is a triumph of modern science, not only in the engineering involved in the design and construction of light parts, but also in the metallurgical knowledge called for to select and produce metal alloys of great strength and lightness.

There were two big problems to be solved, one pertaining to the frame, the other to the envelope and gas bags. The costly and long continued experiments of Count Zeppelin and his corps of engineers were finally successful and the modern airship is the result of years of development on their part. The illustration at Fig. 1 outlines a recent British type, while one of the German rigid dirigibles known as the L-33 is shown at Fig. 2. The frame of the latter may be considered typical of this design and is shown in simplified form without covering or gasbags at Fig. 3. As will be evident, the hull is built up of aluminum alloy or duralumin lattice girders of triangular section, as shown at Fig. 4. These girders are built up of three-corner rails of modified channel section, which are interconnected by X-shaped pieces of fluted cross section. Owing to the great number of these pieces, they were stamped in dies, and besides the flattened out ends provided for attachment to the longitudinal channel section members, the center was also formed so it could be joined to a similar pad on the other member of the pair of rivets, as clearly shown at Fig. 5.



View of hull of British dirigible, showing framework very clearly as outer covering is removed at various points

The alloy used undoubtedly varies in different craft, but a metal sample taken from a Zeppelin that was brought down during the war analyzed as follows: Aluminum, 91.92 per cent.; copper, 4.13 per cent.; iron, 3.27 per cent.; silicon, 0.65 per cent., and tests showed that it had a tensile strength of 40,000 lbs. to the square inch. The thickness of the metal used varied from 0.5 to 1.0 millimeter, depending upon the strength required of the part. The strongest girders weigh about 2.2 pounds for each 40 inches of length. The cross section of the girders is an isosceles triangle measuring 0.27 meters in height and 0.14 meters at the base. The hull comprises twenty-five longitudinal girder elements and thirty-six polygonal frames besides the minor braces and fairing members. The cross section of the hull is a twenty-five sided polygon and while it is not exactly circular, it approximates that ideal cross section sufficiently for all practical purposes. The nose is blunt and the stern is distinctly conical, as shown at Fig. 6, which also outlines the symmetrical control and stabilizing members. The transverse frames are of two types, one a simple girder member; the other is more complex, as it is braced with a King post truss. These frames alternate along the length of the hull, as shown at Fig. 3.

An interesting feature is the keel which runs along the base of the

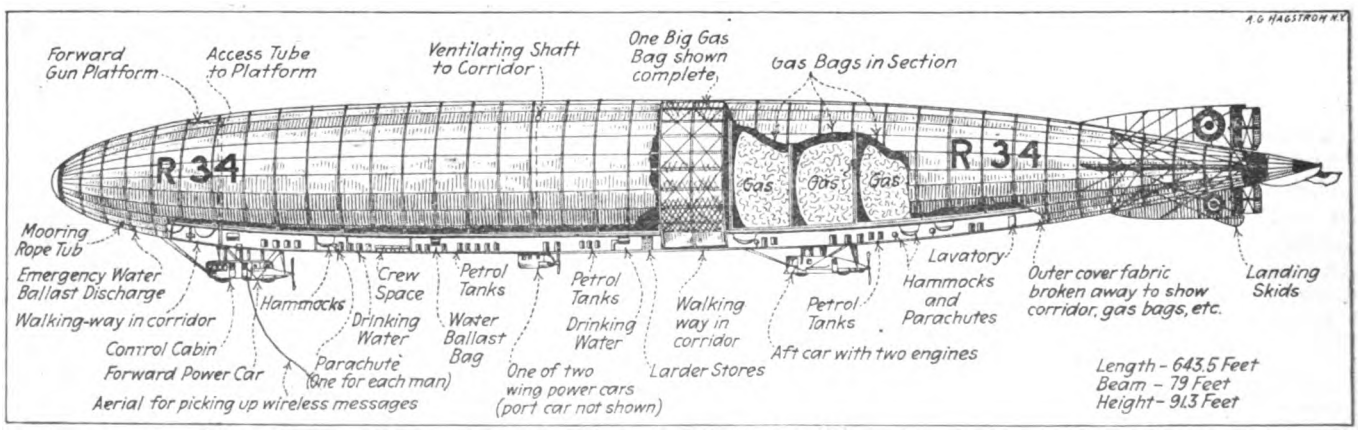


Fig. 1. Part sectional view of latest type dirigible airship, showing arrangement of gas containers, location of power cars, etc.

Digitized by Google

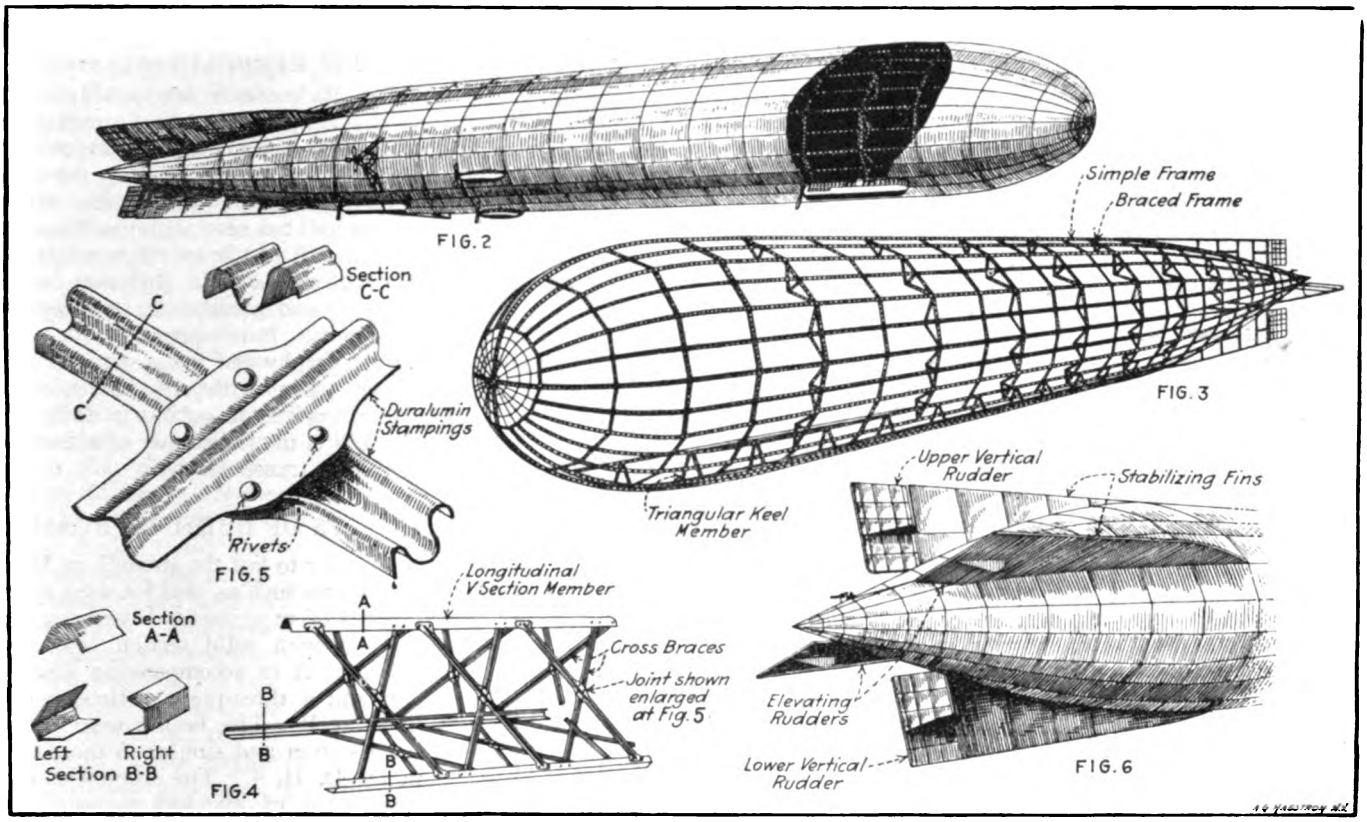
frame. This is triangular in section, as the illustration at Fig. 7 shows. It is formed of two main longitudinals, which are the base, and one situated about ten feet overhead, which forms the apex. The space thus secured is a large corridor, which is utilized as crew space and which provides a means of communication from one end of the main portion of the ship to the other, besides greatly strengthening and stiffening the frame. The way portions of this space are utilized in the R-34, the famous British dirigible, is clearly shown at Figs. 8 and 9. The section of the keel corresponds to the letter A, the crossbar serving as additional bracing. A running board or "cat walk" extends from one end of the keel to the other.

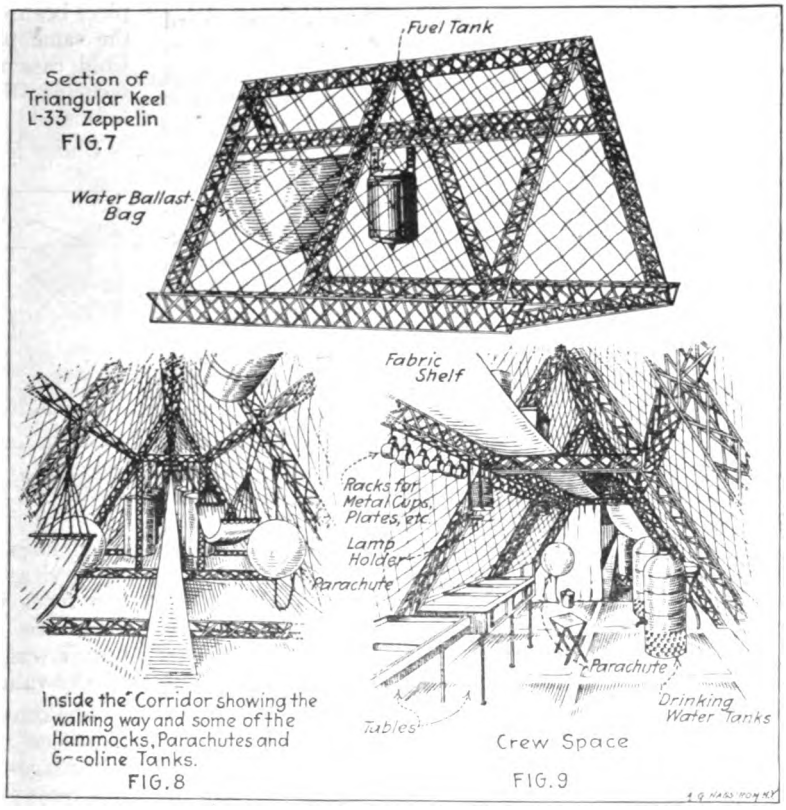
The frames for the control surfaces are also duralumin structures which are composed of smaller girders of rectangular cross section similar in construction to the main frame members.

The envelope of the hull or outer cover is a linen fabric which is doped with black compound on the under side and gray on the upper, and it is composed of strips laced into position on the frame girders. The gasbags are of a special cotton fabric which is lined inside with gold beater's skin, which is said to have resistance to gas penetration superior to the rubberized fabric also used for this purpose.

A netting of special cord surrounds each gas container and holds it in shape to insure against its bulging out into the keel or chafing against the envelope or hull frame. The bags are cylindrical except for the piece which is cut out to fit over the keel structure. Eighteen gasbags are used in the L-33, though the number varies with the length of the airship. In the L-49 the weight of the frame has been estimated at about 8 tons, the outer cover at 2.6 tons and the gasbags at 3.5 tons. The hull is trussed by diagonal stays and special truss members which join the keel to some of the upper longitudinals. The power cars carrying the engines are secured to the main frame and are carried below it, as clearly shown in the illustrations.

The United States Navy has acquired a large dirigible from the British authorities which is larger than the R-34 and which is reported to be the R-38 and to have a number of improvements over the earlier types. This will give our naval authorities the opportunity to become familiar with the features of this type of aircraft and to train personnel for their navigation and care.





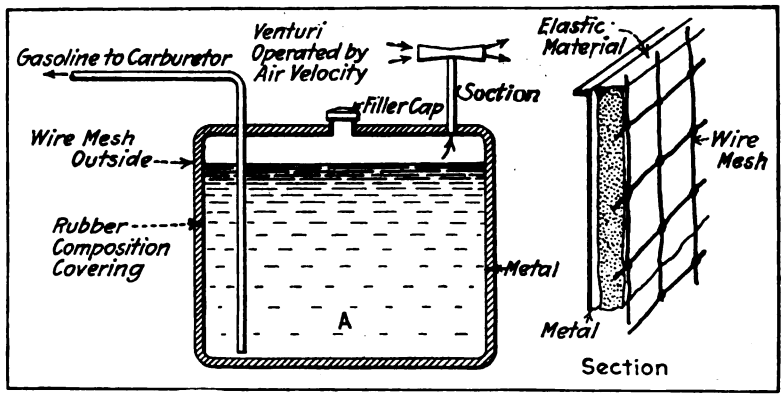
Digitized by Google

AVIATION BRIEFS

A SPECIAL FUEL TANK FOR AIRPLANES

A gasoline tank that cannot leak or burn is of great value in aircraft work, especially in times of war when it may be punctured by numerous bullets. The tank illustrated is the invention of Mr. F. Weinberg, an automotive engineer of Detroit and it has been perfected to a high degree.

Primarily, this container is an ordinary metal tank of any dimensions,



Fuel container designed for aircraft use that is said to be fireproof and puncture proof to a high degree

having two connections and its filler cap. The suction connection is intended to provide a partial vacuum above the liquid of sufficient strength to prevent its escape through any hole that may be shot through the tank wall. The necessary suction can be got in various ways, but probably most simply by the venturi shown, which operates by virtue of the stream of air created by the movement of the plane. The fuel reaches the carburetor through the second opening by overcoming the vacuum created through the former—which may be accomplished by maintaining a greater suction, or by positive feed pumps.

To insure proper functioning at all times, the tank is enveloped in a rubber material under tension which plugs up whatever holes may be shot in the tank as it possesses sufficient elasticity to return to its former state after being pierced, leaving a hole so small as to almost defy detection. The tank may have a number of holes shot in it and still refuse to leak. The application of this principle to render the tank leakproof makes it at the same time explosion-proof. To cause an explosion there must be a combustible mixture of air and fuel; but in the Weinberg tank no such mixture can be created anywhere.

MAN POWER AIRPLANE FLIES

For some time past a group of experimenters in France have been trying to fly with combinations of bicycles and light wings, the usual pedaling gear being attached to a small aerial propeller, as well as to the rear wheel of the bicycle. So much interest obtains that a substantial prize has been offered for the first man to fly 30 yards by his own power. It is reported that Poulain, a French cyclist, recently made a flight of 12 yards at a height of one yard by a man power aviette. Through reports of this flight Poulain has been accepted as a contestant for the Peugeot prize of 10,000 francs for the first 10 metre flight, the prize to be awarded by the Aero Club de France. Such a feat is little more than an acrobatic stunt because a man cannot exert the power required to maintain flight for more than a few seconds at the most with the aerofoils and propellers available with our present knowledge of aerodynamics.

SUPERCHARGER ON RECORD MAKING PLANE

In an airplane equipped with a supercharger for the Liberty engine, Maj. R. W. Schroeder, of the Army Air Service, recently broke the altitude record for a passenger carrying flight. He is said to have reached 30,000 feet in a Le Pere fighter at Dayton, Ohio. The supercharger is a mechanism that supplies air to the carburetor at high altitudes to compensate for reduced density of the atmosphere and thus maintains power output by insuring that as full charges of mixture will be inspired by the motor at high altitudes as at sea level. Several forms of superchargers have been experimented with but no mechanism of this type has been developed that is entirely satisfactory.

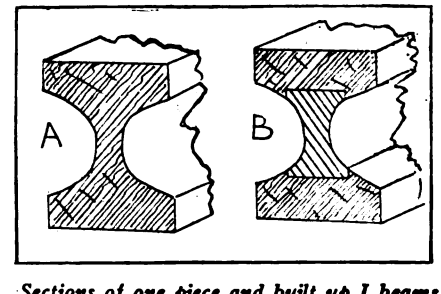
NEW ZEPPELIN AIRSHIP

The Bodensee, a new airship made by the Zeppelin interests, covered the distance between Friedrichshafen and Berlin at the rate of 75 miles per hour on its maiden trip. The familiar cigar-shaped hull has been abandoned and the new aircraft is a more efficient streamline hull shape. The Bodensee is 400 feet long and accommodates thirty-five passengers. It is equipped with wireless telegraphy and has a spacious passenger cabin with all conveniences. The aircraft is to go into a daily service and is the forerunner of a fleet for passenger transport.

TESTS OF BUILT-UP BEAMS

In order to test the strength of built-up I-beams such as used for wing spars, a series of experiments have been carried on with solid section beams as shown at A in accompanying illustration and a three-piece section as outlined at B. The beams were of the same section and similar to those used in the D. H. 4. The specimens were constructed of matched material, the solid beams and the flanges of the three-piece beams being cut side by side from the same plank of clear Sitka spruce. Cold casein silicate glue was used in securing the parts of the built-up beams.

Under four-point loading, which approximates the application of stresses in service, the loads sustained by the two types were about the same. The difference in favor of the built-up beams was too slight to be considered of any value.



Sections of one piece and built up I beams tested

The construction of I-beams of more than one piece offers certain obvious advantages. It enables the builder to use cross-grained material in the web, and since smaller pieces are required than in the case of the solid section, more beams could be produced from a definite amount of lumber.

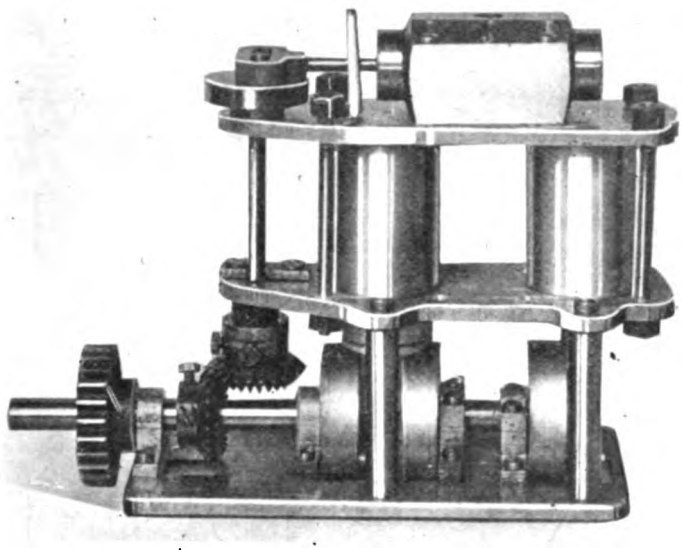
Digitized by Google

A High Speed Flash Steam Engine

By George Bender

Designed and Constructed by the Author.

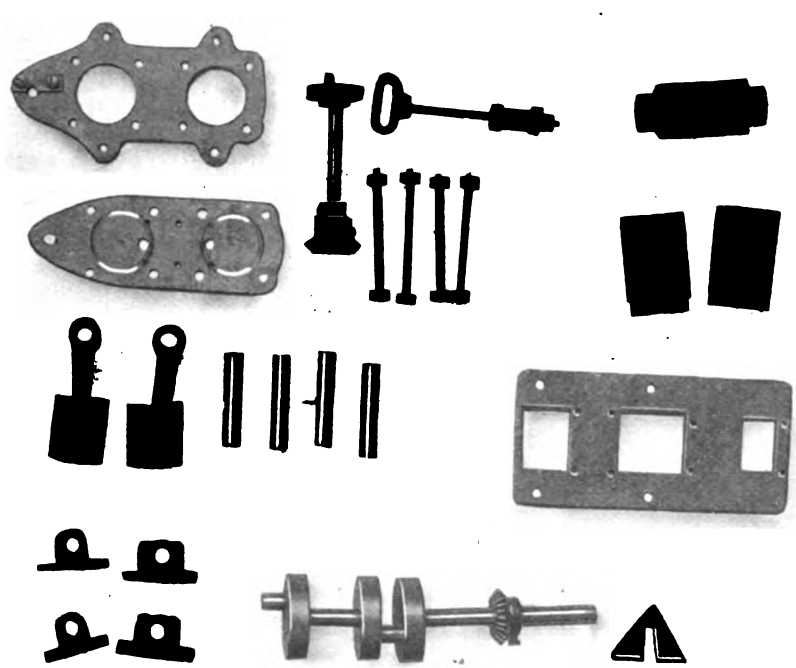
THERE were two reasons for the writer to construct the engine shown in the drawing and photographs and these were cheapness and ease of construction. Regarding cheapness, it can be said that there was not one casting used and everything, with the exception of the bevel gears, was made of scrap material. Regarding ease of construction, it will be seen that most of the parts do not require the use of a lathe but those that do are easily machined with the smallest and crudest piece of machinery. This does not make any exception of the crankshaft which the writer believes is quite novel in construction and very efficient. This engine has been run steadily for over one hour without the least sign of distress.



The engine assembled. Although of very simple construction this engine will prove very suitable to use in connection with flash steam

In construction, let us start by making the three plates which form the cylinder top plate, cylinder bottom plate and bed plate. First lay out the shape of the piece and position of all the holes in the cylinder bottom plate. After the plate has been filed to shape all holes can be drilled and this plate can then be used as a jig for the top and bed plates. After all plates have been drilled and filed to shape, the cylinder bottom plate must be turned out to fit the shoulders which have previously been turned on the cylinder tubes. In the cylinder top plate two grooves are turned about 1/32 inch deep to fit the top of the cylinder tubes and after driving the cylinders into the bottom plate, the top plate can be put on and the whole bolted together with eight bolts and nuts of which only four are shown in the photograph.

The valve chamber is of the piston type with inside steam admission and has both ends open and free to exhaust. This was made from a solid piece of cold rolled steel ¾ inch square. The steam ports are ⅛ inch square and piston valve diameter ⅜ inch. The valve itself was also made of cold rolled steel and was ground into the valve block for a perfect fit. The valve is actuated by a sliding pin in a disc driven by a bevel gear from the crankshaft. The pistons were also made of cold rolled steel and turned to fit the ¾ inch inside diameter of the cylinder tubes which were made of Shelby steel tubing. The pistons were bored out inside to take the connecting rod and wrist pin, three water seal rings were turned on the outside of each piston. The connecting rods were made of ⅛ inch thick brass plate and the shape can be seen by referring to the drawings.



The finished parts of the engine ready to assemble

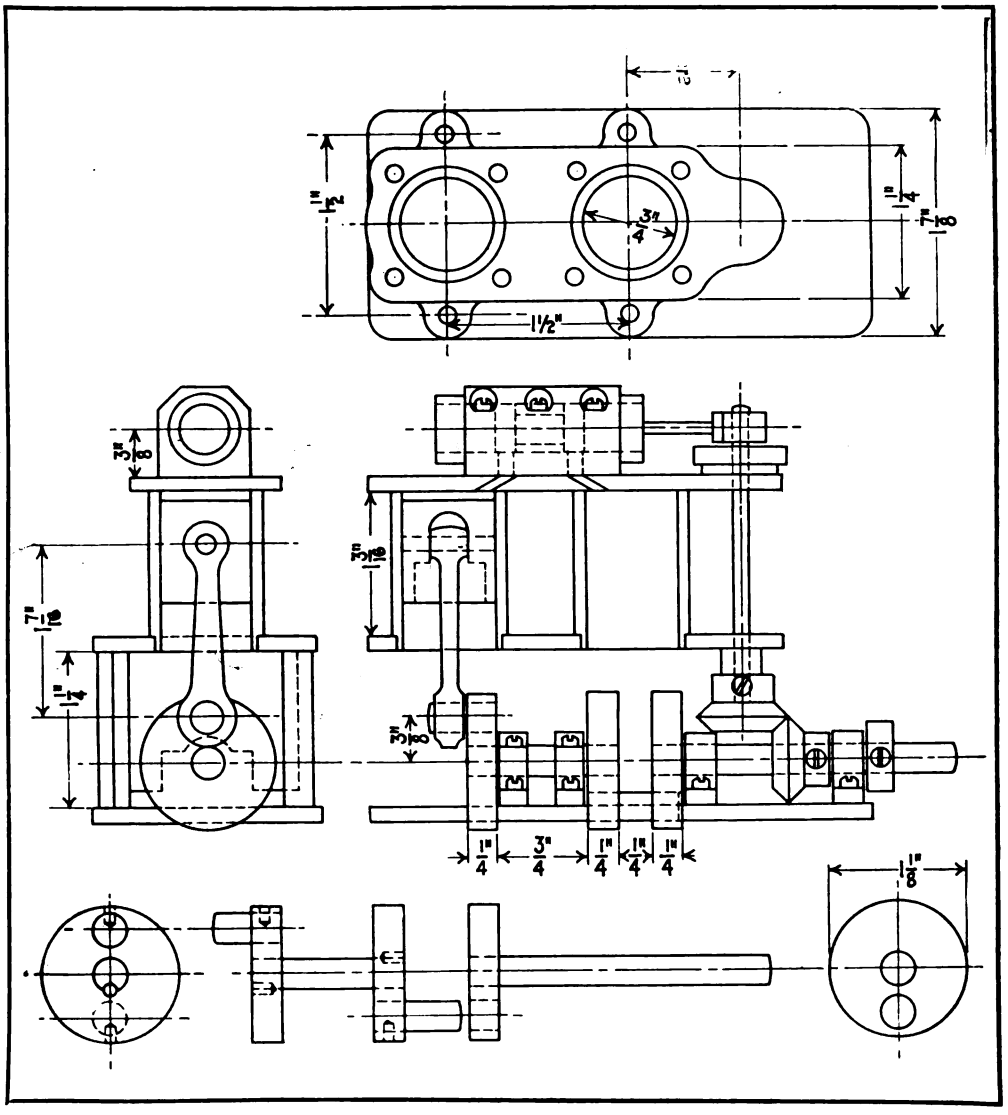
And now we come to the crankshaft. To see whether this method of crankshaft construction would stand up under severe usage was another reason the writer had for the building of this engine. The crankshaft is built in two sections; one long and one short section. It consists of three circular pieces of cold rolled steel 1⅛ inch diameter and ¼ inch thick. These pieces were sawed from a piece of shafting 1⅛ inches in diameter in slices about ⅜ inch thick. They were put in the chuck and faced off at each side down to the thickness of ¼ inch. Before removing the pieces from the chuck, carefully center and drill with a ¼ inch drill. If a drill can be found that is about two one-thousandths of an inch undersize it will be an advantage when fitting the shaft. Now take one disc

Digitized by Google

and drill another ¼ inch hole exactly ⅜ inch away from the center. This one disc can now be used as a jig for drilling the other two discs. Two of the discs are now taken and driven onto a piece of ¼ inch drill rod of the required length, making sure that the crank pin holes are exactly opposite each other. Small holes are drilled into the ends, half being in the crank disc and half in the shaft, and then small pins are driven into these holes to securely fasten discs to the shaft. Crankpins, one short and one long, are next driven in their relative holes and secured with pins driven through the rim of the crank discs. The other long section of the crankshaft is simply one disc securely fastened and pinned. When assembled on the bed plate the long crank pin enters hole of the long section of crankshaft and does all the driving. These crank discs also answer the purpose of a flywheel and therefore no flywheel is necessary. The crankshaft bearings, of which there are four, were made from some 3/16 inch thick brass plate sawed out and filed into the desired shape. The two bearings of the short section of crankshaft must be split bearings but the other two for the long end can be left solid. The split bearing will be found necessary when the engine is assembled. It is very simple to line up the crankshaft bearings. After the necessary clearance holes have been cut into the bed plate, take a piece of ¼ inch steel rod and slip all the bearings on the rod in their relative positions after which set them on the bed plate and mark out the fastening down screw holes. After drilling and tapping the holes, fasten the bearing to the bed plate. If this work has been carefully done, no trouble will be experienced with the crankshaft binding when the long and short sections are put together.

The photographs of parts and finished engine will clearly show details of construction and it can easily be seen that this engine will give a good account of itself, whether put into a speed boat or just a good cruising model.

The engine weighs finished 1 lb. 4 ozs. without boiler or pumps. The engine can be used very successfully with flash steam as well as with saturated steam. It is a powerful engine well adapted for racing models. Like all flash steam engines it is capable of making a tremendous speed and it will stand up under heavy loads considering the labor necessary to produce this engine, it is a serviceable, good machine.



Book Review

PRACTICAL DRY CLEANER, SCOURER AND GARMENT DYER. By Brannt-Gray. 368 pages with illustrations. Size 5 x 7½ ins., bound in cloth. Published by the Henry Carey Baird Co., Nassau Street, New York City.

This book is a well arranged and clearly written treatise on the science of cleaning and dyeing. Its pages include every conceivable process that has proven to be of practical value. The treatment is entirely practical rather than theoretical, and the information is imparted in clear, understandable terms. French Cleaning; Removal of Spots and Stains of Various Kinds; Wet Cleaning; Finishing Cleaned Fabrics; Cleaning and Dyeing of Various Kinds of Materials; Renovating; Garment Dyeing; Stripping Colors; Analysis of Textile Fabrics; and a concluding chapter on Practical Chemistry for the Cleaner and Dyer, form the subject matter of the book. This book will give great practical information as a reference and guide.

INDUCTION COILS IN THEORY AND PRACTICE. By Prof. F. E. Austin, E. E. 64 pages, size 5⅛ x 8½ ins., bound in cloth. Published by the author at Hanover, N. H.

This book is a very involved treatment of the induction coil and includes a mass of advanced mathematics concerning its theory. It is a splendid volume for those who wish to go more deeply into the subject than the average text book takes them. Prof. Austin, the author of the treatment, is specially qualified to prepare such a book, and we have reason to believe that it will be widely read by those who are able to digest its contents. The forepart of the book is devoted to the theory of the induction coil, while the latter part is given over to practical problems in connection with the construction and operation of coils. Some very valuable data in connection with interrupters and condensers is also included, together with a chapter on Tesla coils and choke coils. Magnetic circuits are also explained in detail and the information necessary for a thorough understanding of induction coils and their theory, operation and construction is covered.

Digitized by Google



EXPERIMENTAL CHEMISTRY

METALLURGY—ELECTROCHEMISTRY
PHYSICAL CHEMISTRY

Metallurgy for Beginners

By E. Hurley

In the last issue of EVERYDAY ENGINEERING, *the author discussed the analysis of aluminium, cobalt, nickel, copper, bismuth, barium and chromium. This list will be extended in the present treatment to include all the common elements.*

Lead

GALENA, a heavy gray mineral, is the most important ore of lead, containing 86% of the metal. Cerusite, another lead ore, has a white gray color and contains 83% lead oxide. There are several other lead mineral bearing ores.

Take a gram of the finely pulverized ore in a porcelain dish and add 10 cc. nitric acid and boil until one-half of the acid has evaporated. Then add 5 cc. hydrochloric acid and boil to a complete dryness. Cool and add 5 cc. hydrochloric acid; heat and dilute the solution to 100 cc. with water. Heat again to boiling point and filter while hot. Pass hydrogen sulphide gas through the hot solution and continue to pass the gas until the solution is cold. Absence of a black precipitate shows no lead present. If a precipitate is obtained, wash with ammonium sulphide and then treat the remaining residue with hot nitric acid which will dissolve any lead present. Filter and to the solution add a few drops of concentrated sulphuric acid and if lead is present a heavy white precipitate will slowly settle to the bottom of the test tube.

Manganese

The principal ores of manganese are pyrolusite, which contains about 63% and rhodachrosite, which contains 62%. There are other ores of lesser importance. The principal use of manganese is in the iron and steel industry with a small amount being used as a coloring agent in the manufacture of glass and pottery.

Mix a small quantity of the finely pulverized ore with equal parts of sodium carbonate and potassium nitrate and fuse before the blow pipe. If manganese is present, the mass assumes a bright green color which turns bluish green on cooling. Dissolve the residue in water and boil the solution and if manganese is present the solution will show a purplish-red coloration.

Molybdenum

The principal ore is molybdenite. It has a lead-gray color and contains about 59% molybdenum. Another ore of importance is wulfinite and it contains approximately 35% molybdenum. Its chief use is in the manufacture of steel and in the preparation of ammonium molybdate. Other uses are to color pottery, leather and to dye silk and woolens.

Treat a little of the finely pulverized ore in a porcelain dish with 20 cc. nitric acid. Heat and evaporate to dryness. Cool and add 3 cc. sulphuric acid and again heat until the acid is almost gone. Cool, and add a few drops of alcohol and if molybdenum is present the solution and sides of the dish are colored an intense blue.

Thorium

The principal ore of thorium is monazite, color brown to brownish red. It has been found in the West but the principal production in the states comes from the sands of the many creeks in the Carolinas. Its principal use is in the manufacture of incandescent mantles for gas lamps, etc.

Fuse about one gram of the finely pulverized ore with five grams of potassium sulphate in a porcelain crucible. Heat until the mass is in quiet fusion and cool. Place the crucible containing the melt in a porcelain dish and dissolve the residue in 10 cc. of hydrochloric acid and add 50 cc of water. Boil until everything has passed into solution and filter. Treat the residue on the filter with a little hydrochloric acid, heat and again dilute with water and filter. Unite the two filtrates which now contain all the thorium and heat. Pass hydrogen sulphide gas through the solution and remove any precipitate by filtration and boil the resulting solution. Then add ammonia in excess and if any thorium is present, a white precipitate will be formed. Filter this precipitate off and wash it. Add to it a few cc. of dilute sulphuric acid to dissolve and to this solution add boiling concentrated solution of potassium sulphate and a white crystalline precipitate will be formed if thorium is present.

Tin

The chief ore is cassiterite, a heavy brown and black mineral which contains 75% tin. It is found in many localities of the United States in veins of granite. Another important tin ore is stannite with a steel gray and black color and contains 30% tin. The ores running very low in this mineral can be treated very profitably by the wet concentration method and prospecting and investigating for tin should claim serious attention of the amateur prospector.

Fuse before the blow pipe one gram of the finely pulverized ore with four grams of sodium peroxide. Dissolve the melt in hot water and filter. Acidify the filtrate with hydrochloric acid and to this solution add a piece of zinc. When tin is present, it will be deposited on the zinc in a spongy mass. Remove this deposit and dissolve in a porcelain dish with the addition of 3 cc. hydrochloric acid. Add to this solution a little mercuric chloride solution and if tin is present, it will be thrown down as a white precipitate.

Tungsten

The principal ores are wolframite, which contains 50% tungsten. Scheelite contains about 64% tungsten. It is used in the manufacture of high speed tool steel and in the making of filaments for incandescent lamps.

Place a little of the finely pulverized ore in a porcelain dish. Now add 15 cc. of strong hydrochloric acid and a small piece of metallic tin. Boil a few minutes and if tungsten is present the solution will be colored a beautiful blue. Small quantities of this mineral in the ore tested responds readily to this test.

Uranium

Uranium ores are of special interest since it is from these ores that radium is obtained. The principal ores are

Digitized by Google

uraninite (pitchblende). Carnotite has a canary yellow color. Uranium is also used in the steel industry and in the making of glass.

Put one gram of the finely pulverized ore in a porcelain dish and add 10 cc. of nitric acid and 3 cc. of water. Heat and add 5 cc. of sulphuric acid and dilute with water to 50 cc. Add in excess a saturated solution of potassium hydroxide and if uranium is present a deep yellow precipitate will be formed which will be insoluble in water.

Vanadium

The principal ore is vanadinite. Carnotite (see uranium) is also an ore that has a small content of vanadium. Its principal uses are in the manufacture of steel and in the dyeing industry.

Fuse a little of the finely pulverized ore in a porcelain dish before the blow pipe with a little sodium carbonate and potassium nitrate. Dissolve the melt and filter. Make acid with hydrochloric acid. Put a small quantity of this solution in a test tube and add two drops of hydrogen peroxide. When vanadium is present, the solution will assume a brownish red color.

How to Make a Chemical Balance

FOR serious chemical work the experimenter should have a small balance in his laboratory. Such a balance, however, is very costly and, therefore, many experimenters find it necessary to work without one.

The balance described in this article is very inexpensive and easily constructed. The materials necessary are not uncommon and all of the parts can be made with little labor.

Fig. 1 illustrates the completed balance. In this figure all of the necessary details of construction are shown. The handle (Q) raises the beam lift (H) and thereby not only removes the weight from the bearing, but also prevents the beam from swinging. The lever (O) permits the stop (K) to drop and allows the pans to swing. The bearings are made from an old hack saw blade.

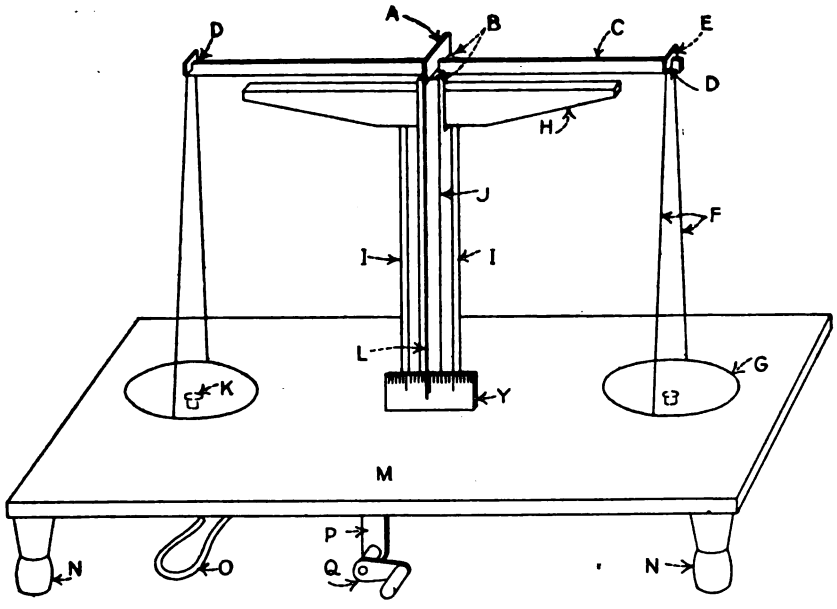


Fig. 1

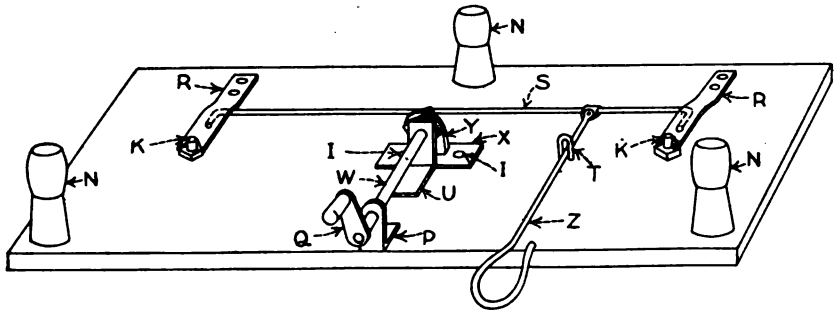


Fig. 2

The beam of the scale will be considered first. This is made of either brass or aluminum and is ⅛ in. thick, ½ in. wide and 10 ins. long.. (See C, Fig. 1.) In the center of the beam a ⅛ in. slot is sawed. A ½-in. hack saw blade is then ground to a knife edge. A piece 1½ ins. long is soldered into the slot. (See A.) This forms the main bearing of the beam. Exactly ¼ in. from each end of the beam a small V shaped groove (D) is made.

The base of the balance (M) is cut from a piece of ½ in. hard wood. It is 7½ ins. wide by 13 ins. long. In the center of the base the upright (J) is placed. This upright is ½ in. thick, 1 in. wide and 8 ins. long. At the top of the upright or standard the slot for the beam lift (H) to slide in is made. This slot is ⅜ in. wide and 1¾ ins. long. The bearings (BB) are screws, the slots of which are filed out to a V shape.

The beam lift (H) is made of ⅜ in. stock. It is one in. wide and 6½ ins. long. 2½ ins. from each end it begins to taper. At the end it is ⅜ in. wide. The brass rods (II) pass through the base and are soldered to the brass strip (X). The cam (Y) causes these rods to be either raised or lowered. This cam is bolted or soldered to the rod (W) which is attached to the handle (Q). The rod (W) is held in place by the brass strips (U, P) which are screwed to the base.

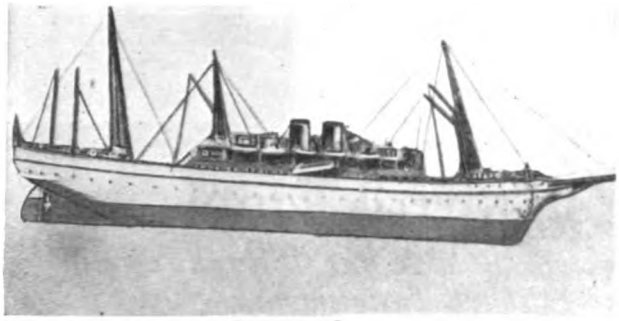
The pieces (KK) prevent the pans from swinging. The nuts adjust them so that they will come to the proper height. These bolts are 3/16 in. in diameter and 1½ ins. long. The springs (RR) hold these bolts in position. These springs should be made very weak. The handle (Z) causes the rod (S) to turn. The hooks on this rod lift the spring and thus allows the bolts to drop. The writer used a rib from an umbrella to make the rod and handle. The guide (T) holds the handle in place. The legs of the balance are turned to shape on a lathe, although square ones would serve the purpose just as well. The pointer (L) is a fine knitting needle. Scale (Y) shows when the beam is in balance.

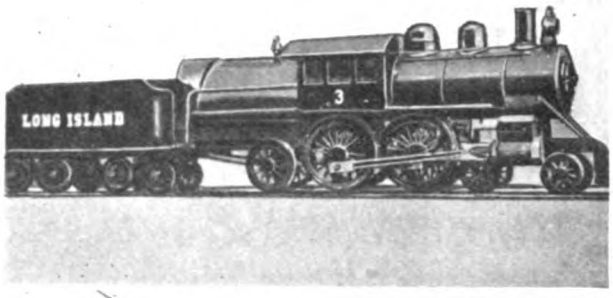
The pans are of aluminum or nickled brass. They are attached to the beam by the two knitting needles (FF). These needles are soldered to the bearings (E), which are made of a hack saw blade. These bearings swing in the groove previously produced in the beam.

The more carefully this balance is made the more accurate and sensitive it will be and the smaller the quantity it will register. The base may be made large enough to enclose the balance in a glass case. If such a case is used the front should have a door that opens. If a case is used, a small beaker of sulphuric acid or calcium chloride should be kept in it to prevent moisture from attacking the balance.

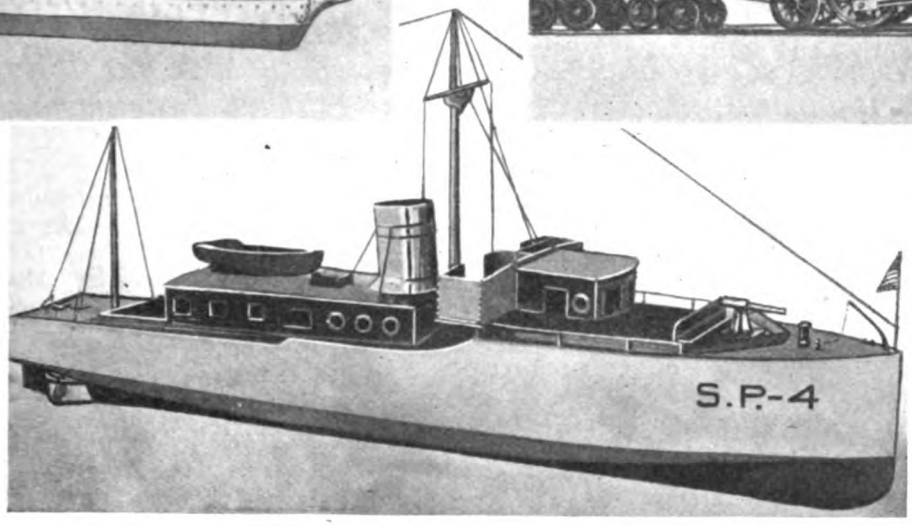
Digitized by Google

MODELS MADE BY OUR READERS

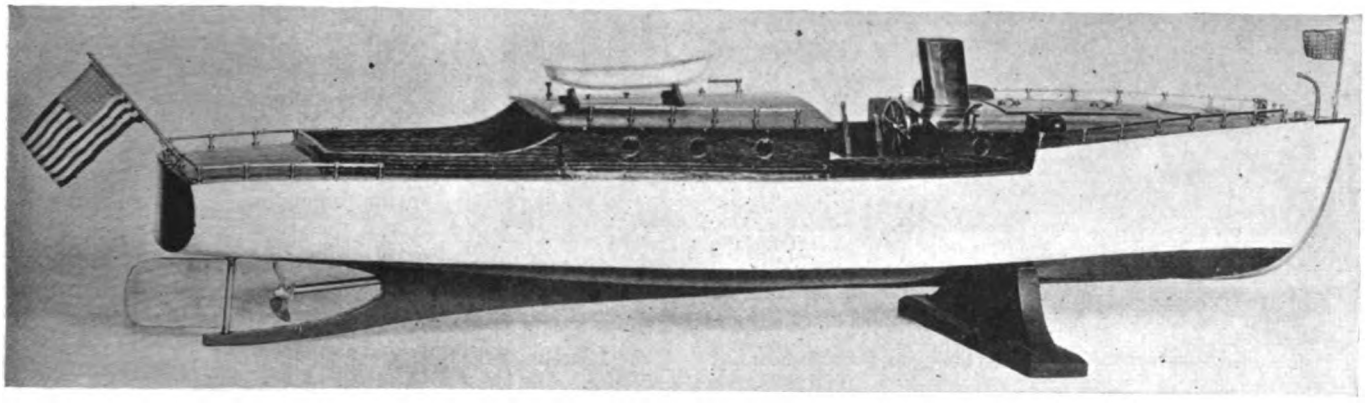




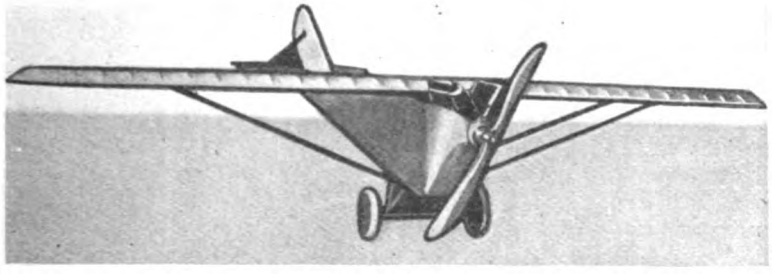
A model steamer of splendid construction built by one of our Canadian readers, Mr. S. Shand, of Edmonds, B. C. This vessel involves a tremendous amount of labor



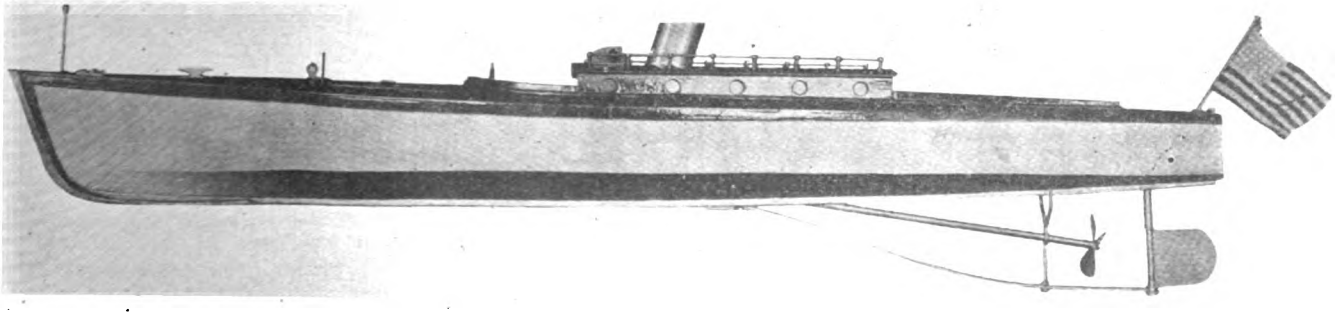
A model locomotive constructed by Mr. J. S. Pearsall. The center picture shows a submarine chaser made by Mr. Zimmerman, of Detroit, Michigan



A beautiful model pleasure yacht made by Mr. E. J. Stroud of Fort Wayne, Ind. The painstaking work on this model is made evident by the photograph



A model Loening monoplane made by members of the Aero Science Club, New York. Another boat by Mr. E. J. Stroud is shown below



Digitized by Google



RADIO TELEPHONE AND TELEGRAPH APPARATUS



Standardized Audion Control Panels

There is Nothing out of Date about a Station Which has Interchangeable Apparatus, nor is it Necessary to Discard Instruments.

By M. B. Sleeper

CARRYING out the ideas given in the April and October 1919 issues of EVERYDAY, additional instruments have been made. The two particularly described in this article are the audion panel and rheostat panel. In the October issue the loose coupler and condenser sections were taken up in detail, and the purpose and advantages of this system of construction were discussed.

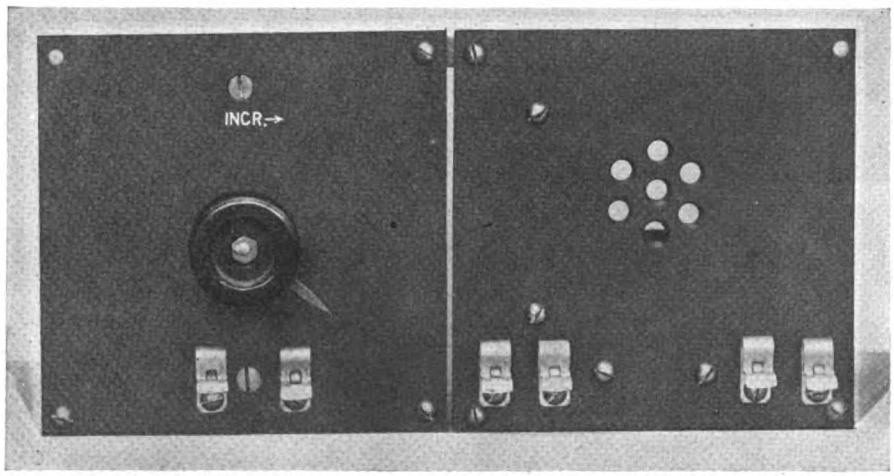


Fig. 1. Always ready to fit into any kind of a set are these standardized audion control panels

The set illustrated here, designed for wavelengths from 200 to 700 meters, shows the versatility of Standardized Panel equipment. Without making a change in the coupler and condenser, the crystal receiver, described in October, has been made into an audion set.

Fig. 1 shows the front of the audion control panels, and Fig. 2 the arrangement of the rear. At the left of Fig. 2 the audion mounting is shown in detail. It comprises a de Forest type audion socket, grid condenser, and four Fahnestock binding posts.

The panel is of bakelite, 5 x 5 ins. Two inches from the top, a 1-in. circle is described and ¼-in. holes are drilled, with another at the center, to give a view of the lighted filament. Each hole is slightly countersunk at the front to improve the appearance. Holes are drilled at each corner, ¼-in. from the edges, with a No. 18 drill. These are to take the mounting straps. Also, holes of the same size are made along the lower part of the panel for the binding post screws.

Drilling details for the audion socket will not be given, for some may have the Marconi type socket instead of the one used here. The illustration shows clearly that the socket is held by brass angle brackets made of ⅜ x 1/16-in. strip. Connections are of No. 14 bare copper wire. This was a little too large for the screws on the socket. Accordingly, the wire was hammered square and bent to form hooks to fit under the screw heads. Plate and filament wires run directly to the binding posts.

The grid connection goes to a grid condenser secured to the rear of the panel. It will be seen that one set of screws serves only to hold the bakelite clamping strips to the panel, while a separate set act as terminals for the condenser. The bakelite plates are 3 x 1½ ins. and 3/16-in. thick. Condenser plates were cut from No. 30 gauge brass, though tin foil will do, to a size 1½ x 1 in., with a No. 18 hole in the center line, ¼ in. from one end. Next, the two bakelite plates were drilled along the center line ¼ in. from each end. The top plate has two more holes ½ in. in from the others. These last holes are deeply countersunk. When the copper and parafine paper strips were put in place, flat head screws were put through them and the inner holes of the upper plate. As the screws were

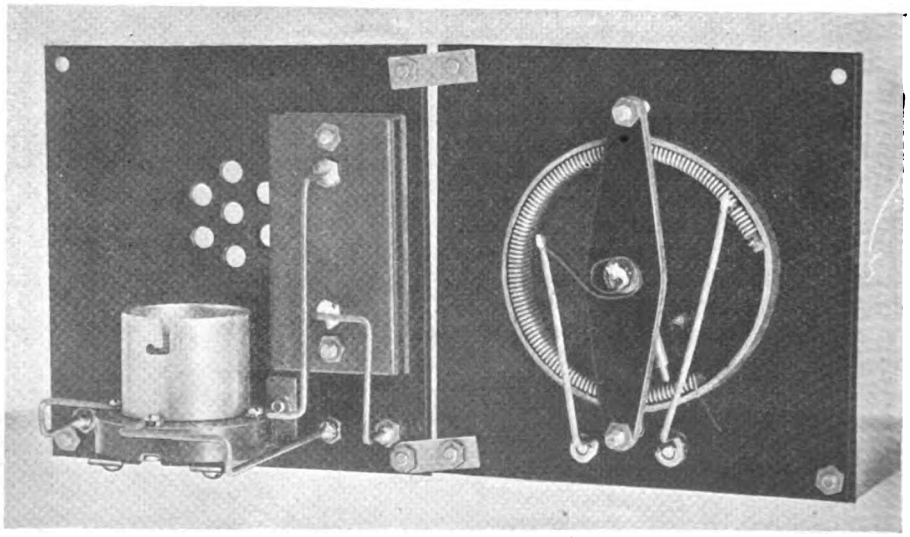


Fig. 2. The neatness and simplicity, upon which efficiency depends, will commend this method of construction to radio men

Digitized by Google

tightened, the heads went down into the countersunk holes, leaving the tops flush with the condenser plates.

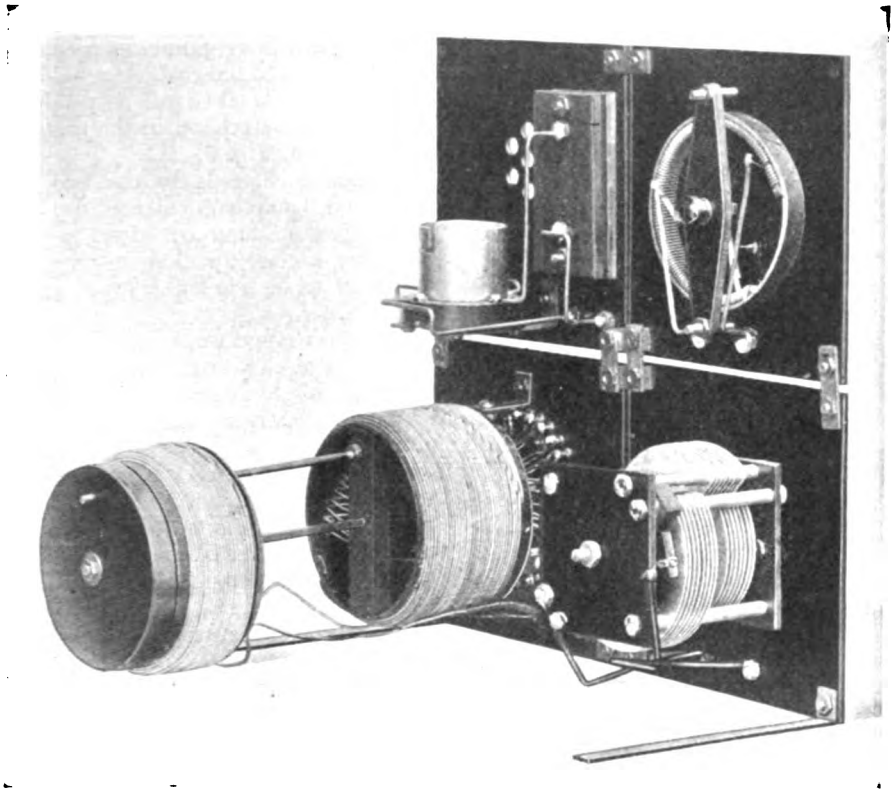


Fig. 3. The audion panels in combination with a simple short wave receiver. Loading coil panels can be added for longer waves

It is advisable to immerse the condenser, with the bottom plate clamped on, in parafin. However, a mistake made when this instrument was built should be avoided. The parafin was boiling hot, and bubbles rose profusely from the condenser. In fact, they did not stop at the end of ten or fifteen minutes. When the condenser was removed for inspection, it was found that the bubbles were coming from large blisters which had formed in the bakelite pieces. Another condenser was made and left in the parafin only one minute. This proved satisfactory in use, and did not injure the bakelite plates.

Numerous methods for building the rheostat were considered. The easiest way seemed to be to mount a regular 10-ohm Mesco rheostat on the back of the panel. However, it was very difficult to take out the screw which held the contact arm. In fact, during the course of operations the base was cracked. Another solution suggested itself. The remaining parts of the base were knocked away until only the resistance element was left. Then it was put inside a short length of cardboard tubing 3 ins. in diameter. Just the thing! It could be arranged with an internal contact.

The next step was to cut off a piece of brass tubing 1½ ins. long with a ⅛ in. hole, and to solder it to a length of 6-32 threaded rod which served as a shaft for the handle. A small brass spring was inserted in the tube, and a ⅛-in. rod put in for a contact. Another difficulty came up. How could the rheostat circuit be opened at the point of minimum resistance? Finally, the wire was cut ¼ in. from the end, and a lead brought out as shown in Fig. 2. Without sticking over the wires, the contact can be run past the lead onto the disconnected end.

A clamping strip of 3/16-in. bakelite was put over the resistance unit and tube to hold them in place. Connection was made to the shaft with a thin strip of brass. Fig. 1 shows the handle and indicator.

These audion mounting and control panels represent a cost of less than five dollars, yet they are equal in efficiency and appearance to purchased sets which cost more than twice as much. Moreover, this equipment has the great advantage of universal use for any type of equipment.

Figs. 3 and 4 illustrate the method by which panels are combined to make a complete set. When front connections are used, care must be taken in wiring the instruments for, otherwise, the appearance of the panels will be spoiled. No. 14 bare wire, preferably covered with black Empire cloth tubing, can be used. Each bend should be at right angles, and the wires pushed up close to the panels.

Next month there will be an article showing these instruments with other new ones, applied to a telegraph or telephone transmitter of a simple design such that any experimenter can readily build it in his own shop.

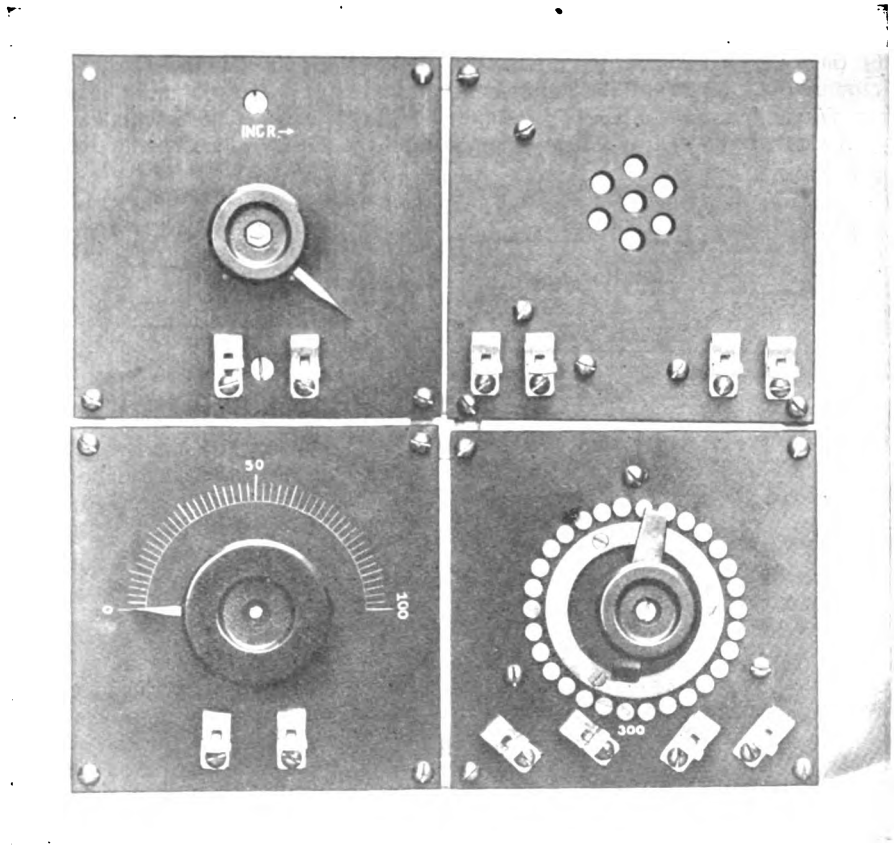


Fig. 4. It is far easier to make good looking equipment by this method than when the instruments are all mounted on one panel

Digitized by Google

Why Tickler Coils are Inefficient for Long Undamped Waves

Although widely used, the tickler coil method of heterodyning causes a very considerable loss of energy on wavelengths over 5,000 meters

WHEN you are copying a station operating on 18,000 meters, you wouldn't knowingly tune your secondary circuit to 17,000 meters, or 19,000 meters—would you? But have you ever stopped to think, when you do this very thing when you use a tickler coil or other means for making the secondary circuit oscilate locally to receive undamped wave stations, that is exactly what happens.

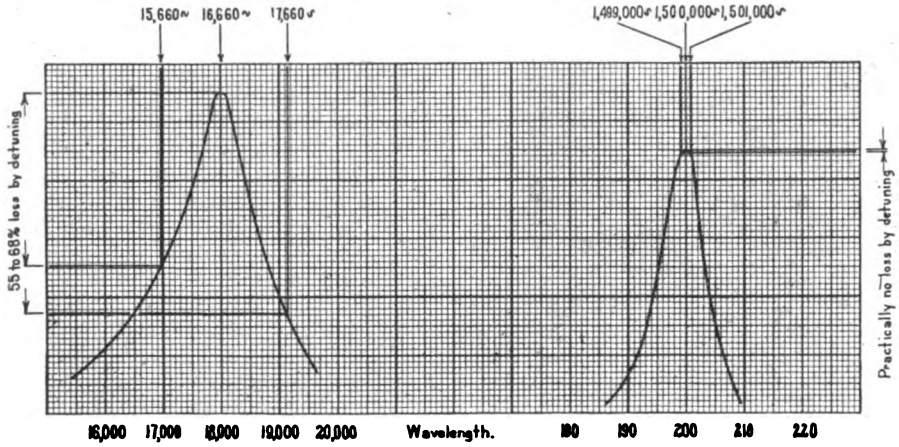


Fig. 1. There is a considerable loss by detuning on wavelengths over 5,000 meters

Fig. 2. As the frequency is lowered, the loss decreases. At 200 meters it is negligible

To make this point clear, consider the theory of heterodyne reception. A frequency is impressed upon the incoming signals, the result of which is a note in the receivers of a frequency equal to the difference in frequency between the incoming and impressed or local oscillations.

In practice, the primary circuit is closely tuned to the transmitter. The secondary is *detuned,* to give an audible frequency. So it is that the secondary circuit is not adjusted to the frequency of the received signals.

At short waves, a slight detuning in wavelength makes a large difference in frequency, so that this affect is not pronounced. Long waves, however, have a low frequency. Thus a small difference in frequency requires a considerable change in wavelength.

Consider Fig. 1. This shows the signal strength when a receiver is tuned above and below the wavelength of the transmitter. A maximum amount of energy flows in the secondary when it is adjusted to 18,000 meters, but, at 17,000, the wavelength for a 1,000-cycle beat note, only 55% of the available energy is being used. This is obviously a considerable loss, of special importance when the signals are weak.

That this percentage of loss decreases with the wavelength is shown by Fig. 2. Here the curve shows the energy in the secondary when it is tuned above and below the wavelength of a 200-meter transmitter. The detuning to produce 1,000-cycle beats is less than 1 meter, and practically no energy is lost.

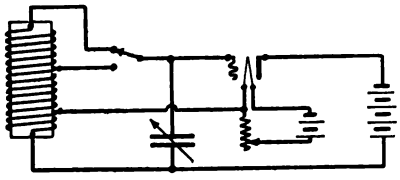


Fig. 3. Circuit for separate oscillator using a tubular coil.

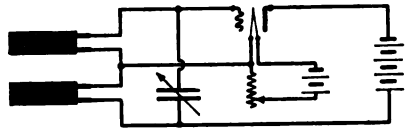


Fig. 4. Honeycomb coils can be used in place of the tubular inductances

On wavelengths above 5,000 meters, heterodyne reception should be accomplished by means other than the use of a detuned, oscillating circuit. The simplest method is to set up a separate oscillator, coupled to a straight receiving set.

Fig. 3 shows the connections for a simple and powerful oscillator which, without any auxiliary adjustments, will oscillate at any wavelength depending only upon the sizes of the coil and condenser. For reception between 5,000 and 25,000 meters, using a 0.001 mfd. condenser, the coil should have an inductance of 125 millihenries, tapped at 50 millihenries for tuning down to 4,000 meters. A coil of this size should be wound for 11½ ins., with two banks of No. 28 single silk-covered wire on a tube 5½ ins. in diameter, 1¼ pounds of wire are required. This may sound like a tedious job, but, as a matter of fact, small wire is not hard to bank. The 50-millihenry point is 5½ ins. from the start of the coil.

Also a tap is taken off 3 ins. from the start, for connection to the filament of the audion, Fig. 3.

Another method is to use two 65-millihenry honeycomb coils for the long range. Connections are given in Fig. 4. They are set up close together, so that they act as one coil, tapped at the center.

For short-range work only a crystal detector is needed to receive undamped waves if this oscillator is used, or for long distance, an audion detector is required.

To operate the set the oscillator is set up near the receiving inductance, so that the axes of the two coils are parallel. The receiver is tuned to approximately the wavelength of the transmitter to be copied, and, as the receiver is adjusted, the condenser of the oscillator is swung back and forth until the proper conditions for heterodyning are found.

While this system introduces a new adjustment, it does away with all oscillating secondary troubles and greatly increases the efficiency of the set.

The Use of B Batteries

THERE seems to be some prejudice among experimenters against the use of the Signal Corps and Navy type B batteries. They feel that they must have a means for adjusting the voltage. As a matter of fact, the Marconi-de Forest tubes now sold need no plate adjustment; 22.5 volts is none too much, and, for receiving, nothing is gained by using a higher plate potential.

It is surprising that experimenters do not recognize the advantages, both in point of economy and apparatus design, offered by Standardized B Batteries. Possibly it is because the average radio man has no means of testing batteries that he does not realize how much greater service is given by 22.5 batteries than by individual flashlight cells. The latter type are designed differently, and are not made by the same formulas which are used for B batteries. The manufacturers know that flashlight cells cannot give the same service as these intended for radio work.

Over a period of one year, it costs twice as much to use flashlight batteries as B batteries.

The efficiency of a set is decreased by the former type, for they do not hold out as steadily or as long. For short distance transmitting, several Navy type B batteries in series cost less and produce better results than the others.

Digitized by Google

The Radio Department

DO radio men ever meet without asking the preliminary question, "What's new?" Then, after agreeing that there is only the same old stuff, they proceed to disclose developments.

The delay caused by the printers' strike makes the announcement of open transmitters rather late, though from the inquiries which are coming in it seems as if the news has not been thoroughly broadcasted. Page 108 gives the details, with some other thoughts which experimenters and others should bear in mind.

It is to be hoped that experimenters, instead of acclaiming the successful conquest of their rights, will think a thought of thanks in the direction of Washington, D. C. People in general seem to think, in these days, that the capitol is a politicians' Baden-Baden. So it is for some of our anti-American labor representatives.

In all events, the experimenters' long period of watchful waiting is over.

AND, speaking of this watchful waiting business, the Army did a little about which most of us knew nothing until it was disclosed by Major Tinsley at the first fall meeting of the Institute of Radio Engineers. Little Silver turned out in good form to support the Major, but the announcements of the meeting were so late that the attendance was far below that merited by the paper.

Major Tinsley gave the results of a long-continued 24-hour watch on the radio compass. This set of experiments, made to determine the errors of the compass, is one of the most complete and accurate set of observations ever made on receiving effects.

The result of these experiments makes possible a new and more satisfactory theory for the propagation of waves, and affords an explanation for radio compass errors.

THE Post Office Department, not to be outdone by the others, is taking up radio work. Just what the plans are, no one wants to say, but there are ground stations and a number of airplane direction finders going into commission. It is understood that these sets are going into the largest airplanes ever built in this country, and that they will carry mail from coast to coast.

AN important step in the popularization of the radio telephone is the new de Forest set which operates on 110 volts, A. C. The set includes a step-up transformer from which current is put through a vacuum tube rectifier. Thus it is possible to put up the equipment in any place where A. C. is available.

There has been much controversy in regard to the expense of various means for producing the potential necessary to operate audion transmitters. This method from de Forest adds another possibility. Already we have the 110-volt motor-generator, and the storage battery operated dynamotor. They seem to be fairly even in the matter of initial cost. Just which one is the least expensive is not settled.

ON at least one point, manufacturers of radio apparatus agree—radio business was never as good. Reports all summer, in fact, were that the orders came in faster than ever before, with a positive promise that this winter will be the biggest season the industry has known.

Prices of complete apparatus are high, but, in the equipment of the reliable concerns, there is a marked improvement in design and workmanship over apparatus sold by the same companies before the war.

As was predicted in previous numbers, one-horse companies are coming back to worry the experimenters and the Post Office Department. It may be said, for the benefit of those who have unsatisfactory dealings with such concerns that the best way of handling them is by Post Office complaints. No one ever argues with that Department. Sometimes, however, trouble arises through mistakes, even with first-rate companies. Where there is an actual attempt to keep money without shipping the goods, it is a service to all the experimenters to see that the company does what is right.

Experimenters can make sure of the reliability of an advertiser in one way at least. The criterion of responsibility is the advertising pages of EVERYDAY. If a company is represented there, it has measured up to the most critical standards.

By the way, are you having any difficulty in getting any kind of supplies for your work? It seems as if some things are not sold by any company, but EVERYDAY is always glad to help when you have trouble. Call on us.

IN the spring of 1917, Philadelphia found the likelihood of alien disturbances imminent, and various means of protection were considered. The peculiar arrangement of the city would have made it possible, by cutting the lines of communication at certain points, to create isolated sections. It was planned to put up radio equipments in the police stations, so that communication could be established by wireless if necessary.

Permission to operate such stations was not granted at that time, however, and fortunately the need did not arise.

Now, with the growing viciousness of strikes and labor uprisings, there are many cities which may find themselves in the plight against which Philadelphia wished to guard. With the Army demobilized, it will be more difficult to get troops quickly than in 1917.

Every locality where there are large factories employing foreign labor should have radio equipment in the police stations and armories. The cost of the apparatus is not great, it is an easy matter to interest men in the operation of stations, and the saving that might be effected in time of need would pay for the apparatus and the interest on the investment for a hundred years.

City officials will find the local experimenters more than willing to cooperate in putting up stations and training operators, or, if necessary, a radio reserve could be organized. Members of the reserve would keep the sets in operating condition, and take charge of them in emergencies.

EVERYDAY ENGINEERING will furnish any data required as to the equipment and available experimenters.

THE enlarged Magazine, with the increased space devoted to the Radio Department, indicates the continued advance and improvement which is always the aim of EVERYDAY.

Next month starts a campaign for better transmitters. It has been thought advisable in the past months to favor receiving equipment since experimental activities were principally in that direction. With the approach of sending permission, however, transmitters will be given their share of space.

The small Simon set which will be described in January will give some new ideas. Also, an audion telegraph set is being worked up for the next issue. There are also a number of suggestions on receiving apparatus which the active experimenter will want to try out.

Mr. Clement only winked his eye when he was asked about his next contribution, but, if he writes it, it will be too good to miss.

The Radio Registry

All kinds of opportunities are coming up in radio work, not only in the United States but in foreign countries as well. Men to fill these positions cannot be located readily, but they will be found through the Radio Register. Is your name among the others?

There are obvious uses of such a listing. The data required is:

Name.
Address.
Engineer or Experimenter.
Age.
Experience.
Special qualifications.
Radio station owned, if any.

Address your letters to the Radio Department, EVERYDAY ENGINEERING.

Digitized by Google

The LC Table and How to Use It

A Short Cut Method for Determining the Wavelength of an Oscillating Circuit

BY means of the LC table, the long struggle with the wavelength formula can be avoided. This table gives the wavelength corresponding to the product of the inductance in cms., and the capacity in mfds. In other words, if the inductance and capacity are multiplied together, that value will be found in the table opposite the resulting wavelength. Or, if it is desired to find the capacity and inductance required for a given wavelength, in the table, opposite the required wavelength, a number will be found to which the product of the inductance and capacity must be equal.

The following examples illustrate the method by which the table must be used.

1. To find the wavelength of a circuit, knowing the inductance and capacity:

a. Multiply the inductance in cms. by the capacity in mfds. Locate the number in the table. If the number is not greater than 286.4, the first two numerals of the wavelength will be at the left-hand column, and the third numeral at the top of the row.

b. If the number is greater than 286.4, add an even number of decimal points until the number is smaller than 286.4. Then the first two numerals of the wavelength will be at the left-hand column, and the third number at the top of the row. Add as many 0's as there were pairs of decimals added to the original number.

Example a. What is the wavelength of a circuit having 1,000,000 cms. and 0.00023 mfd.?

First, 1,000,000 x 0.00023 = 230. In the table, 230 is across from 900 and under 4. Therefore, the first two numbers of the wavelength are 90 and the third, 4. Answer: 1,000,000 cms. and 0.00023 mfd. give 904 meters wavelength.

Example b. What is the wavelength of a circuit having 10,000,000 cms. and 0.0011 mfd.?

First, 10,000,000 x 0.0011 = 11,000. This number is greater than 286.4. Adding one pair of decimal points, this number becomes 110.00, which is less than 286.4. In the table, 110 is across from 620 and under 5. Therefore, the first two numbers of the wavelength are 62, the third is 5, and one 0 is added for the pair of decimal points put on the orignal number. Answer: 10,000,000 cms. and 0.0011 mfd. give 6,250 meters wavelength.

2. To find the capacity and inductance required for a given wavelength.

a. If the wavelength is under 1,009 meters, look for the number opposite the first two numerals of the wavelength and under the third. Such values of capacity and inductance must be used that their product will equal the LC value corresponding to the given wavelength.

LC TABLE

	0	1	2	3	4	5	6	7	8	9
0		.0002816	.001127	.002534	.00450	.007041	.01014	.01380	.01802	.02280
10	.02816	.03407	.04055	.04757	.05518	.06336	.07207	.08136	.09124	.1016
20	.1127	.1242	.1362	.1489	.1622	.1760	.1904	.2053	.2208	.2365
30	.2534	.2707	.2882	.3066	.3256	.3449	.3650	.3855	.4066	.4284
40	.4506	.4734	.4966	.5207	.5453	.5702	.5960	.6220	.6486	.6761
50	.7041	.7324	.7614	.7911	.8212	.8519	.8831	.9149	.9471	.9806
60	1.014	1.047	1.082	1.1108	1.153	1.190	1.227	1.264	1.302	1.341
70	1.380	1.420	1.460	1.501	1.542	1.584	1.627	1.663	1.713	1.757
80	1.802	1.848	1.893	1.940	1.987	2.034	2.083	2.131	2.181	2.230
90	2.280	2.331	2.383	2.435	2.488	2.541	2.595	2.650	2.704	2.759
100	2.816	2.872	2.929	2.986	3.045	3.105	3.163	3.224	3.284	3.345
10	3.407	3.469	3.532	3.596	3.659	3.724	3.789	3.855	3.921	3.987
20	4.055	4.123	4.192	4.260	4.329	4.399	4.471	4.541	4.613	4.686
30	4.757	4.833	4.906	4.982	5.056	5.131	5.207	5.284	5.363	5.441
40	5.518	5.598	5.678	5.757	5.839	5.921	6.003	6.084	6.169	6.252
50	6.336	6.421	6.504	6.592	6.677	6.764	6.852	6.940	7.031	7.119
60	7.207	7.298	7.389	7.452	7.571	7.667	7.759	7.852	7.947	8.042
70	8.136	8.233	8.330	8.426	8.528	8.622	8.722	8.822	8.921	9.024
80	9.124	9.226	9.328	9.432	9.532	9.638	9.740	9.845	9.954	10.06
90	10.16	10.27	10.38	10.49	10.59	10.70	10.81	10.92	11.04	11.15
200	11.27	11.38	11.49	11.61	11.71	11.84	11.95	12.07	12.18	12.29
10	12.42	12.54	12.66	12.77	12.89	13.01	13.14	13.26	13.39	13.50
20	13.02	13.75	13.88	14.01	14.13	14.26	14.38	14.51	14.63	14.77
30	14.89	15.03	15.16	15.29	15.42	15.55	15.66	15.81	15.95	16.08
40	16.22	16.35	16.49	16.63	16.77	16.90	17.04	17.18	17.32	17.46
50	17.60	17.74	17.88	18.02	18.17	18.31	18.45	18.60	18.74	18.89
60	19.04	19.18	19.33	19.48	19.63	19.77	19.93	20.07	20.22	20.38
70	20.53	20.68	20.84	20.99	21.14	21.29	21.45	21.61	21.76	21.92
80	22.08	22.23	22.39	22.55	22.71	22.87	23.03	23.19	23.35	23.52
90	23.68	23.84	24.01	24.17	24.33	24.50	24.67	24.84	25.00	25.18
300	25.34	25.52	25.68	25.84	26.02	26.19	26.36	26.54	26.72	26.89
310	27.07	27.24	27.42	27.58	27.76	27.94	28.12	28.30	28.47	28.65
20	28.82	29.01	29.20	29.38	29.55	29.75	29.92	30.10	30.30	30.48
30	30.66	30.84	31.03	31.22	31.41	31.59	31.78	31.98	32.17	32.36
40	32.56	32.75	32.94	33.13	33.33	33.52	33.71	33.90	34.10	34.30
50	34.49	34.69	34.88	35.10	35.29	35.48	35.68	35.89	36.09	36.29
60	36.50	36.69	36.90	37.10	37.31	37.52	37.72	37.93	38.13	38.33
70	38.55	38.77	38.95	39.17	39.40	39.59	39.81	40.01	40.24	40.43
80	40.66	40.87	41.10	41.30	41.52	41.75	41.96	42.17	42.38	42.60
90	42.84	43.05	43.27	43.49	43.71	43.93	44.16	44.38	44.61	44.83
400	45.06	45.27	45.50	45.73	45.96	46.19	46.40	46.65	46.88	47.10
10	47.34	47.55	47.79	48.04	48.26	48.49	48.73	48.95	49.20	49.43
20	49.66	49.91	50.14	50.37	50.63	50.87	51.09	51.34	51.57	51.83
30	52.07	52.31	52.55	52.79	53.04	53.28	53.53	53.78	54.03	54.28
40	54.53	54.75	55.00	55.26	55.51	55.71	56.01	56.26	56.52	56.75
50	57.02	57.28	57.51	57.79	58.05	58.29	58.56	58.80	59.06	59.82
60	59.60	59.84	60.00	60.37	60.61	60.89	61.15	61.41	61.66	61.94
70	62.20	62.46	62.72	63.01	63.27	63.53	63.80	64.06	64.33	64.60
80	64.86	65.13	65.17	65.67	65.95	66.22	66.49	66.77	67.05	67.33
90	67.61	67.89	68.17	68.42	68.71	69.00	69.28	69.57	69.82	70.11
500	70.41	70.66	70.96	71.25	71.52	71.81	72.11	72.38	72.68	72.95
10	73.24	73.52	73.82	74.09	74.40	74.67	74.96	75.26	75.54	75.86
20	76.14	76.42	76.74	77.02	77.31	77.62	77.91	78.20	78.48	78.81
30	79.11	79.39	79.69	79.98	80.28	80.61	80.91	81.21	81.57	81.82
40	82.12	82.41	82.71	83.03	83.33	83.64	83.95	84.26	84.57	84.87
50	85.19	85.51	85.78	86.10	86.42	86.74	87.06	87.38	87.66	87.98
60	88.31	88.63	88.92	89.25	89.58	89.86	90.20	90.53	90.82	91.16
70	91.49	91.79	92.12	92.47	92.76	93.11	93.42	93.76	94.06	94.41
80	94.71	95.06	95.37	95.72	96.03	96.38	96.70	97.01	97.36	97.68
90	98.06	98.35	98.68	99.04	99.36	99.68	100.00	100.30	100.70	101.00
600	101.40	101.70	102.10	102.30	102.70	103.00	103.40	103.80	104.10	104.40
610	104.7	105.1	105.4	105.8	106.2	106.5	106.9	107.2	107.5	107.9
20	108.2	108.6	108.9	109.2	109.6	110.0	110.4	110.8	111.1	111.4
30	111.8	112.1	112.5	112.8	113.2	113.6	114.0	114.2	114.7	115.0
40	115.3	115.7	116.1	116.4	116.8	117.1	117.5	117.9	118.2	118.6
50	119.0	119.3	119.7	120.0	120.4	120.8	121.2	121.5	121.9	122.3
60	122.7	123.0	123.4	123.8	124.2	124.6	124.9	125.2	125.7	126.0
70	126.4	126.8	127.2	127.6	127.9	128.3	128.6	129.0	129.4	129.8
80	130.2	130.5	131.0	131.3	131.7	132.1	132.5	132.9	133.2	133.7
90	134.1	134.5	134.8	135.2	135.6	136.0	136.4	136.8	137.2	137.6
700	138.0	138.4	138.8	139.2	139.6	140.0	140.4	140.7	141.1	141.6
10	142.0	142.3	142.8	143.2	143.5	144.0	144.3	144.7	145.2	145.5
20	146.0	146.3	146.8	147.2	147.6	148.0	148.4	148.8	149.2	149.6
30	150.1	150.4	150.9	151.3	151.7	152.2	152.5	153.0	153.4	153.8
40	154.2	154.6	155.0	155.4	155.9	156.3	156.7	157.1	157.5	158.0
50	158.4	158.8	159.2	159.7	160.1	160.4	160.9	161.4	161.8	162.2
60	162.7	163.1	163.5	163.9	164.4	164.8	165.2	165.7	166.2	166.5
70	166.9	167.4	167.8	168.3	168.7	169.1	169.6	170.0	170.4	170.8
80	171.3	171.8	172.2	172.7	173.1	173.6	174.0	174.4	174.8	175.3
90	175.7	176.2	176.6	177.1	177.5	178.0	178.4	178.8	179.3	179.7
800	180.2	180.6	181.1	181.6	182.1	182.5	182.9	183.4	183.9	184.3
10	184.3	185.2	185.7	186.1	186.5	187.1	187.5	187.9	188.5	188.9
20	189.3	189.8	190.3	190.7	191.2	191.7	192.2	192.6	193.1	193.5
30	194.0	194.5	194.9	195.4	195.9	196.3	196.8	197.2	197.7	198.3
40	198.7	199.2	199.6	200.1	200.5	201.1	201.6	202.0	202.5	203.0
50	203.4	203.9	204.4	204.8	205.8	205.9	206.4	206.8	207.3	207.8
60	208.3	208.7	209.2	209.7	210.2	210.7	211.2	211.6	212.1	212.6
70	213.4	213.6	214.1	214.6	215.1	215.6	216.1	216.6	217.1	217.6
80	218.1	218.6	219.1	219.6	220.1	220.5	221.0	221.5	222.0	222.5
90	223.0	223.6	224.1	224.6	225.0	225.5	226.0	226.6	227.1	227.6
900	228.0	228.6	229.1	229.6	230.1	230.5	231.1	231.6	232.1	232.7
910	233.1	233.6	234.2	234.7	235.2	235.7	236.2	236.8	237.2	237.8
20	238.3	238.9	239.3	239.9	240.4	240.8	241.4	241.8	242.4	243.0
30	243.5	244.0	244.5	245.1	245.6	246.1	246.7	247.2	247.7	248.3
40	248.8	249.4	250.0	250.3	250.9	251.4	252.0	252.4	253.0	253.6
50	254.1	254.7	255.2	255.8	256.3	256.8	257.4	257.8	258.4	258.9
60	259.5	260.0	260.6	261.1	261.7	262.2	262.8	263.2	263.8	264.3
70	265.0	265.5	266.1	266.6	267.2	267.7	268.1	268.7	269.3	269.9
80	270.4	271.0	271.5	272.1	272.7	273.2	273.8	274.3	274.9	275.4
90	275.9	276.6	277.1	277.6	278.3	278.7	279.4	279.9	280.4	281.0
1000	281.6	282.1	282.6	283.1	283.8	284.3	284.8	285.4	285.9	286.4

Digitized by Google

b. If the wavelength is over 1,009 meters, look for the number opposite the first two numerals of the wavelength, and under the third. Take off a pair of decimal points for each numeral, over three, of the wavelength value. The product of the inductance and capacity must equal the LC value found.

Example a. What inductance and capacity must be used to give 793 meters?

The LC value, opposite 790 and under 3, is 177.1. If it is decided to use a 0.001 mfd. condenser, the inductance will be 177.1 ÷ 0.001 or 177,100 cms.

Example b. What inductance and capacity must be used to give 18,200 meters?

The LC value, opposite 180 and under 2, is 9.328. Since there are five numerals to the wavelength value, two pairs of decimal points must be taken away, making the number 93280. If it is decided to use a condenser of 0.002 mfd., the inductance will be 93280 ÷ 0.002 or 46,640,000 cms.

A New Transformer and Oil Condenser

Two new and interesting transmitting instruments are shown in the accompanying illustration. At the left is a closed core, non-resonance transformer specially designed for use with the usual type of non-synchronous rotary gap used by experimenters.

The secondary winding can be seen at the top of the transformer, wound on the main closed core. Below the panel are two impedances which regulate the primary supply current. They are wound on a separate core.

If the power leads are connected to the left and center terminals, both impedances are in series with transformer primary. Across the center and right terminals, only the larger impedance is in. When the secondary is practically short-circuited by the rotary spark gap, the increased impedance of the regulating coils limits the primary current.

A commendable feature of the three sizes now supplied is that they are rated in kilowatt-amperes, with stated power factors. This may require an explanation. On direct current work, the power in kilowatts is given by multiplying the voltage by the amperage. Not so with alternating current, for the product of the voltage and amperage is only the apparent power. An A. C. circuit may be carrying 100 volts and 10 amperes though it accomplishes only 0.5 kilowatts of work. The 100 volts times 10 amperes means only 1 kilowatt-ampere. To find the true power, the K. V. A. rating must be multiplied by the power factor. To determine this factor is beyond the means of most experimenters.

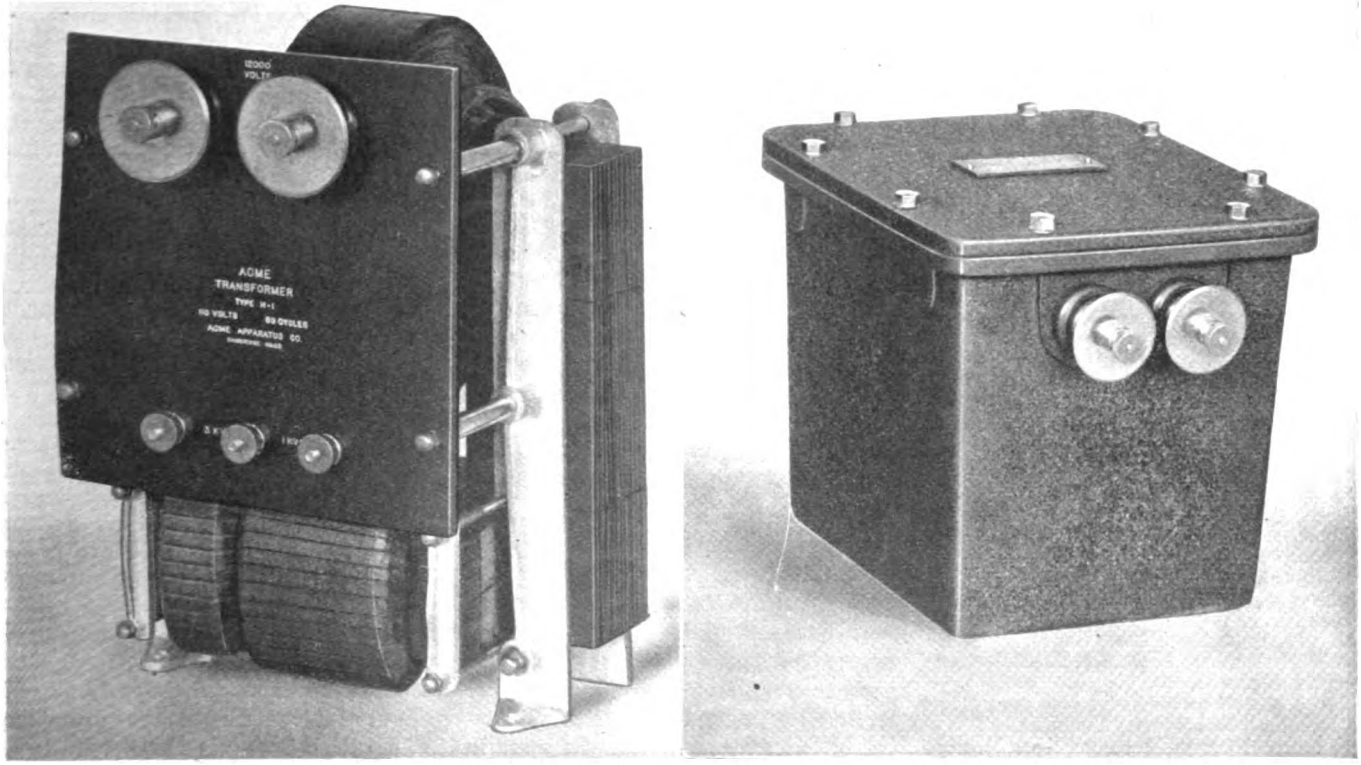
When, as should be done always, the K. V. A. rating and power factor are given, it is easy to determine the true power. For example, the transformer illustrated is rated at 1.15 K. V. A. and 0.345 K. V. A. With a power factor of 0.75 at high power, this means 0.76 K. W. or 760 watts. On low power, 0.345 K. V. A., at a power factor of 0.87, is 300 watts. Reduced power, when possible, means less QRM.

An excellent protective spark gap is fitted to the transformer. It will be seen that the gap length cannot be increased unless the discs are actually removed. The secondary voltage ranges from 6,000 to 12,000 for the three sizes. With a condenser of 0.006 mfd., the spark has a note of approximately 800 cycles.

The oil condenser, at the left of the illustration, is rather new for experimental work. Inside the aluminum case, the metal plates are held by sturdy insulation. Transil oil is used for the dielectric. This gives a capacity of 0.0035 or 0.007 mfd., according to the size. The break-down voltages for the two sizes are 10,000 and 8,000 respectively. Creeping of the oil is prevented by oil-tight covers.

Resistance losses are surprisingly low in a condenser of this type. At 300 meters, for example, the resistance was only .05 ohms.

Don't forget your lightning switch. It is one of the most important possible sources of lost energy from the receiver. The ordinary slate base, fastened to the side of the house, allows energy to leak through the base itself over the dust layer on the surface, and through moisture which may collect on the under side.



Experimenters are making rapid preparations for transmitting. Although there is no promise, there is a good chance that stations will open within a month

Digitized by Google

Radio Experimenters Back On Old Status

All War-time Restrictions Lifted from Stations Used Only for Private Experimental work

HARDLY a branch of the United States Government has escaped criticism and blame on one account or another. Among radio men, at least, the Navy Department has had its share. Even the experimenters, chafing under restrictions which, they thought, should have been removed soon after the signing of the Armistice, have harbored a feeling against the Naval authorities.

On October 1st, 1919, radio experimenters were allowed to resume transmitting provided, as was the case before the war, they have amateur operating and station licenses. Those who are all ready to use their transmitters should apply to the Radio Inspector, Customs House, of the city at which their district office is located. In writing, ask for application blanks for operator's examination, station license, or both, as the case may be. All licenses were revoked at the beginning of the war. New call letters are now being assigned.

This action applies to amateur, technical, training school and experimental stations which do not carry on paid traffic. It will not be possible to issue operators' and station licenses immediately because of the volume of applications. However, temporary permits will be issued on applications which indicate that the equipment and operators comply with the law.

A list of the radio districts is given below, so that each man can locate his district office:

1. BOSTON, MASS.

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

2. NEW YORK, N. Y.

New York (county of New York, Staten Island, Long Island and counties on the Hudson River to and including Albany, Rensselaer and Schenectady) and New Jersey (counties of Bergen, Passaic, Essex, Union, Middlesex, Monmouth, Hudson and Ocean).

3. BALTIMORE, MD.

New Jersey (all counties not included in second district), Pennsylvania (counties of Philadelphia, Delaware, all counties south of the Blue Mountains and Franklin County), Delaware, Maryland, Virginia, District of Columbia.

4. SAVANNAH, GA.

North Carolina, South Carolina, Georgia, Florida, Porto Rico.

5. NEW ORLEANS, LA.

Alabama, Mississippi, Louisiana, Texas, Tennessee, Arkansas, Oklahoma, New Mexico.

6. SAN FRANCISCO, CAL.

California, Hawaii, Nevada, Utah, Arizona.

7. SEATTLE, WASH.

Oregon, Washington, Alaska, Idaho, Montana, Wyoming.

8. CLEVELAND, OHIO

New York (all counties not included in second district), Pennsylvania (all counties not included in third district), West Virginia, Ohio, Michigan (Lower Peninsula).

9. CHICAGO, ILL.

Indiana, Illinois, Wisconsin, Michigan (Upper Peninsula), Minnesota, Kentucky, Missouri, Kansas, Colorado, Iowa, Nebraska, South Dakota, North Dakota.

NAVY DEPARTMENT MWA-ER

UNITED STATES NAVAL COMMUNICATION SERVICE

OFFICE OF

DISTRICT COMMUNICATION SUPERINTENDENT

THIRD NAVAL DISTRICT

44 WHITEHALL STREET

NEW YORK CITY

October 1st, 1919.

The Editor,
Everyday Engineering Magazine,
2 West 45th Street, New York City.

Dear Sir,

Effective October 1st, 1919, all restrictions on amateurs and amateur radio stations are removed.

This does not apply to any station handling commercial business of any character, including business of owner.

Attention is invited to the fact that a Department of Commerce radio station license is necessary before amateur radio stations can transmit. Applications should be made to the nearest radio inspector.

Lieutenant Commander, USN.

This act of the Naval authorities suggests a review of the present radio situation. Word regarding transmitting came through just as the Magazine was being closed, so that it is impossible at this time to say how it came about that restrictions were lifted. At the same time, there is enough information available to throw a different light on some matters which have been discussed by the radio publications in such an emphatic manner.

First off, EVERYDAY wants it understood that it believes the Navy Department to be made up of very human men, men who are trying to do what is right, and as quickly as possible when the right time comes. In other words, we believe that the Navy is one of the strongest supporters of the radio experimenters. However, these men are serving a greater purpose than the control of experimental radio—they are in the service of the United States of America.

When they appear to fail the people of the country, it is sometimes because the people fail them. Take the radio operating system which has been so widely condemned. It is obvious that permanent Government control will fail, if it is put into operation, but, as they are conducting the service until definite action is taken, they are doing it under tremendous handicaps.

If you could see the Naval Communication Office at New York, you would understand that, try as they may, they cannot handle the present tremendous traffic with the reduced personnel now employed. Moreover, it is a different matter, with hundreds of ships, than in the old days when the total number of ship stations did not amount to over five hundred. And, as a matter of fact, the service now is not as bad as some would have us believe.

A little careful thought, with a knowledge of the facts, shows that actually, the people of this country are being very well served by the Navy Department.

Consider the situation in other countries. America, condemned by every sort of destructive agitator, is the only country in which the rights of radio experimenters are recognized. This means more than than the statement indicates at first glance. It means that, as far as the public, which is primarily responsible for emergency acts of the Government, will allow, the authorities are making it possible for them to have what they want as fast as the people take the constructive steps on which the work of the Government depends.

The Navy Department has actually shown a sincere appreciation for the radio experimenters. It has done more than it promised when the stations were closed. As soon as conditions made it practical, on April 15th, 1919, receiving was permitted. Now, though peace has not been declared, experimenters have been put back on their pre-war status. Beside that, the Navy is encouraging radio work by sending out an evening code practice.

Instead of hampering the experimenters, the Department is doing all it can to help them. Perhaps if a spirit of gratitude replaced the grumbling which has been directed toward the authorities, they might do even more for us.

Digitized by Google

The U. S. Navy Radio Compass

PART 1

What the Radio Compass Is, How It Works, and for What It Is Used

THROUGH the courtesy of the U. S. Navy Department, Bureau of Steam Engineering, and the co-operation of Commander H. C. Hooper, complete details are now available on the theory, design and operation of the Radio Compass or direction finder. The development of this apparatus was one of the most important accomplishments of the Navy, and information concerning it, one of the most carefully guarded secrets.

In the first part of this article, the general theory and operation is taken up; the second part deals with the instruments and circuits employed.

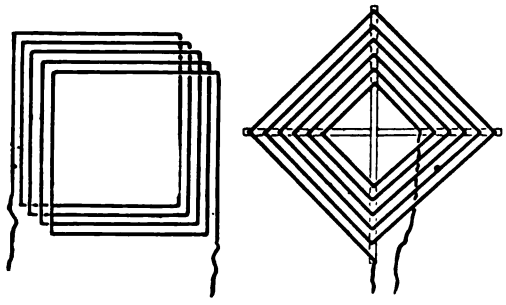


Fig. 1—General design of loop antennas, showing the box and flat types

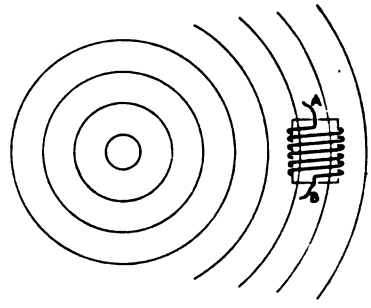


Fig. 2—In this position the turns of the coil are cut at right angles and signals are heard

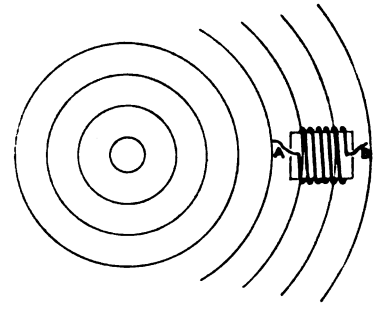


Fig. 3—Here the lines of force are parallel to the turns and no current is set up

The Bilateral Compass

The operation of the radio compass, known more widely as the direction finder, depends chiefly on the action of the loop antenna. Although varying in shape and size, they are usually wound as in Fig. 1, more often in the box type form. A circular shape can be used as well, and in some cases the turns of the box type are bunched together. Inductance requirements determines the number of turns and their size. There is a relation between the turns and area enclosed which give maximum signal strength, but for ordinary purposes, it is safe to make the box type from 3 to 5 feet on a side, with enough turns to give the inductance necessary.

For short wave reception, a coil of 5 turns, ¼ in. apart, on a frame 4 feet square will give good results. Wavelengths up to 20,000 meters can be received on a loop of 40 turns, ¼ in. apart, on a frame 4 feet square. Either bare or insulated wire can be used, but particular precautions must be taken to prevent leakage between the turns.

To illustrate the theory of operation of the loop, let us consider Fig. 2. As is well known, magnetic waves travel out radially from a wireless transmitting station. If a coil, whether round or square, is placed in this field in the position shown at Fig. 2, the lines of force cut through the turns of wire on the coil at right angles, setting up a current in the winding. In Fig. 3, however, the lines of force are parallel with the turns, and induce no current.

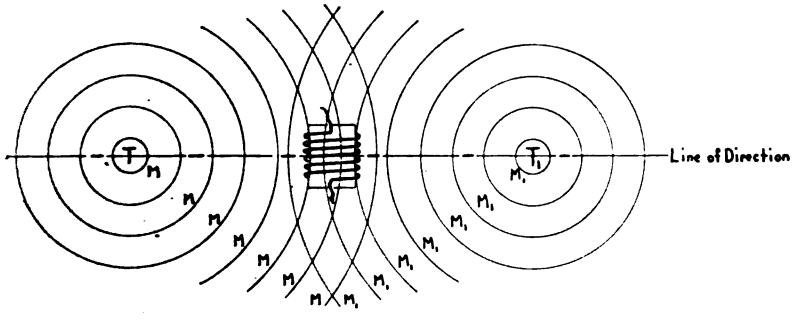


Fig. 4—When the horizontal part of the turns point at two opposite transmitters, signals are heard from both stations

If, then, a receiving set is connected to the coil or loop, and signals are sent out from the transmitter, they will be heard when the loop is in position Fig. 2, but no signals at Fig. 3. This effect can be used to show the line of direction of the origin of the signals. It will be seen that the horizontal part of turns lie in the line of direction when the signals are at maximum intensity.

This system does not show the absolute direction, as will be seen from Fig. 4. Suppose that a transmitter is set up at T, and the loop A B adjusted for maximum signals. Now, if the transmitter is moved to T, diagonally opposite, the loop will still receive maximum signals at the same position.

Under actual working conditions, the apparatus is connected as in Fig. 5. The loop is in series with a loading coil and both shunted by a 0.0005 or 0.001 mfd. variable condenser. A crystal detector can be used for short distances, but an audion is needed for long range receiving. Where both a loop and a regular antenna are used with a loose coupler, Fig. 6, the antenna may be connected in the usual manner, and the loop inserted in the secondary circuit, with a short circuiting switch. For standly or long distance work, the loop is short circuited, and signals received on the coupler by means of the antenna. When signals are heard, the loop switch is opened, the secondary coupling made as loose as possible, and the signals retuned while the position of the loop is varied.

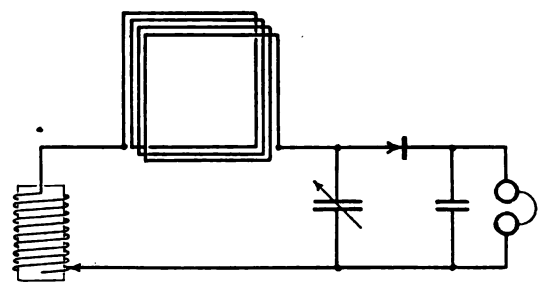


Fig. 5—The connections of a simple loop receiver for bilateral work. An audion must be used to cover any great distance

Fig. 7 shows a method for obviating the necessity of retuning when the loop is thrown in. A S. P. D. T. switch is wired so that it short circuits either the loop or a small variable inductance, A. When once adjusted, it will need no further attention. This initial adjustment is obtained in the following manner:

Signals are first received on the large antenna, with A short circuited and the loop open, but not in a position to pick

Digitized by Google

up signals; then the loop is shunted and the signals tuned in again by varying A. Now A is equivalent to the loop. If a station is tuned in on the antenna, wtih the loop out, A will be in the circuit. When the switch is changed over, A will be cut out, but the wave length will not change, for the loop will be in.

Uses of the Bilateral Compass

The bilateral compass, though it does not indicate the absolute direction of a transmitter, has many inportant uses. Take, for example, a ship nearing port in a heavy fog or storm such that lights are not visible. At either side of the harbor, there is a direction finder, Fig. 8, at which signals are received from the ship. Station T determines the direction of the ship and finds angle C, T_1 the angle D. Then, by simple trigonometry, the exact location of the ship can be found, and the captain informed as to his position.

The same system serves to locate an experimental station which is not licensed, or does not meet the Government requirements. During the war, enemy radio stations were discovered by this method.

Another use of the direction finder is in cutting out interference. A high powered transmitter may be sending nearby, yet, if it is not in the line of direction of the loop, it will not be heard. This is a particular advantage in cities where there are many experimental stations.

On airplanes, the compass serves to guide the pilot toward his objective or home field. The magnetic compass shows the general direction, overcoming the disadvantage of the bilateral effect.

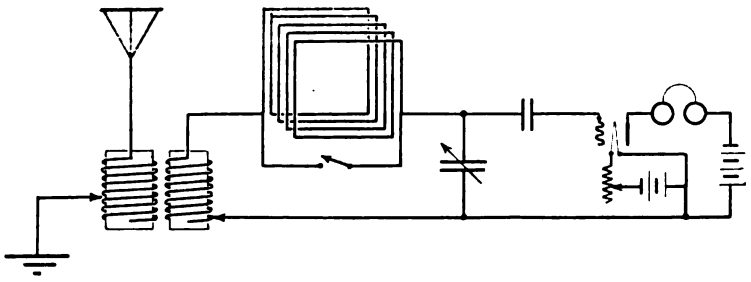


Fig. 6—Standby work is done with the antenna, and the direction determined by using the loop

The Unilateral Compass

Having reached an understanding of the action of the loop and the bilateral compass, the next step is the unilateral or absolute direction type. This shows in which radial direction the transmitting station lies, instead of a diametrical direction.

It is well known that the ordinary T, L, umbrella, and similar forms of antennas are practically non-directional. However, regardless of the direction from which the signals come, the current induced in the antenna is always in the same direction.

Keeping this last statement in mind, let us examine Fig. 9. Coil A B is placed in the position for maximum signal strength and current flows through the winding. It is then turned 180° to the position A_1 B_1. The signal strength has not been changed, but the current flows in the opposite direction. In other words, moving the coil 180° does not change the amount of current, yet the direction is reversed.

The unilateral effect is produced by combining the actions of the antenna and loop. Fig. 10 shows the method employed. Signals are received on the antenna which is connected to the ground through the primary of a loose coupler. At the same time, the signals are picked up by the loop which is inserted in the secondary circuit. In one of the maximum positions, the currents in the antenna and loop will be in the same direction and will aid each other giving a louder response in the telephones. In the other maximum positions, 180° from the first, the loop current will oppose that in the antenna, so that they will produce no signals in the phones.

Since the current is greater in the antenna than in the loop, the coupling must be adjusted until the antenna current in the secondary circuit is the same as that put in by the loop. Otherwise, the signals from the antenna would be so strong that no variation in strength would be noticed as the loop is moved

The Compass Under Working Conditions

In operation, there are two effects not brought out in the theoretical discussion. First, the sharpest indications, with the bilateral connections, are at minimum signal strength. Second, sharp indications cannot be obtained with the unilateral compass.

It is necessary, therefore, to use both effects for accurate absolute direction finding. The method is as follows:

1. Signals are first received with close coupling between the primary and secondary, with the compass switch at Bilateral, Fig. 11. This gives a non-directional effect and maximum receiving efficiency.

2. When a station has been tuned in, the coupling is reduced, the switch put at unilateral, and the loop turned until the position for maximum signals is found. This will indicate the absolute direction approximately, Fig. 12.

3. Finally the loop is turned 90° from its former position and the compass switch is put at bilateral. Now the direction can be determined accurately, adjusting the loop for minimum signals.

Since there is nothing about the loop itself to show on which side the maximum effect is obtained, it is necessary at first to make a determination on some station whose direction is known. This side should be marked, as it will be always the same, provided that no connections are reversed.

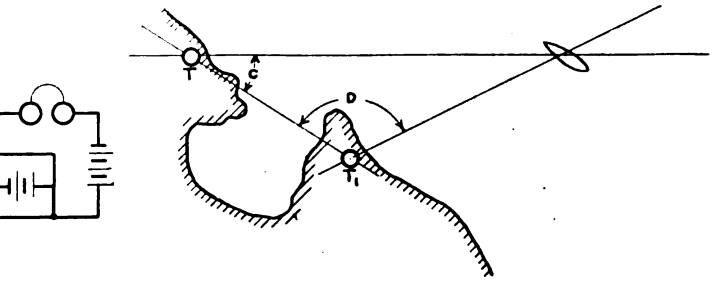


Fig. 8—A ship at sea can be located by using two direction finding stations on the coast

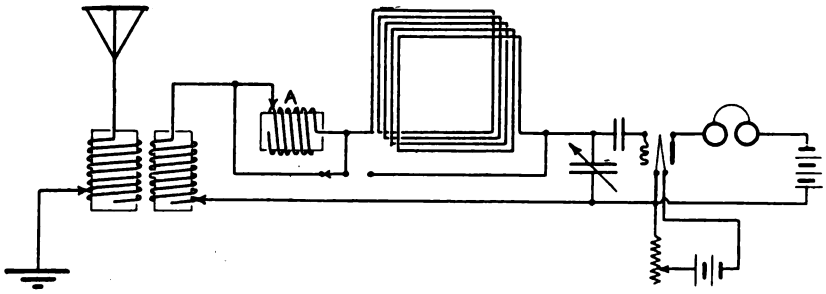


Fig. 7—The loop can be used or cut out without changing the wavelength of the secondary

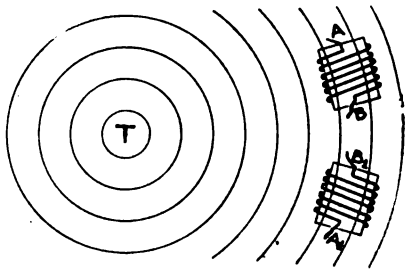


Fig. 9—Turning the coil 180° changes the direction of the current but the signals are still as strong

Digitized by Google

Compass Faults and Troubles

Certain difficulties may arise which will make the direction finding effect inoperative. The symptoms and remedies are listed here:

1. Lack of sharp turning at minimum position, bilateral connection.

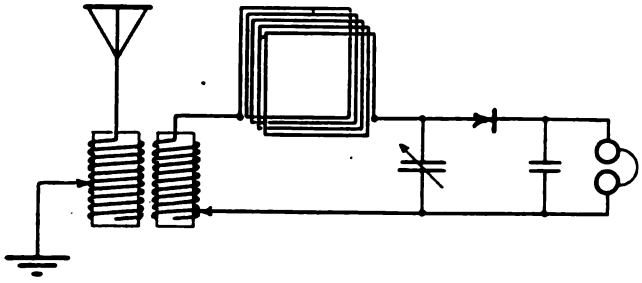


Fig. 10. Combination receiving for unidirectional work

a. If any connection is made between the receiving apparatus and the ground, this trouble will result.

b. The grounding may be due to excessive distributed capacity between the secondary and the ground or large metal objects in the operating room. All apparatus must be kept away from such objects.

c. Leakage or excessive distributed capacity between the loop and antenna leads.

2. Minimum signals always at the same position, bilateral connection.

a. Neighboring antennas not disconnected from the ground.

3. Readings reversed 180°, unilateral connection.

a. Antenna and ground and coil connections reversed. This can be connected by locating a known station and reversing connections until a correct reading is obtained.

Calibration for Distortion

At stations where metal buildings or structures are located nearby, it may be found that distorted directional readings are obtained. The distortion of the electrical waves by metal objects is comparable to the bending of light or sound waves.

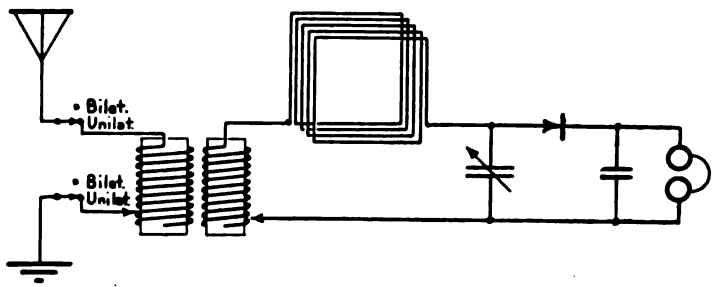


Fig. 11. Either system can be used by changing the compass switch

This effect increases with the wavelength, so that if a loop is used over a long range of frequencies, determinations for distortion should be made at several wavelengths. In the case of a ship, the work is easy, since the station and metal structures, the ship itself, can be swung around in various directions.

A land station, however, presents greater difficulties. The only way by which it can be calibrated is to carry an adjustable transmitter around the receiving station. In general, this is not necessary, even in a metal framed building unless the limit of accuracy is required.

The second part of this article will appear in the November issue. It will describe the apparatus used by the Navy Department, and will give photographs, circuits, and details of the instruments.

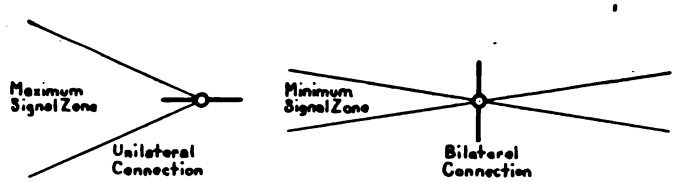


Fig. 12. By listening in both ways, the transmitter can be located accurately

LOOP ANTENNA USED THIRTEEN YEARS AGO

THE loop type antenna has come to general notice only within the last year, since the necessity for secrecy regarding Government activities was removed. As a matter of fact, Prof. G. W. Pickard filed a patent in June, 1907, covering the use of the loop, operating on magnetic wave components.

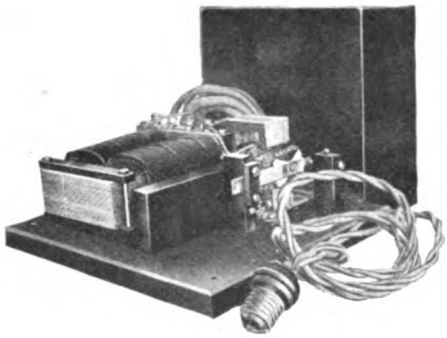
Possibly because of the limitations in equipment, results obtained were of little practical import. It is interesting to know, however, that Prof. Pickard was well aware of the possible use of the loop, and carried out many experiments to determine various directional effects.

This patent is number 876,996. Copies can be obtained from the Patent Office, Washington, D. C., at a cost of five cents.

RECTIFIER FOR STORAGE BATTERY CHARGING

IT can be truly said that the electrical engineer's work is never done. There are always improvements and refinements to make.

The new Clapp-Eastham rectifier is a product in keeping with the continuous advance in electrical devices. The illustration here shows the storage battery charging outfit, consisting of a step-down transformer and vibrating rectifier.



When the connecting plug is put into any light socket on an A. C. line the voltage is reduced, and the low tension current is put through the rectifier, which allows it to pass into the storage battery in one direction only. An interesting feature is that if the A. C. current fails the battery cannot discharge back into the transformer. Moreover, the battery can be connected to the rectifier in either direction, yet the current will always flow into the battery in the right direction.

It will be seen that the instrument is as nearly proof as it can be made, a great advantage to the unskilled man who takes care of his own car. Two sizes are made, one for charging a 6-volt battery at 7 amperes, and one for a 12-volt battery at 4 amperes. These types are made for 110 volts or 220 volts.

Using this rectifier, the cost for charging the ordinary 6-volt battery is only ten to fifteen cents.

RADIO CLUBS

EVERYDAY invited all radio clubs throughout the country to send in announcements of activities, or other matters of general interest for publication in the Radio Department.

We are still looking for methods by which clubs can increase the balance of the exchequer. If you have used any plan successfully, let the others know about it. Get together a few of those good ideas. We know you have them!

Digitized by Google

The Problems of Vacuum Tube Circuits

An Explanation of the Problems encountered in the Design of Detectors, Amplifiers, and Undamped and Modulated Telegraph and Telephone Transmitters

By L. M. Clement

THE AUDION AS A DETECTOR

BEFORE discussing this subject, it may be well to show the action of a detector and the necessity for its use in the reception of radio signals.

When an alternating current is applied to the terminals of a telephone receiver, the diaphragm is alternately attracted and repelled from the receiver magnet at the rate equal to the frequency of the applied current. This to and fro movement of the receiver diaphragm sets up a corresponding movement of the air. The human ear is so constructed that these air vibrations, if they take place between 15 and 15,000 times per second, affect the ear and produce a sensation known as sound. Such vibrations give rise to sound waves. The ear is unable to detect air vibrations outside of this range. If currents of higher frequencies than the upper limit are applied to the telephone receiver, no sensation of sound will be produced on the ear. In radio telegraphy and telephony, currents varying in frequency from 15,000 to 7,000,000 cycles per sound are employed, and are generally referred to as radio frequencies, to distinguish them from the group of frequencies which are known as audio frequencies.

In order to illustrate how the radio frequencies are made audible, let us consider the following example. Suppose an ordinary spark radio station, Fig. 39, is transmitting electromagnetic waves of 200,000 cycles per second in groups occurring 1/200ths of a second apart. There will be introduced across the inductance coil of the receiving station a voltage similar in every respect to the transmitted current of Fig. 39. Suppose this voltage were impressed on a telephone receiver, Fig. 39, no movement of the diaphragm would result, due to its inertia. If the diaphragm would follow the 200,000 cycles current, it would set up air vibrations which would be outside the range of audibility.

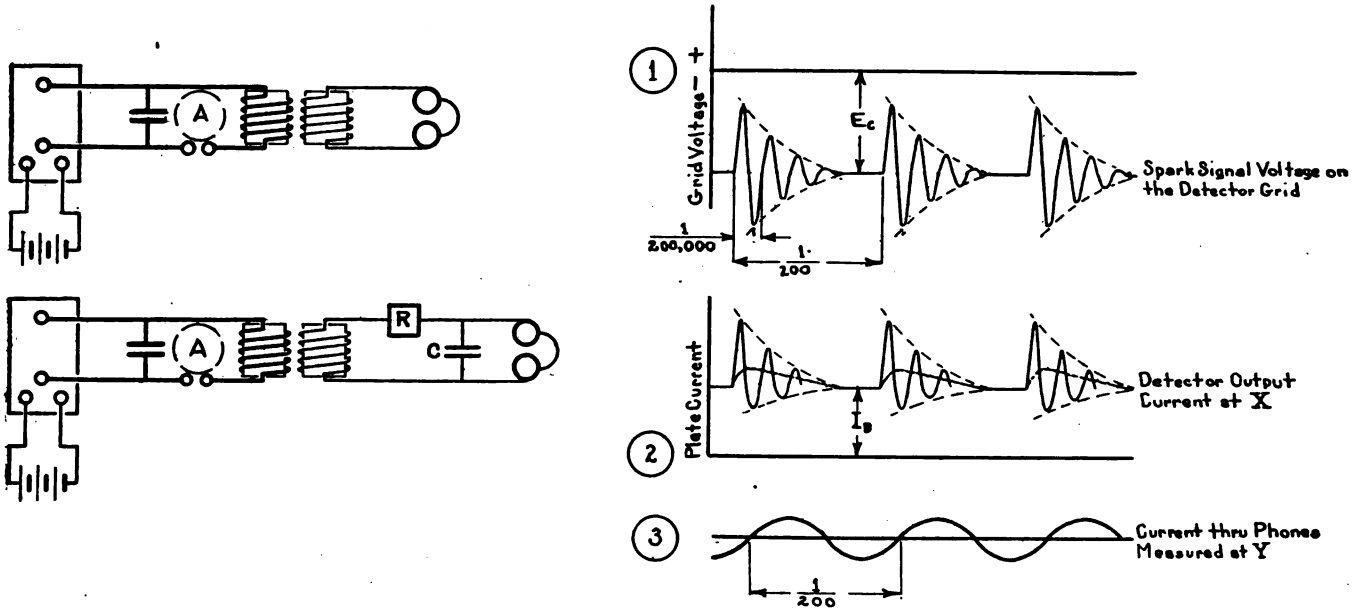


Fig. 39. Left, a transmitter and receiver with and without a rectifying device. Right, current actions as they take place in the different parts of a receiving set

If now a device R, which will allow the current to pass in one direction and not in the other, is placed in the circuit as shown, the current wave will be rectified and appear as shown in 2 of Fig. 39.

The added effect of the resulting distorted high frequency currents will cause the diaphragm to be displaced to and from for each group of oscillations as shown in 2, Fig. 39, by the inside dotted lines. Since these groups follow one another at a rate within an audible range, namely, 200 per second, the air wave set up by the diaphragm will be audible. Very little of the high frequency current will pass through the telephone receivers because of their high reactance. The condenser is provided to shunt these high frequencies around the telephone receivers; the low or group frequency currents pass through the telephone receivers. This telephonic current is shown graphically in 3, Fig. 39.

The audion, as we have seen, can be made to function as an amplifier with but little distortion by arranging the circuit so that the signal voltage is applied to the straight portion of the E_c, I_b—grid voltage, plate current—characteristic of the tube. By applying radio frequency voltages to the grid-filament circuit of a tube, the circuit of which is so arranged that distortion results, apparent rectification takes place and the tube can be used as a detector. This is accomplished by making use of the curved portion of the E_c, I_b curve of the tube to produce distortion. This is exactly the effect to be avoided in using the tube as an amplifier.

For normal operation of the audion as a detector or amplifier the voltage applied to the grid circuit does not exceed the permanent negative voltage applied to the grid, E_c, Fig. 40.

For this reason the grid never becomes positive with respect to the filament and no current can flow between the filament and the grid during any part of the cycle. From this we can see that no rectification of the signal takes place in this circuit.

Possibly the best explanation of this action can be had by taking a specific example. Suppose a constant potential E_c, Fig. 40, is applied to the grid of the tube, of such a value that the incoming signal voltage will be applied to the curved portion of E_c, I_b curve.

Digitized by Google

If now the signal voltage of the form 1 of Fig. 39 is applied across the condenser C_1, Fig. 41, it will be superimposed on the negative grid voltage E_c, from the grid battery. Referring to Fig. 40, the steady value of the plate current with the steady value of grid voltage E_c, will be X'. If the grid voltage is increased from E_c to E_c + XM, the plate current will be reduced by a value X' M' and if the grid voltage is reduced by the value XN the plate current will be increased by the value X' N'. X' N' is much larger than X' M', due to the curvature of the E_c, I_c curve, although X N and X M are equal.

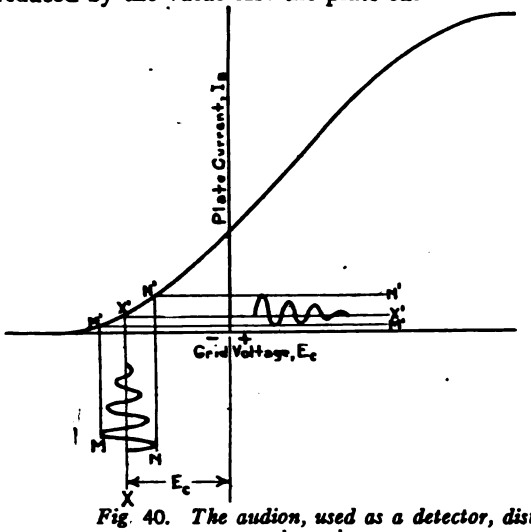


Fig. 40. The audion, used as a detector, distorts the incoming waves

This leads to the conclusion that other things being equal, maximum detection is obtained when the curvature of the E_c, I_c characteristic is greatest. Obviously, then, for best detection, E_c should be so chosen that the signal can be applied to the part of maximum curvatures of the characteristic curve just referred to.

The current in the output circuit of the detector would then look something like 2, Fig. 39, if measured at the point marked X in the circuit diagram, Fig. 41.

The mean value of this current is indicated by the dotted line of 2, Fig. 39. The current through the telephones approximates this, but is smoothed out to a certain extent by the high inductance of the telephone receivers. The final form of the telephone current is shown in 3. In order to prevent the plate current from passing through the telephones, the choke coil K, of high impedance, and the condenser C_3, of low reactance to the signal current, are employed and connected as shown in Fig. 41. The number of impulses passing through the telephones per second determines the note of the signal received. In the case of the example, there are 200 impulses per second which correspond to the note produced by each spark transmitter sending out 200 groups of waves per second.

It is seen that the E_c, I_c curve bends near its upper as well as its lower extremity. Obviously, detection can take place around this curved portion, but the average plate current will be reduced upon the arrival of the wave trains.

This detection point is seldom, if ever used for two reasons. First, the plate current is many times that at the lower detection point. This exhausts the plate batteries more rapidly than is necessary. Second, when the grid is maintained at such a positive potential, a considerable amount of current flows in the grid circuit of the tube, which causes a reduction of the signal voltage across the tuning condenser, giving the same effect as a series resistance, namely, to reduce the current flowing in the tuning circuit and consequently the voltage across C_1, in addition to decreasing the sharpness of tuning in the circuit.

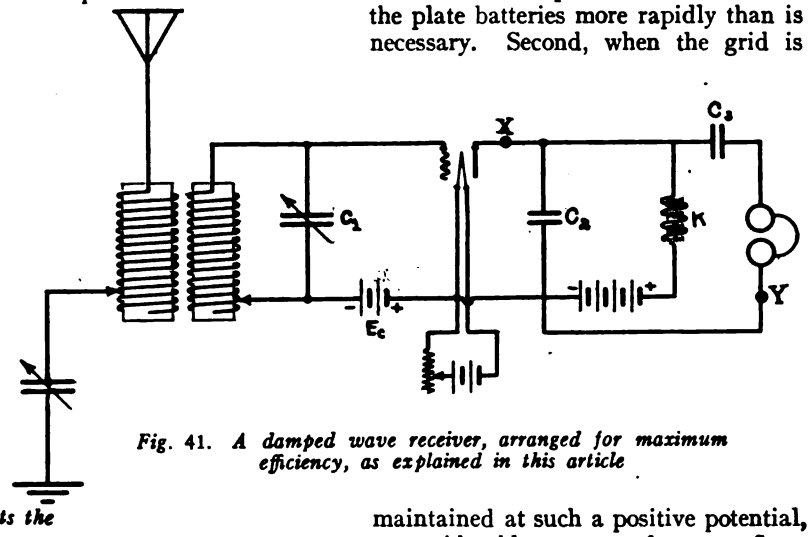


Fig. 41. A damped wave receiver, arranged for maximum efficiency, as explained in this article

The eight articles of this series will be a further discussion of damped wave reception with a grid condenser and heterodyne reception.

This Announcement is Repeated for the Benefit of Those Who May Not Have Seen It Before

BY authority of the Director Naval Communications, commencing October 5th, a code broadcast schedule, addressed to all amateurs, will be transmitted by the Naval Radio Station, 44 Whitehall Street, on 1500 meters. This broadcast will be transmitted immediately following the 9:00 P. M. press schedule.

Various items of interest to amateurs, such as the establishment of new stations and changes in wave lengths of high power stations, will be transmitted in this broadcast schedule.

Copies of the code to be used may be obtained by any amateur by sending a request to the District Communication Superintendent, 44 Whitehall Street, New York City. When writing this request an amateur should give the following information:

1. Name.
2. Address.
3. Age.
4. Date concerning any military service.
5. Commercial experience, if any performed.
6. Class of operator's license, if any.
7. Number of words per minute he can copy.
8. Education.
9. Size and power of transmitting set, if any erected.
10. Type of undamped wave receiver, if one installed.
11. Name of any radio organization or club to which he may belong.

The object of this radio broadcast is to maintain the interest of radio amateurs and to train them in receiving code.

A Warning

Many amateurs are also under the misapprehension that if they have low power transmitting sets which, they believe, cannot transmit beyond the limits of the state in which they are located, they do not require licenses. This is not the fact, inasmuch as the law includes stations which can interfere with messages from outside the state in which the station is located. This proviso, therefore, includes every transmitting station.

Licensed stations require licensed operators. There is a penalty of $500 provided for the person operating an unlicensed radio station, and an additional penalty of $100 and imprisonment of not more than two months or both for an unlicensed operator, and unless some of the offending amateurs promptly realize the necessity for station and operator's licenses, there is a possibility of their being prosecuted for violating the law.

Digitized by Google

Constructional Details of the Double Condenser

A Design by Which the Capacity of a Variable Condenser is Doubled Without Occupying Any Additional Space

ALTHOUGH the peculiar constructional problems of the double condenser has prevented its wide use, for apparatus where expense is not a primary consideration it has the advantage of giving double the capacity of the usual types of condensers without an increase in the overall dimensions.

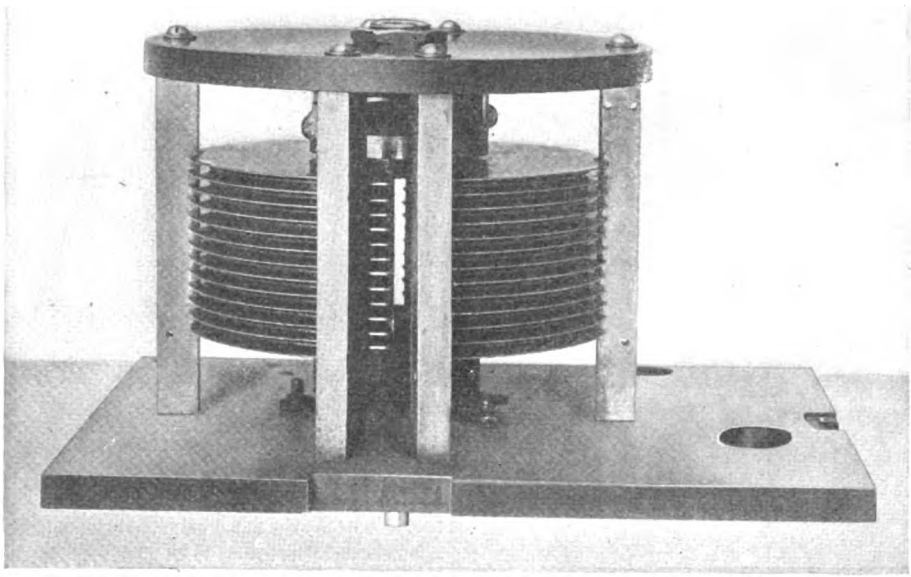


Fig. 3. The condenser inverted, showing the assembled instrument

Fig. 1 illustrates the principle of the instrument. There are two sets of semi-circular fixed plates and two sets of semi-circular rotating plates. The sets of rotating plates are insulated from each other, but by the use of commutators and brushes, one movable set is connected to one fixed set, and the other movable set to the other fixed set.

When the rotating plates are in the position shown at Fig. 1, they are inside their corresponding fixed plates. Consequently, the only capacity in the condenser is from the edge affect across the straight parts of the semi-circular plates. It should be kept in mind that sets No. 1 and 1 are the same as a group of plates on an ordinary condenser and No. 2 and 2 act as the other group.

Then, when the movable plates are rotated, variable plates No. 1 go inside fixed plates No. 2, and variable plates No. 2 go inside fixed plates No. 1. The result is the same as that obtained with the single variable condenser. At maximum capacity, opposite plates are intermeshed.

Fig. 2 shows the separate parts of the double condenser, with the assembled instrument in Fig. 3. This particular type was used for a large number of wavemeters built for the U. S. Signal Corps. The use for this purpose called for extraordinary stability and permanence. Because the wavemeters were used for portable work in the field, it was necessary to make the condensers so sturdy that rough handling would not change the calibration.

The plates are of thick brass, set in milled brass posts and soldered in the slots. Brass posts which hold the movable plates are supported on bakelite washers, to which the shafts are clamped. Accuracy was carried to an extreme by using jigs and fixtures in drilling and machining the parts. Details of the rotating plates and commutators are shown in Fig. 2.

The idea of soldering plates to the uprights is not new, though it is not done for experimenters' equipment. However, standard condensers, such as those made by the Leeds-Northrup Company, are made in this way. It is not practical, with aluminum plates, to use solder, but brass plates can be secured in that way. Aside from the added rigidity, there is an advantage over the washer separated plates in that the latter are liable to offer considerable resistance due to poor contacts between the plates.

Stopping pins on the under side of the panel intercept short arms projecting from a brass piece on the upper part of the movable plate assembly. Thus, the plates are prevented from turning more than 180°.

Bearings for the upper part of the

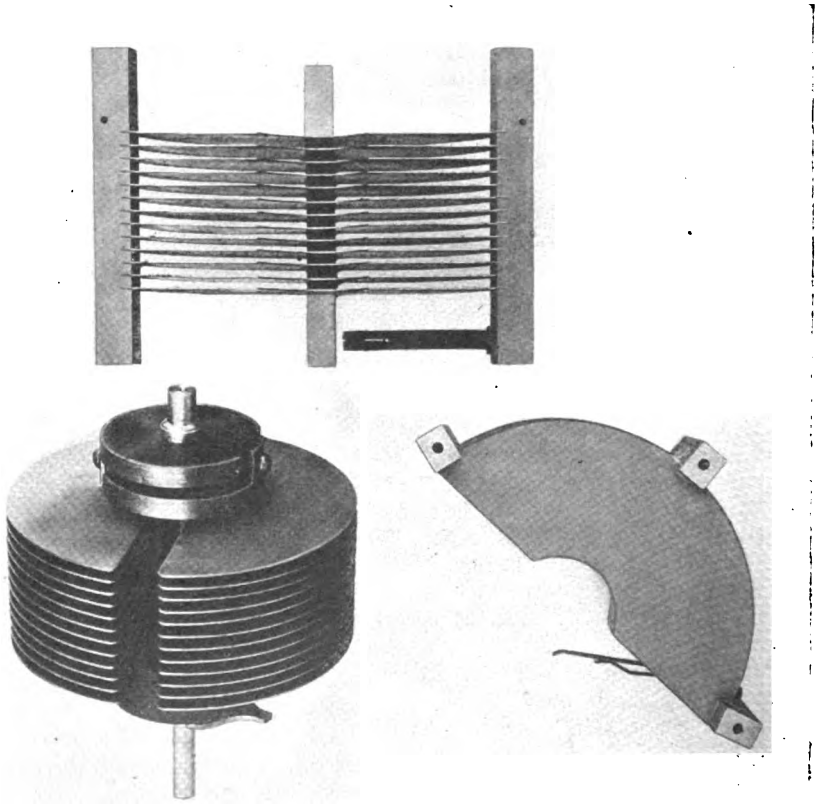


Fig. 2. Views of the fixed plates and the rotating plates, bottom up, illustrating the commutator

Digitized by Google

steel shaft are provided by a brass bushing set in the hard rubber panel. The use of a drilling jig made possible the accurate location of the bushing hole through the panel. There is a shoulder on the shaft which bears against a heavy phosphor bronze spring washer.

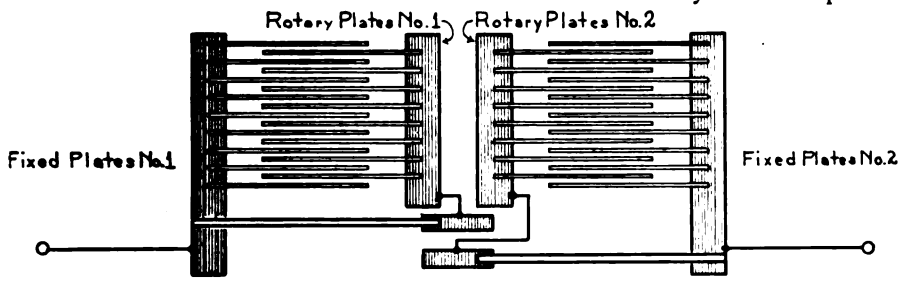


Fig. 1. In this position the capacity is minimum, for each rotary set is within its own fixed set

At the lower end, a thick bakelite panel is screwed to the brass plate supports and carries, at its center, an adjustable bearing of conical shape. The conical shoulder on the lower shaft centers itself in the bushing. This bushing is threaded and fitted with a lock nut. In adjusting the position of the movable plates, the lower bearing is screwed up, pushing the shoulder on the upper shaft against the spring washer. When the rotating plates are accurately centered between the fixed ones, the lock nut is tightened and the plates are maintained securely in position.

A conical bearing for the lower end is more satisfactory than a pointed screw adjustment, because the former has a large bearing surface, while the latter operates entirely against the point of the screw. On heavy condensers of this type, such a point would wear away quickly, and wearing, permit the plates to drop. This would change the capacity of the condenser and the wavelength calibration of the meter.

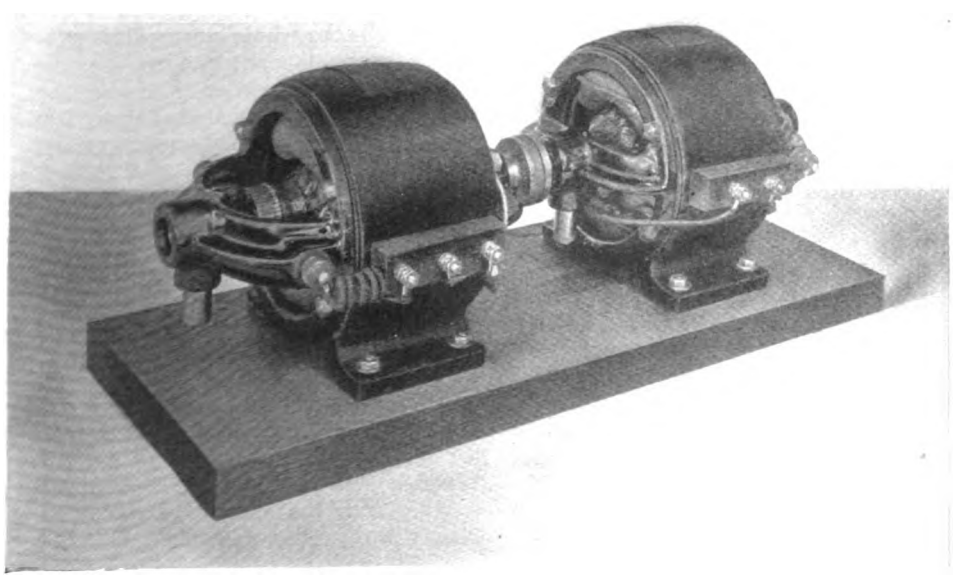
A 200 to 500 Volt Generator for Vacuum Tube Work

The greatest drawback to the use of vacuum tube transmitters for long-distance work has been the difficulty in getting a high-voltage direct-current generator. A motor generator set operating on 110 volts a.c. or d.c. has been brought out by the International Radio Company.

This set gives 200 to 500 volts at 0.2 ampere. At a speed of 1,750 r.p.m. the 48 commutator segments of the generator give a smooth current from which the ripples can be taken out with a small iron core choke and shunt condenser.

The voltage is regulated by a separate rheostat, making it possible to control the input to the tubes and to obtain the proper operating potential. Motor and generator, connected by a flexible coupling, are mounted on a heavy wooden base approximately 19 in. long by 9 in. wide. Rubber feet on the base absorb any vibration.

Now that power tubes are available, a number of undamped wave telegraph and telephone sets have been erected, and others are under way. In some cases audio frequency modulation is used because of the difficulty in heterodyning 200-meter undamped waves. This can be done without any trouble however, with a rotary tone condenser at the receiving station. A coming article will describe the construction and use of the tone condenser.

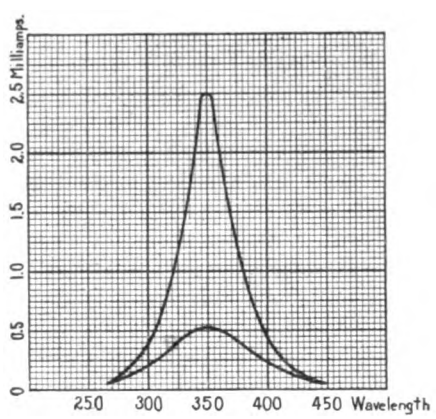


The Advantages of High Frequency Cable

A NUMBER of experimenters have sent in inquiries as to the advantages of using high frequency cable. They say, "Of course, I know it has less resistance, but does a small change in resistance have any appreciable effect on the signal strength of tuning?"

The curve accompanying this article shows more clearly than words the actual effect of resistance in the radio receiver. A coil was used first which had a resistance of 17.5 ohms at 350 meters, connected with a variable air condenser and a thermo-couple operated ammeter. Loosely coupled to this circuit was a calibrated oscillator. As the wavelength of the oscillator was varied, current readings were taken in the circuit under test.

The results, when plotted, gave the lower curve in the illustration. It will be seen that the tuning was very broad, and the maximum current at resonance through the 17.5-ohm coil was 0.5 milliampere.



A coil of high frequency cable, measuring 4.9 ohms at 350 meters, was then tested. At resonance, the current was 2.5 milliamperes—five times greater than with the other—and gave a sharp resonance peak. Thus an increase of current equal to that of a one-step amplifier was obtained, with far sharper tuning, by using high frequency cable to cut down the resistance. When radio currents are so minute at best, the experimenter can see for himself why cable should be used in place of solid wire.

Undamped audion transmitters also require cable-wound coils, for losses due to solid conductors are very pronounced, particularly at such high frequencies as 200 meters.

Digitized by Google

Standardization of Receiver Wavelength Ranges

A Method of Classifying Radio Receiving Sets According to the Wavelength Range for Which They Are Designed

ALTHOUGH the old practice of indicating the tuning range of a loose coupler or receiver by some wavelength value, such as a "1,000-meter loose coupler," has been condemned, no practical alternative has been suggested.

The persistence of some companies in keeping to this old method of designation has done more to confuse or prevent the proper understanding of tuning circuit design than anything else. Particularly the beginners are led to think that there is such a thing as the wavelength of a loose coupler, as applied to the tuning range, and many experimenters who are older in the game have clung to the idea.

Unfortunately, matters were not set aright at the start, as shown by the volume of answers to the query, "What is the wavelength of my loose coupler? It has coils . . ., etc.," in the Question Boxes of radio magazines, even up to the present time. To tell a man the wavelength of a coil is like telling him where to find the four-foot yard stick. The difference is that the latter case is only a joke, while the former is a misleading statement and a discredit to the publication.

Every experimenter should burn into his mind that the wavelength to which a coil will tune depends entirely upon the capacity connected with it. For example, a coil of 1,000,000 cms. inductance will tune to 596 meters when shunted by a condenser of 0.0001 mfd., but, with a condenser of 0.001 mfd., the wavelength is 1,885 meters.

Classification of Wavelength Ranges

Since there was no practical natural basis on which to determine the wavelength ranges, an arbitrary standard was created. Such a standard must be operative under the present communication schedule, it must also be suited to possible future schedule changes, and, at the same time, it must adapt itself to the design of tuning circuits.

The range of wavelengths, from amateur to commercial, might have been divided into a large number of small steps, or the steps divided according to the communication schedule now in use, but these methods offered no special advantages. Finally, a number of wavelength ranges for inductances and condensers were worked out, of which the following table offered the solution which has been adopted:

L	0.0001 *mfd.*	0.001 *mfd.*
cms.	*condenser*	*condenser*
12,000	65	206
120,000	206	653
1,200,000	653	2,065
12,000,000	2,065	6,529
120,000,000	6,529	20,650

The wavelength ranges, then, are:

A range, 65 to 206 meters.
B range, 206 to 653 meters.
C range, 653 to 2,065 meters.
D range, 2,065 to 6,529 meters.
E range, 6,529 to 20,650 meters.

This can be modified slightly to

A range, 60 to 200 meters.
B range, 200 to 600 meters.
C range, 600 to 2,000 meters.
D range, 2,000 to 6,000 meters.
E range, 6,000 to 20,000 meters.

Which have been adopted as the standard wavelength ranges.

These ranges fit into the present operating schedule, and include a class of stations in each one. The A range is for short, undamped wave experimental stations. Short wave commercial stations are included in the B range. Most commercial traffic comes in the C range. Long wave spark transmitters and undamped stations operate in the D and E ranges.

Letters have been used to designate the ranges, as they are more suitable than names. Although the Navy uses letters to indicate certain wavelengths, no confusion will arise on this score.

Classification of Receivers

Particularly manufacturers of experimental equipment have been slow to take steps toward standardizing their apparatus, in some cases because they do not wish to bring technical consideration into their catalogs for fear of confusing those with only a slight knowledge of radio, and in other cases because the companies are run by non-technical men who only know what sells and what does not.

Objections may be raised that, while the secondary circuit of a loose coupler can be standardized, the different kinds of antennas used make it impossible to follow such practice in the antenna circuit. Of course, the impossible cannot be done, but even here, by striking an average, serviceable standards can be applied.

The standard short, long and super range antennas, of a single wire 30 ft. high and 100, 200 and 300 ft. long, respectively, have approximate capacities of 0.0002, 0.0004 and 0.0005 mfd., respectively. To put this in the form of a table:

Standard Single Wire Receiving Antennas, 30 ft. High.

Types	*Length*	*Capacity*
Short Range.....	100 ft.	0.0002 mfd.
Long Range.....	200 ft.	0.0004 mfd.
Super Range.....	300 ft.	0.0005 mfd.

Resultant Capacities with Series Tuning Condenser

Type	*½ C antenna to 0.0005 mfd.*	*½ C antenna to 0.001 mfd.*	*½ C antenna to 0.0015 mfd.*
Short Range.....	0.00006 to 0.00014	0.00006 to 0.00017	0.00006 to 0.00018
Long Range.....	0.00013 to 0.00022	0.00013 to 0.00028	0.00013 to 0.00032
Super Range.....	0.00016 to 0.00028	0.00016 to 0.00033	0.00016 to 0.00038

Resultant Capacities with Shunt Tuning Condenser

Type	0.0001 *to* 0.0005 *mfd.*	0.0001 *to* 0.001 *mfd.*	0.0001 *to* 0.0015 *mfd.*
Short Range.....	0.0003 to 0.0007	0.0003 to 0.0012	0.0003 to 0.0017
Long Range.....	0.0005 to 0.0009	0.0005 to 0.0014	0.0005 to 0.0019
Super Range.....	0.0006 to 0.001	0.0006 to 0.0015	0.0006 to 0.002

From the data given in these tables, the primary of a loose coupler can be designed, allowing a 10 per cent. overlap of wavelength at the bottom and top of the range. Then, in stating the range of a loose coupler, it might be said, "B-C wavelength range on a long range antenna, no primary tuning condenser 0.00005 mfd. secondary condenser," for example.

This tells the whole story. The purchaser knows the antenna to use, the tuning condenser needed, and that the set will receive wavelengths from 200 to 2,000 meters. If experimenters and manufacturers would adopt this system, they would have accurate information on the requirements and performance of their apparatus.

Navy Code Practice Receiver

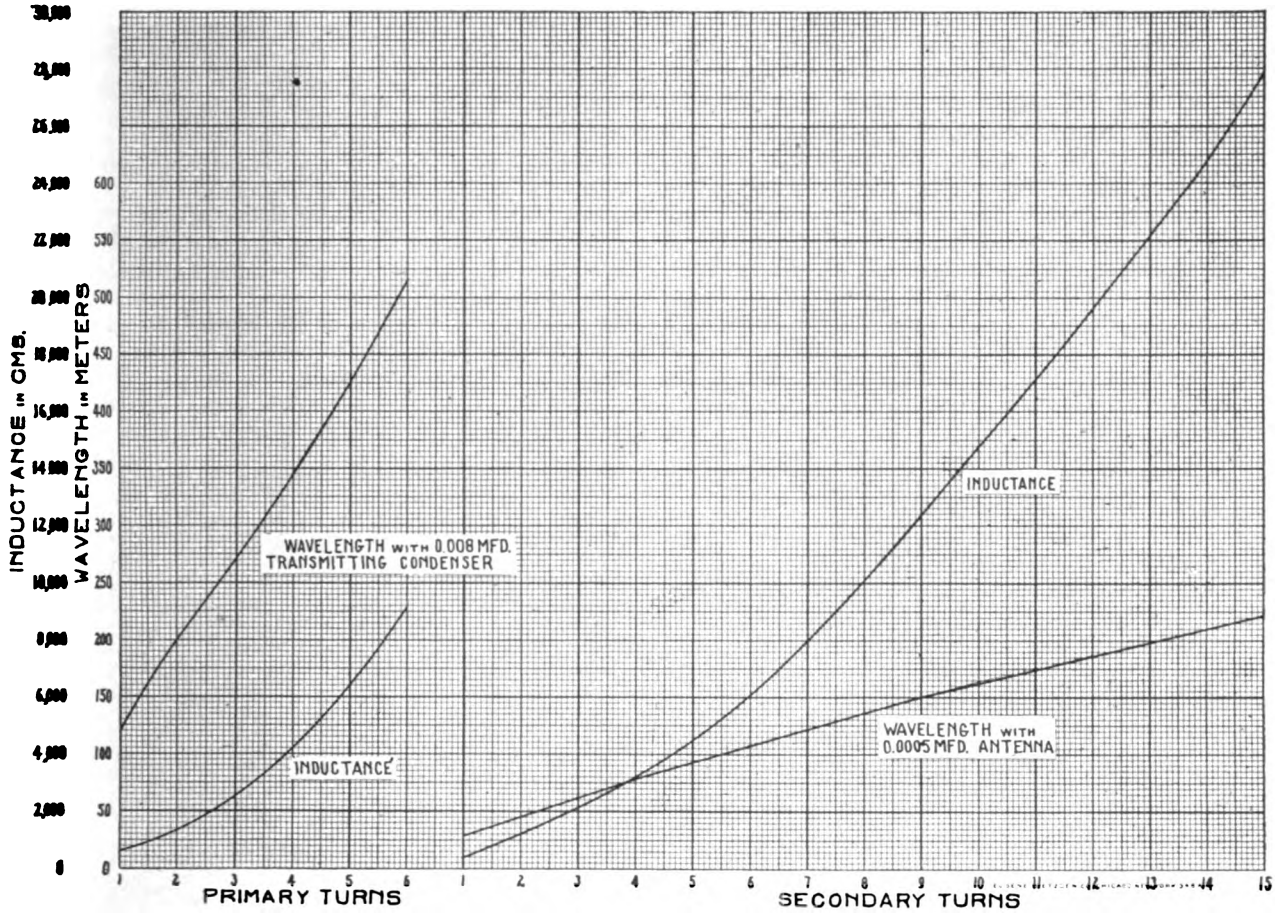
(*Continued from page* 92)

Connections for the set are given in the illustration. To tune in a transmitting station, the detector slider should be set at different points, and the antenna slider moved up and down. When a station is heard, it is tuned roughly with the antenna slider, then closely in the detector slider.

Digitized by Google

Data on the International Radio Oscillation Transformer

Cooperating with the ideas previously expressed in the Radio Department, the International Radio Company has supplied the data given in the accompanying curve on their oscillation transformer.



Primary inductance per turn is given by the lower left-hand curve, with the wavelength, using a 0.008 mfd. transmitting condenser. The inductance of the secondary is shown by the upper right-hand curve, with the wavelength, when operating on a standard transmitting antenna, below.

There is, of course, a change in the effective inductance when the coils are coupled, resulting in an upper and lower wavelength hump. As the upper wave is the more powerful, the wavelength adjustment should be made slightly lower than that given by the curve.

If a different condenser or antenna capacity is used, the required inductance can be determined by

$$L = \frac{\lambda^2}{3552C}$$

where λ = wavelength required in meters,

C = antenna or transmitting capacity in mfds.,

and L = inductance required, in cms.

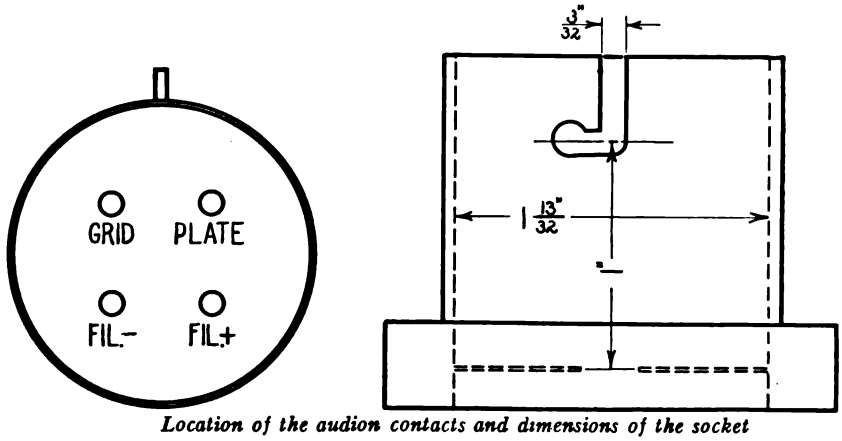
Audion Socket Dimensions

THERE seems to be some question about which is which of the audion base contacts. At the left of the illustration here the arrangement, as it appears when looking at the bottom of the base, is shown.

An easy way to remember is that the locking pin at the side of the base is between the grid and plate contacts. Holding the bulb with the contacts up, the grid is at the left and the plate at the right.

The polarity of the filament points has been fixed arbitrarily. As a matter of fact, the battery can be applied in either direction to the tube, though the polarity does make a difference in respect to the receiving circuit as is shown by reversing the connections at the battery.

The right-hand illustration indicates the general design for a socket. Any method can be used for mounting the spring contacts and for holding the tube in place. The important dimensions are the inside diameter of the socket and the distance from the springs, when the bulb is removed, to the locking point at the side of the socket.



Location of the audion contacts and dimensions of the socket

Digitized by Google

The Still Gas and Steam Engine

A Combination Form That Increases the Efficiency of the Internal Combustion Engine by Utilizing Heat Energy Ordinarilly Wasted

By Prof. T. O'Conor Sloane

MUCH interest has been created in the gas engine world by the Still engine, a combined gas or oil and steam engine. Internal combustion engines, while they give high efficiency on account of the high temperature developed by the combustion within the cylinder, to some extent overcoming the second law of thermo-dynamics, in one aspect are very unscientific. The necessity of cooling the cylinder and sometimes even the piston with water involves a great waste of heat. A second loss of heat is due to the escape of the hot products of combustion. In the Still engine both these losses are diminished and a higher economy of fuel is obtained. More than this is done. The relation of the cooling system to the operation of the engine is such as to introduce new factors and produce a different operation of the explosion or internal combustion division of the machine.

The construction of the engine is shown in the diagram. The water in the water jacket surrounding the cylinder is kept at such a pressure as to be above the temperature of boiling. The effect of this is that it is a reservoir of steam, evolving steam at working pressure as called upon. The steam produced by this arrangement is admitted to the under side of the piston and expands and drives it up on its gas-expelling stroke. In the engine illustrated the gas engine is a two-cycle one; the admission of steam below the piston makes every stroke a working one, so that the combined steam and gas or oil engine has as many impulses as a one-cylinder steam engine. A two-cylinder, two-cycle engine with the Still construction would give four impulses for each revolution, two of steam and two due to gas combustion.

The following explanations giving the different steps of the Still mechanism may be taken as describing a true cycle. The description may be followed by the aid of the diagram herewith.

A. Steam and water are taken from the top of the gas-cylinder water jacket. The water in the jacket is kept at a temperature of 350°F. The gas cylinder is the primary source of heat, and the maintenance in it of one pressure and one temperature is due to the balance between the heat produced and the steam generated.

B. The steam and water from the water jacket are taken to a boiler entering at about the level of the crown-sheet. Here a pressure of 120 lbs. to the square inch is maintained.

C. From the top of the boiler steam is taken and by a slide valve is admitted below the piston, the steam end operating as a single stroke steam engine. The exhaust steam is preferably taken to a condenser and air pump with hot well.

D. Water from the bottom of the boiler enters the heater and thence circulates through the water jacket.

E. The loss of water due to the steam used in the steam end of the cylinder is replaced by feed water from the hot well. This water also passes through the heater and enters the jacket at a high temperature along with the circulation water from the boiler, against a pressure of 120 lbs. to the square inch.

F. The exhaust gases from the gas end of the cylinder pass through the tubes of the heater, imparting most of their heat to the water on its way to the water jacket. The combustion gases leave the heater at a temperature of about 150° F.

The steam chest of the ordinary steam engine here becomes a steam jacket surrounding the lower end of the cylinder. Asbestos lagging or other non-conducting packing is used to retain as much of the heat as possible to further increase efficiency.

The water in the water jacket being kept at a uniform and unvarying temperature, well above that of boiling water, the gas end of the cylinder is much hotter than when comparatively cold water is kept in contact with its walls as in the case of the ordinary gas or oil engine. The steam is evolved at constant pressure and its evolution in a sense takes the place of the water circulation of the ordinary engine. To make the cooling action of the water jacket efficient it is made of thin material and is braced by a series of ribs abutting against a steel band. The construction is shown in cross-section in one of the cuts. The action of the steam is different than in the ordinary steam engine because it enters a hot cylinder and gains heat from it as it expands. This is a minor source of saving heat, but it prevents any condensation of steam also. The normal steam pressure has been 14 pounds to the square inch. The weight of steam at full load is 7 lbs. per brake horsepower hour; at the minimum load it may be barely enough to balance the loss of heat due to radiation.

The range of temperature is excellent; the terminal or boiler stack temperature may be as low as 150° F., and this with the 2,000° in the internal combustion phase gives a range of nearly the full 2,000°.

Taking the mean effective gas pressure at 90 lbs. and the steam pressure

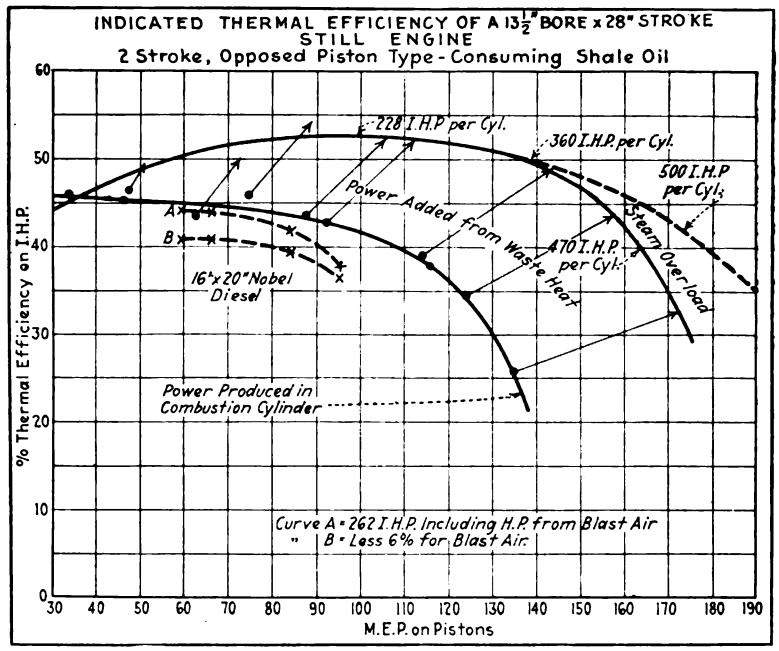


Diagram showing thermal efficiency of Still engine

Digitized by Google

at 14 lbs., the steam will add approximately 16% to the power. In a four-cycle engine, where the steam does double work in each cylinder, this ratio is doubled for an increase of about 30%. This is in power, based on pressures; a brake test showed 29% additional power. This was when the steam escaped into the air. Condensing the steam as in regular steam engine practice and with the air pump driven by outside power, the increase in power was as much as 40%. As regards efficiency the figures are taken to indicate a possibility of an increase of 15% or more.

The usual water jacket losses are eliminated because the cooling of the cylinder is done by the generation of steam which is used. Another point of advantage is that the entering steam cools the piston; no water circulation in the piston is needed for this as in other large gas power units. The system lends itself to various compounding arrangements. The compounding may be from high pressure independent steam cylinders to the gas engine cylinder or vice versa.

In Diesel or semi-Diesel engines the pressure in the gas end of the cylinder may be reduced 50% on account of the heat of the walls, which heat the entering charge and make it explode at a lower pressure than in the regular Diesel engine.

The gain from the use of steam more than balances the mechanical losses, so that it is safe to take the indicated horse-power as no greater than the brake horse-power. The boiler as shown in the cut may be heated by oil fuel in addition to the heat received from the water jacket, an oil burner discharging into a combustion chamber lined with refractory material.

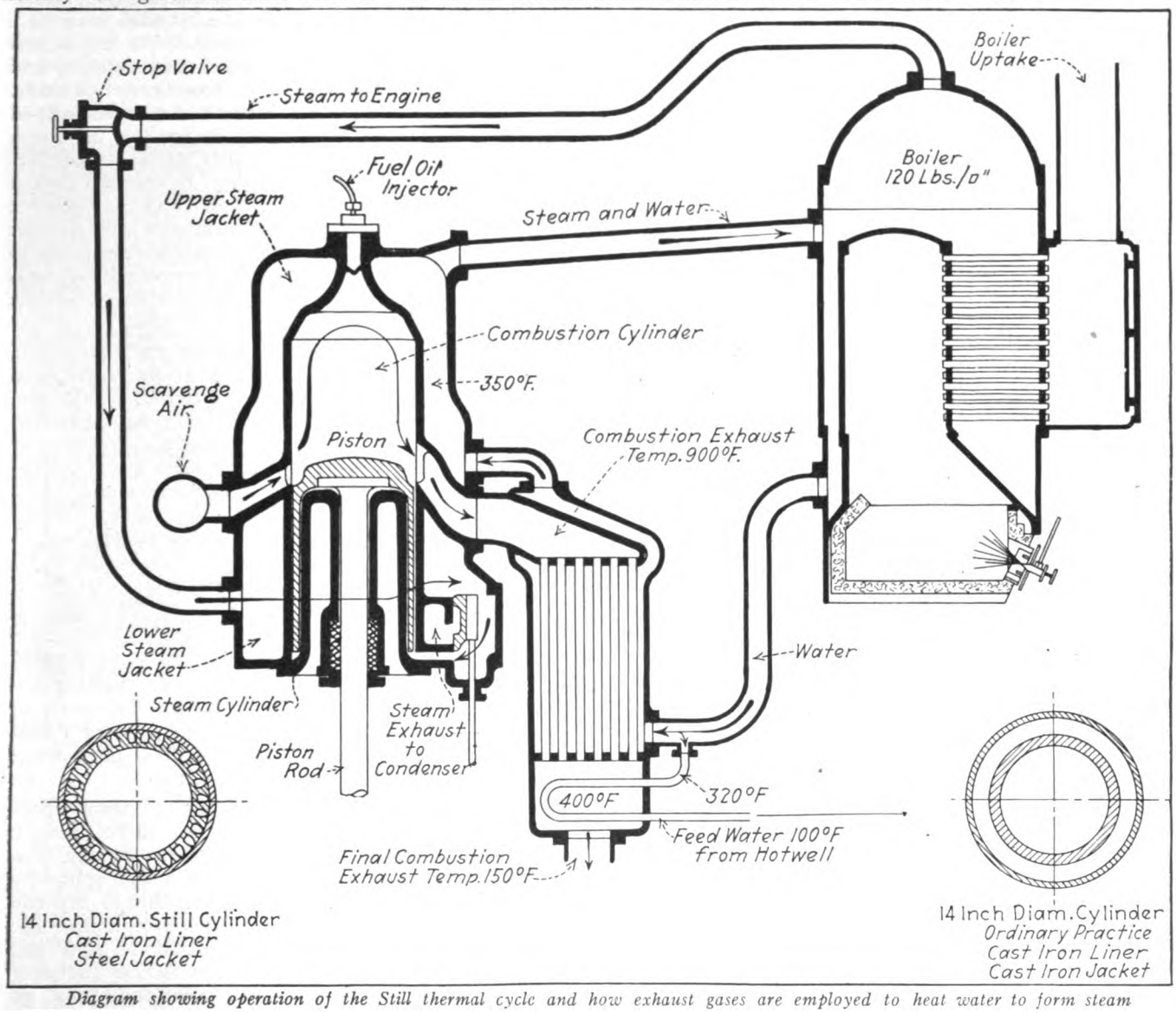


Diagram showing operation of the Still thermal cycle and how exhaust gases are employed to heat water to form steam

Aluminum Coating for Wood

A very effective agent for moisture-proofing wood has been found in an aluminum leaf coating. This material is said to practically insulate the wood it protects against any change in atmospheric conditions and is particularly valuable for use where accurate form and balance must be maintained, as would be necessary in an airplane propeller.

Zinc Wire in Germany

Owing to the shortage of copper, it is stated that German manufacturers are producing zinc wire which is but slightly inferior to copper wire from a mechanical standpoint. The new zinc wire is now authorized by the Electro-technical Union for electric wiring purposes, such as for insulated wires or cables employed in steel conduits for house wiring, or for larger conduits. Lead-covered cables are now made with the conductors of zinc.

The main advantage of zinc over iron lies in the fact that zinc has double the electric conductivity of that metal, and, besides, it is non-magnetic. Again, zinc wire is more flexible than iron, hence it works better upon insulators; and another point is that it does not need to be protected from rust. It lacks the strength of iron, however. It took some time for the new wire or cables to be introduced, especially as during the first stages the manufacture of it gave considerable trouble, but these defects have been eliminated and satisfactory results are now obtained.

Digitized by Google

Five Different Kinds of Ice

By W. C. Dumas

RECENT scientific work has shown that under certain conditions ice can exist in five different and distinct forms. The four additional forms of ice are very unstable under ordinary conditions, but they are of intense interest on account of their queer and unexpected properties. For instance, P. W. Bridgman, of Harvard, has found that under the enormous pressure of 44,000 pounds per square inch water can be made to freeze although it is nearly boiling hot. This reverses all our usual ideas of the meaning of freezing, but then our idea of this phenomenon is based entirely on conditions as they ordinarily exist under atmospheric pressure of approximately fifteen pounds per square inch.

Most of the properties of ordinary ice are familiar to everyone. Ice is lighter than water and floats because upon freezing at atmospheric pressure it expands and therefore its density becomes less than that of the water it is floating in. This expansion makes ice from 10% to 13% lighter than water.

Tammann, a German scientist, experimented to see what would happen if enough pressure were applied to water at the moment of freezing to prevent this expansion. The result was that he obtained an ice heavier than water which would not float in it. He named this modification Ice III. As would be expected, Ice III is very unstable, and upon even slight warming it swells up and breaks into a fine white powder which is nothing more than ordinary ice in very small crystals. The volume of this snow is from four to eight times that of the original Ice III.

Prof. P. W. Bridgman, of Harvard, and Prof. Tammann have made many observations on the behavior of water when it is cooled at the same time these extreme pressures are applied. The conclusion drawn from their investigations is that there are five varieties of ice.

In this work, enormous pressures had to be used which surpassed by far any pressure ever previously measured. Up until the time Bridgman began experimenting, the highest pressure that had ever been measured was 150,000 pounds per square inch produced by exploding nitroglycerin in closed vessels. But for his purpose such pressures were not sufficient, being only one-half of that required. In his work on ice, this experimenter used pressures as high as 300,000 pounds to the square inch.

The magnitude of such an unusual pressure can be better appreciated when he tells us that the average firing pressure of artillery is only about 30,000 pounds per square inch. The pressure in the ocean at a depth of six miles is about 15,000 pounds per square inch, so to obtain a pressure of 300,000 pounds, such as he used, it would take an ocean one hundred and twenty miles deep.

It would be a reasonable question to ask: What material can be found out of which to construct apparatus to be used in enclosing water under such pressures without breaking or leaking? The modern research experimenter is very ingenious. A glass hard steel was found that could withstand pressures of from 600,000 to 750,000 pounds per square inch. Cylinders were made of this material. Pistons of the same metal fitted into them and to avoid leaks around the pistons, an ingenious method of packing was devised, so that the higher the pressure became, the tighter the packing fitted. Special gauges were also devised for registering the pressures.

With such an apparatus as this, Bridgman cooled water under very great pressures. He found that water is not absolutely incompressible. At 180,000 pounds per square inch it decreases in volume about twenty per cent at ordinary temperatures.

Ordinary pressures applied to ice cause it to melt. For example, if a weight is placed on a block of ice, the ice will melt much more quickly under the weight than anywhere else on the block. But at such enormous pressures as Bridgeman used, the water sometimes solidified from the pressure alone.

As previously mentioned, Prof. Tammann in pursuing these investigations, found that when ordinary ice is subjected to about 5,000 pounds per square inch and at a temperature of 22° Centigrade, that it was no longer possible to melt it even under considerable pressure. Instead it changed in form to an ice denser than water. He named this Ice III, and called ordinary ice Ice I. Common ice and Ice III are analogous to the two forms of carbon, graphite and diamond.

A short table will give in an interesting and concise manner the temperature and pressure relations between the several varieties of ice obtained by these investigators:

At 142,200 lbs. per sq. in. and 0° C is formed Ice VI.

At 28,400 lbs. per sq. in. and 20° C is formed liquid water.

At 14,200 lbs. per sq. in. and — 20° C is formed Ice L (ordinary ice).

At 28,400 lbs. per sq. in. and — 20° C is formed Ice V, heavier than water.

These interesting transformations can be stated in another way. Commencing at atmospheric pressure and — 30 degrees C, Ice I or ordinary ice is obtained, and upon holding the temperature stationary and increasing the pressure, we get the dense form, Ice III, first obtained by Tammann. Still more pressure changes Ice III into Ice II, and a further increase changes Ice II into Ice V, and finally at the highest pressure Ice VI is formed. This variety is the heaviest modification.

It was observed that the transformation of these varieties takes place in a remarkable manner. We are accustomed to see water freeze slowly, and everyone knows how slowly ice melts. But under favorable conditions some of the above forms change into the others so rapidly that they almost explode. A concrete example of this sudden change is that of ordinary ice (Ice I) into Ice III. At — 25 degrees C, the reaction is so sudden that it was impossible to measure the pressure involved. A sudden explosive click was heard and the reaction was instantly over.

Now three of these modifications of ice (Ice II, V, VI) have never been seen, as they are formed inside steel cylinders under immense pressures. But all data obtained give indisputable evidence of their existence, and the experimenter has at his command a method of reasoning, known as the Phase Rule, which enables him to analyze the data he gathers.

Fire and Chemical Proof Paint

A FIRE and chemical proof paint, which leaves a nice looking finish is made by boiling 790 parts of Copper Sulphate, 790 parts of Potassium Chromate and 1000 parts water in the same container.

When the solution is boiling, apply one coat to the article to be finished. Allow the solution to dry one day, then boil the solution again and apply the second coat, allowing this to dry two days. Heat 100 parts of aniline oil. 100 parts of hydrochloric acid and 1000 parts water in another container to a high boiling point and apply one coat to the article, and let dry for one day.

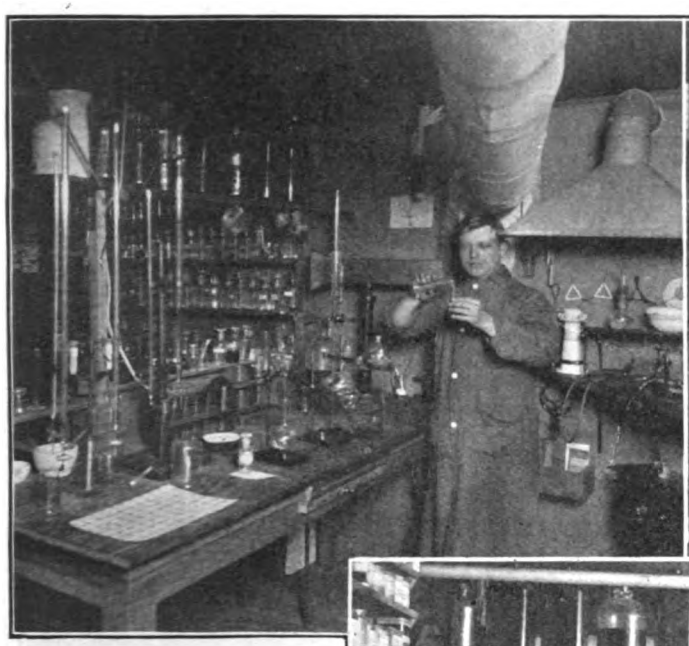
Make a new solution of aniline oil, hydrochloric acid and water, like the previous one and apply in the same manner. Let the article dry two days. Wash the article in soapy water and let it dry thoroughly, then rub with linseed oil and it will leave a highly polished dark gray surface.

The parts used are taken by weight, and the solutions may be applied with a paint brush. Care should be taken not to mix the two solutions before applying. NOMAS TALLMAN.

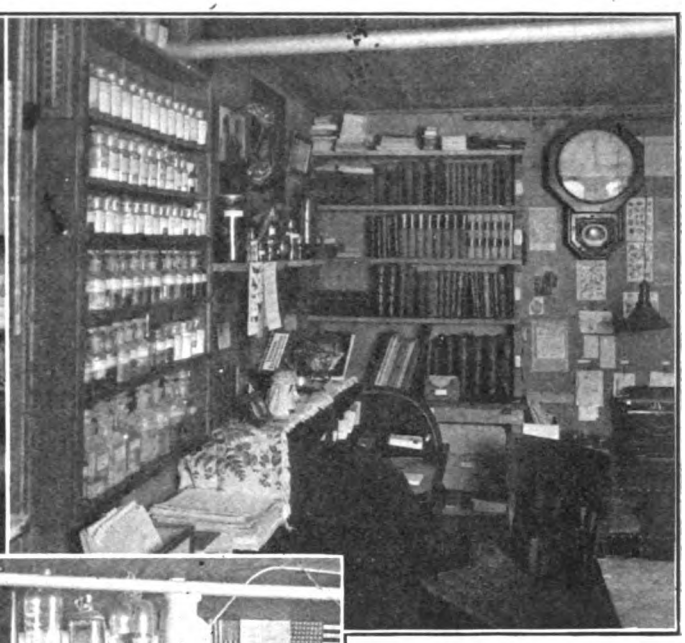
Digitized by Google

The Winners of the Everyday Engineering Workshop Contest

As announced in the August number of EVERYDAY ENGINEERING, the workshop contest closed October 1st and the workshops of the following men have been selected for first, second and third prizes, respectively: W. Nushawg, Dayton, Ohio; Elmer Hutchison, Cleveland, Ohio; S. C. Swanson, Chicago, Illinois, and Edward H. Bitner, Harrisburg, Pa. The judges found Mr. Bitner's and Mr. Swanson's workshops so well arranged and possessing so many similar features that it was decided to award each of these men the third prize.



Mr. Nushawg at work in his chemical laboratory



Mr. Nushawg's study. This looks very cosy, "scientific" and neat



A general view of the laboratory, showing the biological equipment

The pictures of Mr. Nushawg's laboratory were the first ones to be received and we believe that our readers will agree with us that he is in possession of a wonderful workshop. It is carefully planned, well kept, well arranged and contains a vast amount of equipment. However, the judges did not consider the equipment of the laboratory so much as its arrangement and neatness in arriving at the final decision. The idea was to reward the owner of a model laboratory in every way.

The photographs of the winners of the third prizes will be pictured in the January number of EVERYBODY ENGINEERING.

The description of Mr. Nushawg's laboratory which accompanied his photographs follows:

My Workshop, What Is in It, and How I Use It. Herewith are three views of my "Chemical Laboratory." I think it will be needless for me to give a description of the contents of the laboratory, as the views were so photographed as to cover that part. A brief outline or history of my laboratory, I think, would not be out of place. The "Lab.," as will be seen in the accompanying views, is an accumulation of five years' experimental work. My first laboratory consisted of an old wash-stand, of which a part can be seen directly behind "yours truly" in the view in which I am standing. Year by year I have added to the aforesaid wash-stand, as my finances would permit. To-day, I have what I consider a model "Amateur Chemical Experimental Laboratory."

The laboratory is not only a place which affords me much amusement, but also my "Study Hall" and my "College of Science," combined in one. I maintain a schedule of study, which embraces two hours each evening, including the study of chemistry, mechanics, electricity, biology, and other kindred subjects interesting to those contemplating a life of science.

The laboratory is located in the cellar of my home and is twenty-two feet in length by fourteen feet in width. It is constructed of plaster board and has a four-inch air cushion around it on three sides, so as to protect it against any dampness from the cellar. It is heated by a furnace pipe that you will notice running through the laboratory. It is fitted with electric lights for general illumination and a gas lamp for use in the printing of photos. I have gas and running water at hand. A hood is also among the apparatus. This serves in eliminating all obnoxious odors. Among the apparatus of my own construction I will mention an electric furnace, which I constructed of fire brick, using an arc as the source of heat, which gives me a heat of 3500°. This I have found very successful in the analysis of alloys. A hydrogen sulfide generator of

Digitized by Google

my own design also will be noted among the apparatus. This I constructed of odds and ends found around any laboratory and have found it to give only the desired results.

As to the use to which I put my laboratory. I have before mentioned I use it for personal advancement in those subjects interesting and useful to one who has an ambition to get to the seat of those things around us that have as their fundamental principle some law or theory based upon science. I am a machine designer by trade, and with my present knowledge and that which I can gain by my experimental research work and study in my laboratory, hope to become an expert in foundry practice. I take a keen delight in trying some new experiment relative to these branches and look forward with expectation to the next issue of EVERYDAY ENGINEERING MAGAZINE, which I have found of great assistance and benefit to my researches and study. I have found it to be the best of its kind in the field and have recommended it highly to my friends, gaining it quite a few friends by so doing.

I think I have covered my interest in life and the description of my laboratory and its use and will close, trusting to your good judgment in finding me eligible for your contest on "My Workshop, What is in it, and How I use It."

We hope that this contest will help create interest in home workshops and laboratories, not only among those who have a laboratory at the present time, but those who have no laboratory at all. The owners of laboratories will find many valuable suggestions by examining the photographs of the laboratories that are published.

The experimental research laboratory of Mr. Elmer Hutchison and Mr. Wilbert Hartle was found very deserving of second place. This particular laboratory is not limited to any special work, but has mechanical, electrical and chemical equipment. The following description of the laboratory accompanied the photographs and it is in the words of Mr. Hutchison:

"Sir, the parade is formed," is an expression to describe our shop. It is, of course, dressed up to have its picture taken. It does not look natural nor nearly as seaworthy as when wood chips are on the floor and the long steel curls climging up the lathe.

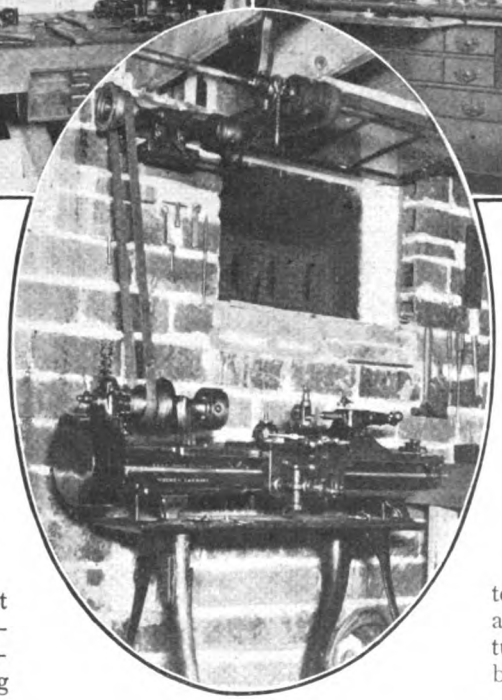
The "lab" belongs to Wilbert Hartle, 1293 Andrews Avenue, Lakewood, Ohio, and myself. We have been in partnership several years and are constantly adding things to our "lab." We have equipment for pattern and cabinet making, metal spinning and turning, and for making drawings and blueprints. We also make a few small castings.

My partner and I are both interested in chemical research work. For quantitative and qualitative analysis one of us can mix up something for the other to analyze. We also do most of our own developing, printing and enlarging of pictures. We have a vest pocket and a 4 x 5 inch kodak.



The mechanical workbench in the laboratory of Messrs. Hutchison and Hartle

A corner of the chemical laboratory owned by Mr. Hutchison and Mr. Hartle of Cleveland,, Ohio



The lathe which forms a very important part of the laboratory

In our physical research corner we have electrical meters and instruments, dynamo, electric arc furnace, microscope, micrometer, balance and other small apparatus. We also have many scientific books.

We have our "lab" in a corner of the basement. This has disadvantages as well as advantages. It is cool in summer and warm in winter, but the odors from chemicals rise and visit the people above. The pictures show the location and apparatus better than can be described."

Next month there will be published more photographs of shops owned by our readers. The next two shops will be those that won the third prize, as the judges decided to make this award to two owners, owing to the fact that their shops possess so many similar features.

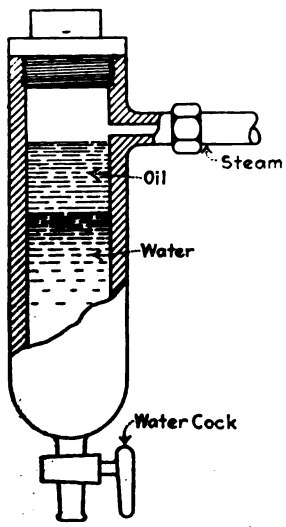
It has been decided to publish photographs and descriptions of readers' shops from time to time.

Digitized by Google

Displacement Lubricator for Model Engines

THE displacement lubricator is a convenient form to use on a small steam engine providing flash steam is not employed to drive the engine. If flash steam is used, the only device that will supply a sufficient quantity of lubricating oil in the cylinder is a small pump driven off the engine shaft.

Displacement lubricators are very easily constructed and positive in action—which cannot be said of all pumps when the check valve is considered as a part of the pumping unit. The operation of a displacement lubricator will be understood by referring to the sketch. It really consists of a small reservoir interposed on the steam feed pipe between the boiler and the steam chest. A small quantity of the steam passing through the lubricator condenses and the resulting water falls to the bottom of the reservoir, the oil floating on top. As the water accumulates in the bottom of the lubricator, oil is forced out into the steam feed pipe and carried into the engine cylinder. A cap screw is used on the top of the lubricator. A small petcock is placed on the bottom to run off the water. Such lubricators give very little trouble and the only attention they need is the occasional filling of the oil cup.



Making Wire Terminals

Suitable terminals for wire in electrical work can be made of brass or copper tubing cut to the proper length and pinched together at one end in a vice. A hole is then drilled in the flat end. If the copper or brass is too hard and cracks upon bending, it should be annealed first. Brass, unlike most other metals, is annealed by heating it and then plunging it into cold water.

The American Society of Experimental Engineers

Who's Who in the A. S. E. E.

JOHN GIFFORD.

Mr. John Gifford is an active member of the American Society of Experimental Engineers. At the present time he is employed as superintendent of the A. R. Mosler & Co. of New York City, having advanced to this position from apprentice in the machine shop, where he started in 1907. Mr. Gifford started his industrial and business career in the book bindery of I. Male & Sons, New York City, in the year 1906. During this year he resigned to assume the responsibilities of a position that would bring him in closer relationship with mechanical work. His next position was with the Isaac S. Johnson Co., Spuyten Duyvil, N. Y., founders. Mr. Gifford served six months as a coremaker for this concern, and finally left its employ to start with the A. R. Mosler Co., where he is now located. Before becoming superintendent, he was foreman of the assembly department.



Mr. Gifford was born on July 21st, 1892. His parents died while he was in his youth. He was educated in the city schools of New York. The A. R. Mosler Co., where Mr. Gifford is now employed, is engaged in the manufacture of spark plugs and automobile ignition equipment. Mr. Gifford's experimental work is concerned entirely with refractories and insulators used in connection with automobile ignition apparatus. It was Mr. Gifford's job to make the spark plugs for the NC-4 at the start of the trans-Atlantic voyage.

Mr. Gifford is a careful student of military tactics and is a member of the First Company, Eighth Coast Artillery, New York Guard. Boating is also another hobby of Mr. Gifford's.

The A. S. E. E. in Canada

The American Society of Experimental Engineers is well represented in many parts of Canada. In the city of Toronto, the A. S. E. E. has a number of very enthusiastic members. The city of Winnipeg has formed a very successful local chapter. Mr. A. W. Dery is now the president of this organization, which promises to be a very successful one as well as a great help to the many experimental engineers in Winnipeg and vicinity.

The Winnipeg society is now contributing to a laboratory fund which will later be used in purchasing the necessary equipment for a modern workshop and laboratory.

Many of the members of the Winnipeg society are well advanced in the various phases of experimental engineering. These men have volunteered to act as instructors for the rest of the membership. This is a commendable plan and one which will do much toward making the society a success. This is a spirit of co-operation which is sure to further interest and ambition.

The A. S.. E. E. is also very well represented in the city of Montreal. The formation of a local chapter is now under way. A great number of A. S. E. E. members are in Canada, but aside from Toronto, Montreal, and Winnipeg, they are not in any definite locality.

NOTICE

The Mansfield, Ohio, chapter of the American Society of Experimental Engineers is now planning a large membership campaign. Mr. Richard Hautzenroeder, the Secretary of this live chapter, requests that all the experimental engineers in and around Mansfield communicate with him. The Mansfield Chapter was started some time ago and has been very successful. Those interested should not hesitate to get in touch with Mr. Hautzenroeder.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

A Half Million-Volt Condenser

AN air condenser has been built at Palo Alto, Cal., for conducting tests with voltages up to 500,000 and frequencies up to 60,000. This condenser is probably the largest that has ever been built and it possesses many unique features. A special shed has been built to contain the condenser. The ceiling of the shed is of copper and forms one plate. The other plate rests on a bed of insulating material about four and a half feet below the ceiling of the shed. The distance between the plates is made adjustable by lowering or raising the lower plate. The bottom plate is formed by two copper plates about two feet apart. These are connected along the edges by copper sheets curved on a 12-inch radius.

A Poulsen arc converter of 30 k.w. capacity is used to supply energy for the tests with the condenser. One side of the arc is grounded and the other is connected to the insulated plate of the condenser on a coil of Litzendraht 9 feet long and 31 inches in diameter.

The air condenser has been designed and built by the Federal Telegraph Company, manufacturers of radio telegraphic apparatus.

A Giant Electric Ore Unloader

AN electrically operated ore unloader equipped with a 15-ton bucket has been brought into use at Ashtabula, Ohio. In fact, a battery of eight of these machines are employed in this locality for unloading ore-carrying lake vessels. The combined unloading capacity of the eight machines aggregates 76,000 tons in 24 hours; 76,000 tons would require six of the largest ore-carrying vessels in use on the lake. The unloaders are equipped with a total of 930 horse-power. The unloading cost ranges from two and a half to four and a half cents per ton. This cost includes superintendents, labor, materials and power.

Rivets Heated Electrically

AN electric rivet heating device has been perfected and is in operation in several of the large ship building plants and foundry companies. Two methods are used in rivet heating machines. In one method the rivet short circuits a welding transformer. The other method employs granulated carbon which short circuits the secondary of the transformer and radiates heat to the rivets. The capacity of the rivet heating machines depends entirely upon their size. They are made in sizes that will turn out from 25 to 250 lbs. of rivets per hour with a power consumption of 7½ k.w. to 300 k.w. and an energy consumption of 20 k.w. hours per 100 lbs. of rivets. The rivets can be heated in 30 seconds.

In an efficiency test on one of the machines 200 rivets were turned out per hour at a temperature of 2000° Fahr. No tendency to overheat was noticed and a power demand of 40 k.w. only was necessary. The initial cost of the welding type rivet heater is one hundred dollars per k.w.

Charging Storage Batteries with a Tungar Rectifier

A TUNGAR rectifier is a very simple and inexpensive device that has been brought out by the General Electric Co. It is used mostly for charging storage batteries from A. C. mains where the efficiency of the operation does not need to be over 40%. A Tungar rectifier is a vacuum tube device and has many advantages. It operates directly from 115-volt mains with an out-transformer and forms a very simple and compact device for storage battery use.

Mr. F. Keith D'Alton, electrical expert, has recently described the theory and application of Tungar rectifiers in a number of commendable articles which appeared in the Electrical News. He brings out the fact that having obtained a given efficiency and output from a single phase, 115-volt pair of mains, it is possible to duplicate the plant and obtain double the output from single phase 330-volt outside wires.

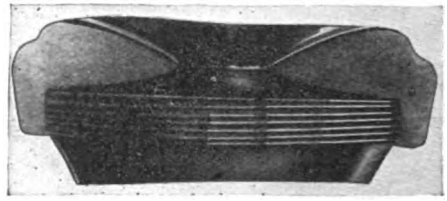
A Large Experimental Spot Welding Machine

ONE of the largest spot welding machines ever constructed has recently been built and tested by the General Electric Company. The machine has a capacity of 100,000 amperes at 20 volts. It is capable of exerting a hydraulic pressure aggregating 36 tons at the electrodes. An important series of experiments were carried out with this machine using plates from ¼ in. to 3 in. total thickness. The engineers working on the device demonstrated that satisfactory spot welds can be produced within this range. The necessity of providing a gap large enough to handle the width of the plates in ship work gave rise to a number of practical difficulties which were finally overcome.

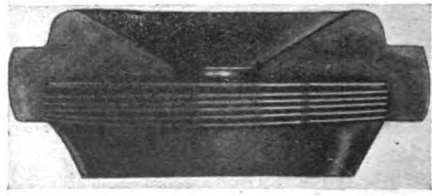
A New Telephone Receiver

A NEW telephone receiver cap has been brought out which seems to possess many advantages over the conventional form. The cross section of the new and old type of receiver cap are shown in the illustration.

The diaphragm seat of the new cap is ground scientifically true with the thread so that all rattling of the diaphragm through poor locking as well as harsh and undesirable sounds are prevented.



The new telephone receiver cap



The old type telephone receiver

A sound concentrating chamber of inverted convex formation guides and concentrates the entire sound wave that is thrown off or produced by the diaphragm with each vibration through the central opening. The contour of the sound concentrating chamber prevents distortion and insures the best possible results.

Melting Brass Electrically

BRASS is now being successfully melted in electric furnaces. It is claimed that brass melting furnaces, even more than steel furnaces, are proving their economic value in producing a better quality of product, minimizing metal loss and decreasing the amount of labor necessary.

Digitized by Google

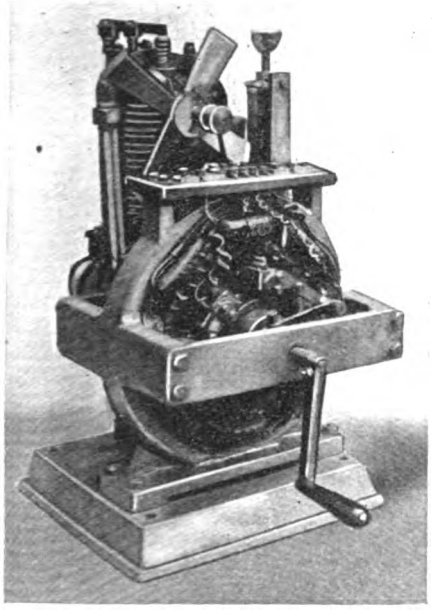
A 37,500 Horse Power Unit

THE Niagara Falls Power Company is now installing two units aggregating 65,000 H. P. or 37,500 H. P. each. The water wheel of this unit is placed in the path of a solid column of water 14 feet in diameter and a drop of 210 feet. The speed of this column of water will probably be in excess of 3 miles per minute at the foot of the drop.

About 14 years ago the Hydraulic Power Company installed 13,000 H. P. units and at that time these units represented the limit of engineering. The fact that a 37,500 H. P. unit is now made possible shows what tremendous progress has been made in hydraulic and electrical engineering during the past 15 years.

A Small Gasoline Electric Generator

ONE of the foreign readers of EVERYDAY ENGINEERING MAGAZINE, Mr. J. A. Armstrong, of Dublin, Ireland, has constructed a gasoline electric generator of rather novel design. The accompanying photograph pictures



the device which was made up of a 1 1/3 H. P. gas engine and dynamo capable of producing a current of 15 amperes at a pressure of 15 volts. Mr. Armstrong mounted his motor and generator on the same shaft and in this way produced a very portable and self-contained equipment for various uses, such as charging accumulators, isolated lighting, etc. When coupled to the generator the engine does not need to have a flywheel, as the armature of the generator will serve in this capacity. The engine turns over at a speed of 900 R.P.M., and of course, the generator is driven at the same speed.

An Apparatus for Testing Magnetic Permeability

By William G. H. Finch

THERE is a need in every electrical laboratory for an apparatus to test the permeability of the various grades of iron and steel in the make-up of cores used in electro-magnets.

The necessary parts for the apparatus are:

Spring balance
Brass rod
Wood base and standards
Binding posts
Electro-magnet
2 or 3 dry cells.

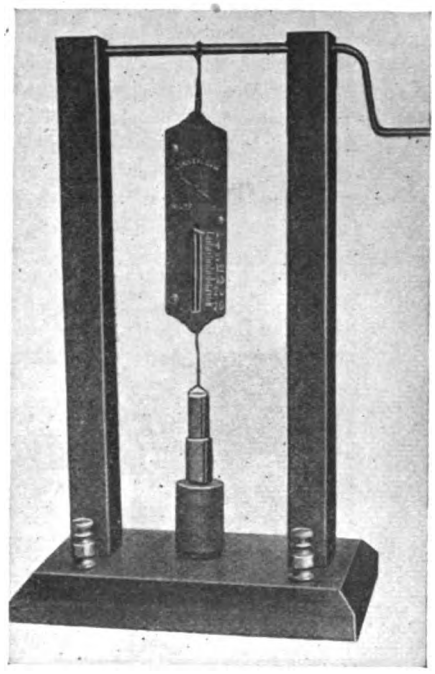
First, remove the spring from the spring balance and replace it with one that will respond to smaller weights. The new spring will be much more sensitive and a new scale should be made from cardboard for it. By the use of known weights of small value the new scale can be very easily calibrated.

Assemble these parts as shown in the photograph. Cut the various grades of iron into pieces having the same dimensions (preferably 1 inch cubes). Attach the piece to be tested to the spring balance, being sure to let the surface of same touch the core of the electro-magnet; watch the scale and raise the balance slowly until the cube of iron is separated from the magnet. The number of ounces or pounds pull it required to break away from the electro-magnet will be noticed. After the experimenter has tested the remaining samples, he will find that the permeability of each will rank as follows:

1. Wrought iron
2. Mild steel
3. Cast iron.

It is evident that if the permeability of the different grades of iron and steel can be tested in this manner, the magnetic pull of any electro-magnet can also be tested by mounting same on the base and using a cube of wrought iron in the same manner as in testing for the permeability of iron and steel.

An electro-magnet consists of a coil of wire carrying a current, and may possess a core of iron, or may not, as the case may require. It is understood that the production of magnetism depends upon the number of turns of wire carrying the current. It must be understood also that not only the number of turns are to be considered, but also the strength of the current they carry. Therefore, the greater the number of turns of wire, and the greater the current in these turns, the greater the pull or magnetic effect produced. It is also customary to speak of the combination of current and turns as *ampere turns*. It is to be seen that the ampere turns of an electro-magnet are most important considerations. These are obtained by multiplying the number of turns of wire by the number of amperes passing through the coil. For instance, if an electro-magnet consists of 500 turns carrying a current of 5 amperes, the ampere turns would be equal to $5 \times 500 = 2{,}500$. Then if we reduced the current to one ampere, the product



equals $1 \times 500 = 500$ ampere turns. Suppose there are 1,000 turns and 1 ampere, or 1 turn and 1,000 amperes. In either case, the total ampere turns equal 1,000.

Some very good experimental work can be performed with this simple but none the less workable device. With it the experimenter can plot many interesting curves showing the magnetic permeability of different metals and at different current values. The effect of variation in potential and current strength can be shown by a curve through all points up to the point of saturation.

If the reader desires to construct a more elaborate device than the one described above, it will be very easy to make a few additions that will increase its efficiency. The device can be made larger to accommodate larger and more powerful electromagnets.

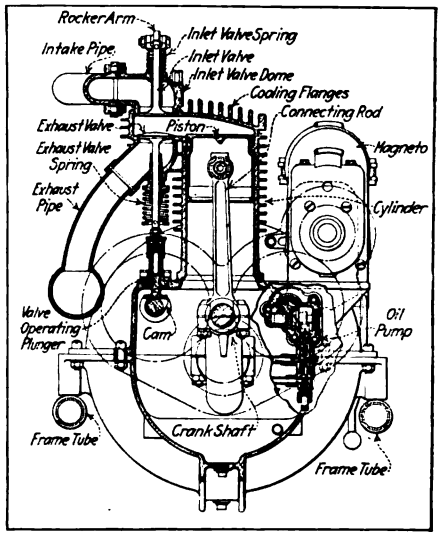
Digitized by Google

Motorcycle Lubrication

By Andrew Jackson, Jr.

ONE of the most important considerations, making for efficient action and promoting long life of the mechanism, is to provide proper lubrication. The lubrication of the power plant is the most serious proposition. The best oil is the only kind that should be used, as more good motors have been ruined by the use of lubricant of improper quality or insufficient quantity than have been destroyed by accidents. If a drip feed is used, a medium grade oil may be employed in warm weather, but a light grade will be necessary in cold weather. If the supply is by mechanically operated pump, a heavier bodied lubricant may be used than when the drip feed system is employed. When oil is introduced to the engine crank-case by means of a hand-operated pump, which means that lubrication is directly under the control of the rider (only on old-time machines), one pumpfull of oil, every 8 or 10 miles, at speeds of 20 miles per hour, will be sufficient. For a speed of 30 miles per hour it will be necessary to inject a pumpfull every 5 or 6 miles. It is better to over-lubricate a machine than not to supply enough. If the engine is over-lubricated, the exhaust will be smoky. If a mechanically operated oil pump is used and the hand pump is provided only as an auxiliary, it will not be necessary to supply oil except at such times that the engine is run exceptionally fast for extended periods.

Among some of the points that should receive oil every time the machine is used may be mentioned the valve lifters, or rocker arms, the free engine clutch, the steering head, and the various hinges and joints on the spring frame or spring fork. If a two or three speed gear is provided, the supply of lubricant should be renewed every 300 miles. Planetary gearing requires more lubricant and a lighter semi-fluid grease than either the sliding clutch or sliding gear forms. It is well to put a few drops of oil in the front hub and coaster brake oilers every day. About the only point on the motorcycle that can receive too much oil besides the engine interior is the magneto, and only a few drops are required every two or three

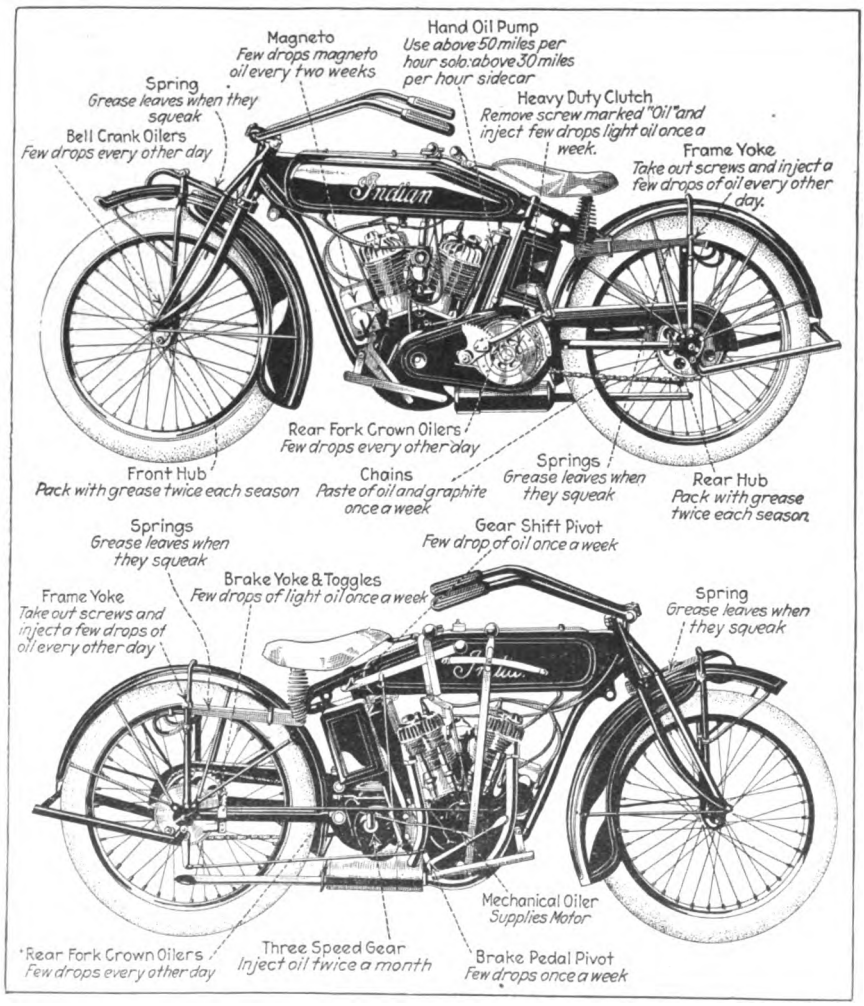


End elevation of Henderson four-cylinder motor, showing principal parts

months to insure adequate functioning of this device. A special light oil is necessary for the magneto, and a good grade of sewing machine or 3-in-1 oil will be found satisfactory for this purpose. The hand oil-can may be filled with cylinder oil which can be used on all points of the machine, because if it is good enough for the engine interior it is much better than needed for the various external parts. The ball bearings in the hubs, countershaft and steering head may be packed with grease once or twice a season, which will be adequate.

Keep Distributor Clean and Dry

Excessive oiling of a magneto can do nearly as much harm as insufficient lubrication. One thing it does is to cause the surplus oil to be thrown into the distributor, where it works all kinds of mischief. It gets between the brush and the contacts and either insulates them from each other entirely, causing missing, or it causes arcing. Arcing in turn burns the oil and forms soot which soon gums things up badly, and it also produces heat which disintegrates the carbon brush and causes it to crumble in time. All magneto manufacturers make their distributors so that they may be removed easily and wiped clean with a dry, clean cloth. Dixie magnetos, for instance, have their distributors held on by three little clips, retained by three thumb nuts. These may be loosened by hand. Other Dixies have three screws to retain the cover. Some have a central revolving brush and stationary contacts in the cover and others a revolving contact and individual stationary contacts in the cover. The brushes in either case are attached to small springs and may be slipped into or out of their sockets by hand.



Views of Indian power plus twin cylinder motorcycle, showing points needing periodical lubrication

Digitized by Google

Winter Care of Storage Batteries

Precautions to Be Taken to Prevent Depreciation of an Unused Storage Battery and How to Maintain Its Efficiency During the Period of Low Temperature

IT would not do simply to leave the battery in the car for a period of, say, four or five months without giving it any care or attention, for in that case at the end of that time it would be found to have its plates so thickly covered with lead sulphate as to make

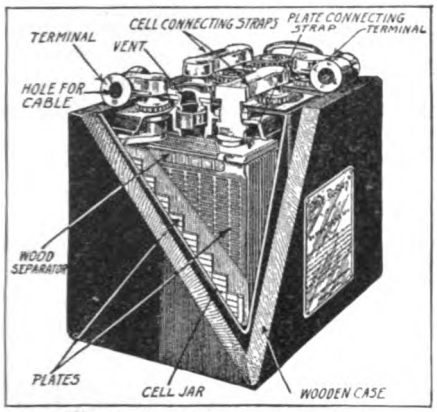


Fig. 1. Typical storage battery

it practically useless. For storage batteries "to rest is to rust" and become ruined unless special precautions are taken. Automobile storage batteries are all or nearly all of the sealed-in type from which the elements cannot be removed without a great deal of trouble, as shown at Fig. 1.

The storage battery is made up of several hard rubber cells or containers for the active plates and liquid electrolyte. The whole is surrounded by a wood casing for mechanical protection and ease in handling. Each individual cell is provided with a screw cap for inspection and the addition of electrolyte or distilled water when necessary. (See Fig. 4.) The electrolyte must at all times cover the tops of the plates at least one-quarter inch. Insufficient electrolyte will result in warped or buckled plates, and an accumulation of sediment at the bottom of the cell. The battery will be ruined in a short time if the tops of the plates are not kept covered. Each cell must be inspected at least every two weeks in winter. All screw caps must be removed and distilled water added to each cell to make up for the natural evaporation. If distilled water cannot be had, use clean rain water which has not been in contact with metal or cement.

Never Add Acid to Battery Cells

Never add acid to the cells of the battery. If part or all of the electrolyte has been lost through accidental spilling or leakage get full instructions and advice from the maker. A hydrometer arranged with a rubber bulb to draw a portion of the electrolyte from each cell furnishes the best indication of the condition of the battery. The hydrometer shows the specific gravity of the electrolyte, which for a fully charged cell should be 1.280 to 1.300 on a specific gravity scale. If the car is out of service for a considerable length of time, as when laid up for the winter, it is necessary to charge the battery at regular intervals. The parts of a typical battery are shown at Fig. 2 and the construction should be easily understood.

The following advice concerning the care of batteries during a protracted period of idleness of the car refers especially to the batteries of starting and lighting systems of automobiles.

At intervals of two weeks the engine should be run until the electrolyte shows a specific gravity of 1.280 to 1.300. If this is done regularly the engine need not be run only about an hour each time. But if the owner should not be in possession of a hydrometer it is better to run the engine for two or three hours each time to be safe. To charge the battery properly the engine should be run at a speed corresponding to a car speed of about 20 mph on the direct drive. There may be cases, however, where the owner is compelled to store his car in a space where it is practically impossible to run the engine. Where this is the case it is recommended, if electric current is available, that the owner purchase a rectifier or small charging machine.

Periodical Charging Necessary

A charge over night, or for about twelve hours, every two weeks with this apparatus will be sufficient to keep battery in healthy condition. For those of our readers who are interested in chemistry, the action on charge and discharge is clearly shown at Fig. 3, which is presented through the courtesy of the Electric Storage Battery Co. Before beginning the charging the battery should be inspected to see if it is filled with solution. If the solution needs replenishing distilled water should be added until the solution fully covers the plates, which may be determined by removing the vent plugs and looking down into the cells.

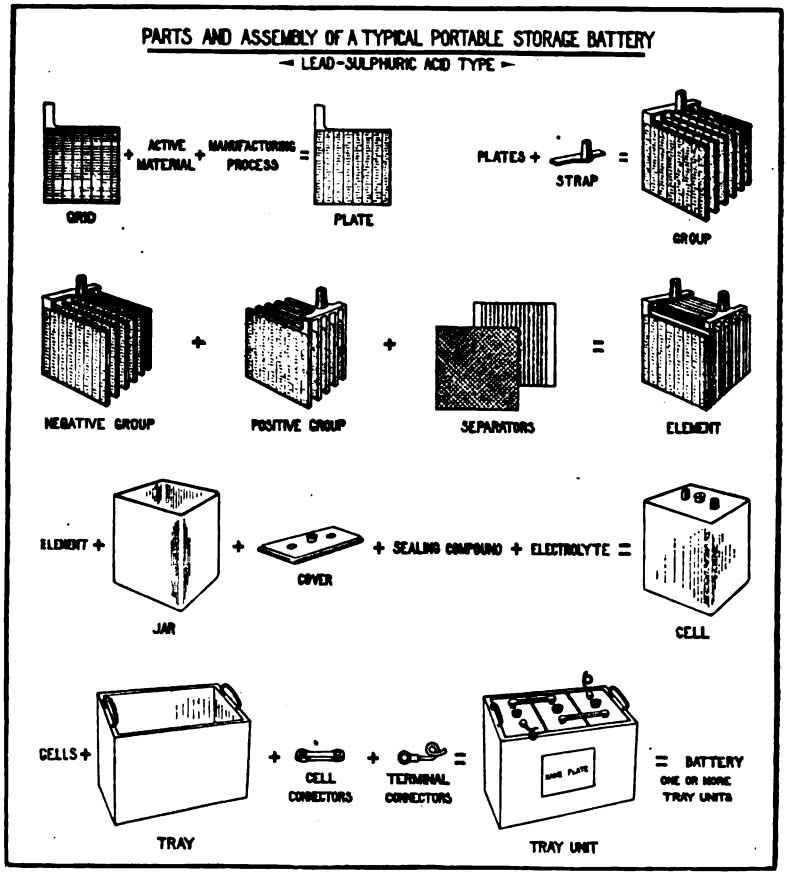


Fig. 2. Parts and assembly of typical portable storage battery

Digitized by Google

In case it is impossible to run the engine for charging and the owner does not care to incur the expense of purchasing a rectifier, he should remove the battery from the car and arrange for its storage at a garage which has charging facilities, stipulating that it must be charged every two weeks. The cost of having it so cared for will be nominal and will prove excellent insurance against deterioration.

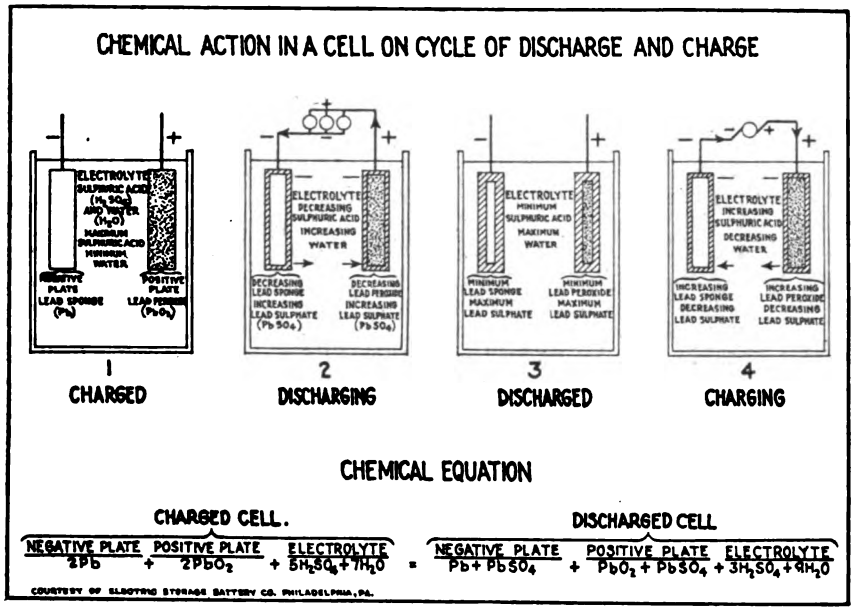


Fig. 3. Chemical action of a cell on cycle of discharge and charge

Caring for Take-Down Types

To care for storage batteries of any type that is easily taken apart, such as used for experimental work in the laboratory or in isolated lighting systems for country homes and in yachts, the following method is recommended: First charge the battery until every cell is in a state of complete charge. If there should be be any short-circuited cells they should be put into condition before the charge is commenced, so that they will receive the full benefit of the charge. Then remove the elements from the jars, separating the positive from the negative groups, and place in water for about one hour to dissolve out any electrolyte adhering to the plates. Then withdraw the groups and allow them to drain and dry. The positives when dry are ready to be put away. If the negatives in drying become hot enough to steam they should be rinsed or sprinkled again with clean water and then allowed to dry thoroughly. When dry the negatives should be replaced in the electrolyte (of from 1.275 to 1.300 specific gravity), care being taken to immerse them completely and allow them to soak for three or four hours. Two groups may be placed in a jar and the jar filled with electrolyte. After rinsing and drying the plates are ready to be put away.

The rubber separators should be rinsed in water. Wood separators after having been in service, will not stand much handling and had better be thrown away. If it is thought worth while to keep them they must be immersed in water or weak electrolyte, and in reassembling the electrolyte must be put into the cells immediately, as wet wood separators must not stand exposed to the air for any unnecessary amount of time, especially when in contact with plates.

Store Batteries in a Dry Place

Storage batteries always should be stored in a dry place, preferably in one where the temperature will never fall below 40° Fahr. Storage battery solution or electrolyte varies greatly in density between the points of complete discharge and full charge. The electrolyte of the average battery has a specific gravity of 1.140 and a sulphuric acid solution of this specific gravity has a freezing point of about 10° Fahr. The hydrometer used and the methods of taking specific gravity readings with a hydrometer syringe are clearly shown at Fig. 4. Therefore if a completely discharged battery is allowed to stand where it is exposed to extremely low temperature it is quite possible for the electrolyte to freeze and the cells to be injured in consequence.

However, as already pointed out, a battery for other reasons must not be allowed to stand in the discharged condition for any length of time. With increasing charge the density of the electrolyte increases until when the charge is complete it attains 1.300 specific gravity. The freezing temperature of the solution drops very quickly as the specific gravity increases somewhat as follows:

Spec. Grav.	*Fr. Pt. Deg. F.*
1.140	+ 10
1.160	+ 5
1.175	— 4
1.200	— 16
1.225	— 36
1.250	— 60
1.280	— 85
1.300	—100

Consequently there is no possibility of a storage battery being injured by freezing in temperatures ordinarily met in the temperate zone if it is kept in a fair state of charge. The accompanying graphic chart (Fig. 5) shows the freezing point of electrolytes of varying specific gravity.

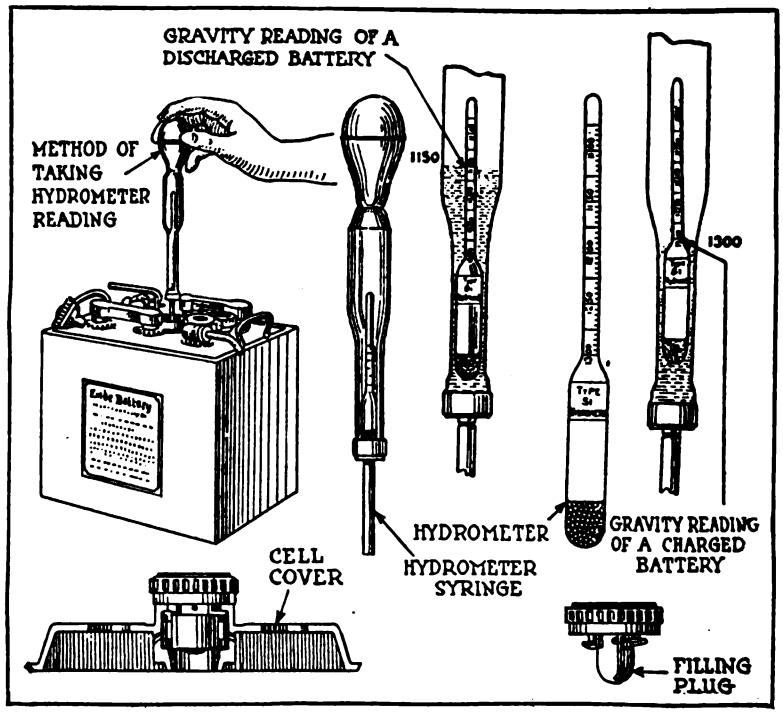


Fig. 4. How to use hydrometer in testing battery condition

(*Continued on page* 135)

Digitized by Google

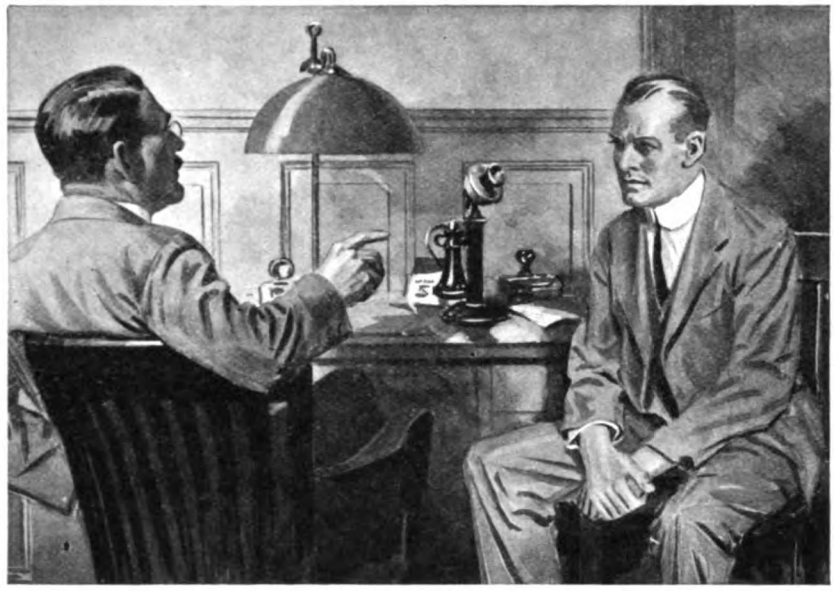
TWO-CYCLE MOTOR REPAIRS

It will be evident that a worn cylinder, piston rings or piston will result in the loss of compression as in any motor and that loose connecting rods or main bearings will produce noisy operation just as in the four-cycle type. In the two-cycle motors there are other conditions to be looked for besides those involving normal depreciation of the mechanism. There are two chambers to keep tight instead of one, as in the four-cycle type. In the two-cycle form it is not hard to maintain compression in the combustion chamber because there are no valves to leak and the only chance for escape is by worn piston rings.

It is imperative, however, that a certain amount of compression be maintained in the crankcase of most two-cycle engines because the degree of compression in the crankcase determines the rapidity of transfer of explosive gas from the base where it is first received to the combustion chamber where it is exploded. Because of this the main bearings demand more attention than do those of a four-cycle engine because they must be fitted so well that there is no possibility of leakage through them. Similarly the packings between the cylinder and engine base and between the crankcase halves must be carefully maintained.

In examining the piston and cylinder care must be taken to remove any deposit of carbon from the baffle plate or deflector, which is usually cast integral with the piston top, as any sharp point or corner would remain incandescent and would cause either base firing or premature ignition. Base firing is generally prevented by making the charge from the crankcase pass through wire gauze in the by-pass passage. This prevents the flame igniting the explosive gas in the engine base because practically all of the heat is abstracted from any heated gas as it passes through the mesh of the screen. These screens sometimes become clogged with oil and reduce the speed of gas flow and consequently diminish the power output of the motor; the remedy is a simple one, as it involves only the removal of the clogged screens and cleansing them thoroughly in gasoline before replacing.

Brass Castings.—When clear, yellow brass castings are desired, a mixture of 7 lbs. of copper, 3 lbs. of spelter, 4 oz. of tin, and 3 oz. of lead makes a good casting alloy and one which will cut clean and free, and is also strong. An increase in the amount of tin augments the strength of the alloy and also increases the degree of hardness.



"The Job is Yours— on One Condition!"

"For a long time I watched the new men who came into this business. Some stood still—stayed right where they started. Others climbed—made each job a stepping stone to something better.

"Now, what was the difference? Well, I investigated and found out. The men who were getting ahead had been devoting part of their spare time to study along the line of their work. Our treasurer used to be a bookkeeper. The factory superintendent was working at a bench in the shop a few years ago. The sales manager started in a branch office up state. The chief designer rose from the bottom in the drafting room.

"All of these men won their advancements through spare time study with the International Correspondence Schools. Today they are earning four or five times—yes, some of them *ten* times as much money as when they came with us.

"So out of this experience we have formed a policy. We are looking for men who care enough about their future not only to do their present work well, but to devote part of their spare time to preparation for advancement.

"And I'll give you this job on one condition—that you take up a course of special training along the line of your work. Let the I. C. S. help you for one hour after supper each night and your future in this business will take care of itself."

Employers are begging for men with ambition, men who really want to get ahead in the world and are willing to prove it by training themselves in spare time to do some one thing well.

Prove that you are that kind of a man! The International Correspondence Schools are ready and anxious to help you prepare for advancement in the work of your choice, whatever it may be. More than two million men and women in the last 28 years have taken the I. C. S. route to more money. Over 100,000 others are getting ready in the same way right now. Surely the least you can do is to find out what there is in this proposition for *you*. Here is all we ask: Without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6064-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name .....
Present Occupation .....
Street and No. .....
City ..... State .....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

To cut down the cost per cut

A Matter of Teeth

The efficiency of a hack saw blade depends almost entirely upon the rake, the "set," and the pitch or number of teeth to the inch.

There's no overhanging "hook" to the teeth on a Starrett blade. With proper adjustment of weight or pressure, they'll cut just as fast on the last cut as on the first. The teeth are uniform in shape, "set" and spacing. That's why every blade in a box of Starrett saws cuts alike.

Starrett Hack Saws are made in varying pitches or number of teeth to the inch, from 10 to 32, according to the work they are intended for.

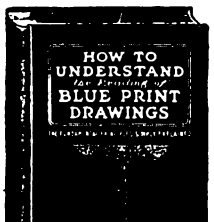
Different kinds and shapes of metal need different blades for economical cutting. Get Starrett blades, use them according to the Starrett Hack Saw Chart and watch your cost per cut decrease. Write for Catalog No. 21 "M B" it's free.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



Use Starrett Hack Saw Blades

42-963



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

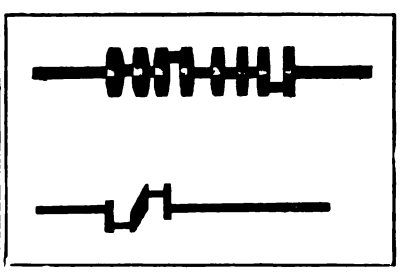
Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr.,
U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE. YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
169 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 131 Rowland Bldg., Detroit, Michigan



CRANK SHAFTS

For Model Steam and Gas Engines Our Specialty—Any type or number of throws to specification. Also needle valves for blow torches. Quotations on receipt of specification.

Send Stamp to

MODEL MACHINE SHOP CO.
415 E. 71st St. New York

Replacing Broken Side-Curtain Lights.

AUTOMOBILES of the "open" or touring and roadster forms have windows in the top curtains made of a material known to the trade as transparent sheeting. This sheeting is made on a soluble cotton base and while not so brittle as glass, as the same time it is breakable and is often damaged through careless storing while not in use.

The ordinary way of replacing a broken sheeting window light is to rip the stitching that secures it to the top or curtain and insert a new pane. Top repairers charge several dollars for this work, if the light is in a side curtain and even more if in a rear curtain, which must be removed from the top to be handled conveniently.

The motorist may do the work himself at less expense if he desires. It is becoming common practice for hardware stores to carry transparent sheeting in stock for the accommodation of their customers desiring to make just such repairs. A piece large enough to replace a broken light costs but a few cents. The windows are sewed in with a double row of stitches. First cut the inside row of stitching. Leave the second row. Then cut out the broken light, leaving a strip about one-half inch all around and held in place by the stitching left intact. Cut the new pane the right size and cement it to the edges left on the old pane.

This method reduces the cost of the replacement to less than one dollar. The success of the method depends on using the right kind of cement; in short, one made on a pyroxylin base. This is because the cement and the transparent sheeting are both made of the same ingredients. Cotton is the base. A pyroxylin cement combines with the sheeting in such a way that the two pieces of sheeting become a practically homogeneous unit.

Drilling.—Use kerosene to drill, ream or turn malleable iron, or to drill or turn aluminum. Turpentine should be used instead of oil for drilling hard steel, as it will cause drilling readily when the metal cannot be touched with oil. By using a combination of turpentine and camphor, glass may be drilled with a common drill. When the point of the drill comes through the hole should be worked with the end of a three-cornered file, having edges ground sharp. Use the corners of the file to scrape rather than as a reamer. Great care must be taken not to crack the glass or flake off pieces of it while finishing. The mixture should be used freely, both while drilling and scraping. It may be used as well to drill hard cast iron and tempered steel.

Digitized by Google

FREE TRIAL

Keep It For $3.00 Per Month



Or Return It At Our Expense

The Oliver Typewriter—Was $100—Now $57

The Guarantee of a $2,000,000 Company that it Is the Identical Model

Be your own salesman and earn $43. You get the identical typewriter formerly priced $100—not a cent's alteration in value. The finest, the most expensive, the latest Oliver Model. Old methods were wasteful. Our new plan is way in advance. It is in keeping with new economic tendencies. It does away with waste. Inflated prices are doomed forever.

During the war we learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Brand New—Latest Model

Do not confuse this with offers of earlier models, rebuilt or second-hand. Note the signature of this advertisement. This is a $2,000,000 concern.

We offer new Olivers at half price because we have put typewriter selling on an efficient, scientific basis.

You can now deal direct—sell to yourself, with no one to influence you. This puts the Oliver on a merit test.

You Save $43 Now

This is the first time in history that a new standard $100 typewriter has been offered for $57. Remember, we do not offer a substitute model, cheaper nor different. But the same splendid Oliver used by the big concerns. Over 700,000 Olivers have been sold.

We ship direct from the factory to you. No money down—no red-tape. Try the Oliver Nine at our expense. If you decide to keep it, send us $3 per month. If you return it, we even refund the outgoing transportation charges. You are not placed under the slightest obligation. That's our whole plan.

We rely on your judgment. We know you don't want to pay double. And who wants a lesser typewriter? You may have an Oliver for free trial by checking the coupon below. Or you may ask for further information.

An Amazing Book

All the secrets of the typewriter world are revealed in our startling book entitled "The High Cost of Typewriters —The Reason and the Remedy"—sent free if you mail the coupon now. Also our catalog. Order your free-trial Oliver—or ask for further information at once.

Canadian Price, $72

THE OLIVER TYPEWRITER CO.

C-40 Oliver Typewriter Bldg., Chicago

NOTE CAREFULLY—This coupon will bring you either the Oliver Nine for free trial or further information. Check carefully which you wish. (24-02)

Mail This Coupon Now!

THE OLIVER TYPEWRITER CO.,

C-40 Oliver Typewriter Bldg., Chicago

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $57 at the rate of $3 per month. The title to remain in you until fully paid for.

My shipping point is.....
This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address.....

City .....State.....

Occupation or Business.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Protect Your Tools From Rust

Nearly every man owns at least a few tools such as chisels, hammers, augers, saws, wrenches, files, etc.

These tools as a rule are infrequently used. They are often kept in places where they are exposed to moisture and consequently rust. Almost all tools with the possible exception of hammers are rendered less efficient by rust.

When it is so easily prevented, it seems strange that steps are not taken to do it. It is well worth while to save the tools as every one knows that has had occasion to buy any new ones lately.

Probably the best tool protector and carrying case for a small kit may be made in the shape of a roll from a piece of pyroxylin coated fabric having a napped or fleecy back. This material is thoroughly waterproof and if care is taken in wrapping the tools in it after use, it will prevent moisture from reaching them and no damage from rust can occur.

The material is durable and will last a long time. It is obtainable at many department and general stores where it is sold under the general name of leather substitutes. There are many leather substitutes on the market sold under various manufacturers' trade names. Practically any of them will answer very nicely for the use specified.

Gasoline Engine Fly Wheel Retention

Many mysterious knocks, which are often attributed to worn bearings, are due to the flywheel being loose on the shaft. In a number of the earlier forms of marine engines the flywheels are held to the shaft by a simple gib key. It often happens that these keys become worn and the wheel is slightly loose on its supporting shaft. When the engine is revolving at high speed a pronounced thump or knock will be produced because of the hammering action of the flywheel upon the loose key. The proper remedy for such a condition is to make a new key that will fit the keyways in flywheel and shaft and drive it tightly in place.

In practically all modern forms of motor the flywheel is secured to a flange forged integrally with the crankshaft by means of bolts. It may be possible for the bolts to loosen, which will permit the flywheel to rock and to pound the hole out oval. This condition is easily remedied by drilling or reaming the worn holes to the next largest standard size and to fit larger bolts to correspond. Loose or worn propeller shaft or reverse gear couplings will also cause knocking.

Statement of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of Everyday Engineering Magazine published monthly at New York, N. Y., for October 1, 1919.

State of New York, County of New York, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Stephen Roberts, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Everyday Engineering Magazine and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager, are: Publisher, Everyday Mechanics Co., Inc., 2 West 45th St., New York City; Editor, Raymond Francis Yates, 2 West 45th St., New York City; Managing Editor, Victor W. Page, 2 West 45th St., New York City; Business Manager, Stephen Roberts, 2 West 45th St., New York City.

2. That the owners are: Everyday Mechanics Co., Inc., 2 West 45th St., New York City; Norman W. Henley, 2 West 45th St., New York City; Edward J. Richmond, 2 West 45th St., New York City; Stephen Roberts, 2 West 45th St., New York City; George Rosendale, 52 Broadway, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiants' full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

S. ROBERTS,
Business Manager.

Sworn to and subscribed before me this 1st day of October, 1919.

(Seal.) ANNIE M. HOLDEN.
(My commision expires March 30, 1921.)

Reg. No. 1461, N. Y. Co. No. 501.

Signalling Apparatus

(*Continued from page* 93)

grain and when this is done the diaphragm is put in place and the holding screws soldered. The length of the holding screws should be a little under ¼ in. so that they will not meet to cause a short circuit. Two terminals are then soldered to the device, one to each side. The connections for the receiving station will be noticed in the drawing. The device must be used in connection with a battery and a telephone receiver.

A word about the operation of the device. It is, of course, understood that the batteries, key and receiver are all kept above the surface of the water. The oscillator and microphone should not be sunk over a depth of six feet. A greater depth than this will cause too severe a pressure upon the diaphragm and the device will fail to function. The oscillator will require some patience to adjust. The contact screw should be regulated until the device gives a musical hum. It may be found, however, that when it is immersed in the water it will loose its adjustment owing to the fact that the operating conditions are not the same. It may be that an adjustment that will not work out of the water will work under the water. The oscillator should be so placed that the diaphragm faces the microphone. In other words, the diaphragms of the devices are placed in the same plane. The regular Morse signals can be used to carry on communication.

By using a larger can and more powerful magnets, an oscillator can be made that will transmit up to 100 feet. The same microphone can be used.

Cup Races

(*Continued from page* 81)

Mr. N. Fischer, who operated one of the Elmara boats, made a good but unsuccessful attempt to win the prize. His craft clipped off two laps (15 and 17 seconds), but power plant trouble prevented another successful lap from being made.

This cup race is the first one that has ever been run in the United States for steam driven power boats. It was a tremendous success throughout and next year there will be many more entries. The real sportsmanship displayed by the various contestants was a gratifying feature of the event. The spirit of co-operation was manifest in no small degree. The boat owners helped one another in every possible way. It required two experienced men to operate each boat with one man continuously watching the blow torches and keep one in readiness.

The Central Park Model Yacht Club also ran off a season's cup event for a one design hydroplane class.

Digitized by Google

SMALL VULCANIZERS USEFUL TO MOTORISTS

THESE small vulcanizers are intended primarily for the use of the motorist in making minor repairs and are not practical tools for the tire repair shop, though they may be used to advantage in small garages where no attempt is made to carry on tire repair work on a large scale.

For general use of motorists and in small shops a combination vulcanizer, which is composed of a large hollow cast-iron body filled with water and heated with a spirit lamp, is marketed. In this the curved face and the flat face may be used simultaneously and an inner tube patched at the same time that the outer casing is being treated. As very complete instructions are furnished with these small vulcanizers, any motorist may become familiar with their use without much difficulty.

In some vulcanizers, the heat is furnished by electricity passing through resistance coils imbedded in the device, similar to an electric flat iron in action. In vulcanizing, the most important precaution is to maintain a proper temperature. Too great a degree of heat will burn the rubber, while a proper cure cannot be effected if the temperature is too low. The temperatures recommended for vulcanizing vary from 250 to 375 degrees F. The lower degree of heat is used in working material that has been previously cured, while the higher temperature is recommended for new rubber. Small thermometers may be obtained from auto supply houses to gauge the temperature of the vulcanizer.

Treating Polished Iron or Steel.—Wash polished iron or steel that has become gray and lusterless, with a stiff brush and ammonia soapsuds. Rinse well and dry by heat if possible. Then apply a plentiful supply of sweet oil and dust thickly with powdered quicklime. Let the lime stay on two days, after which it should be cleaned off with a stiff brush. Polish with a softer brush and rub with cloths until the luster comes out. By leaving the lime on, iron and steel may be kept from rust almost indefinitely.

When replacing anti-skid chains on your tires be sure to have the hooks toward the back as you lay them over the wheel. This gives a whipping motion to the hooks when in use, which tends to keep them closed. If the chains are put on the other way they will tend to open and be in danger of coming off.

Repair Any Auto or Auto Truck

Examine These NEW AUTO BOOKS FREE

BE an expert auto repair man. You can have the skill that makes every complicated trouble as easy to fix as taking out a spark plug. Learn every detail of all makes of cars and trucks. Know exactly how to find what's wrong and how to make all show you how.

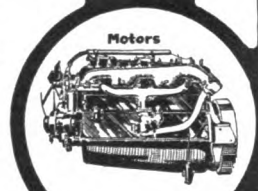
MAKE MONEY REPAIRING AUTOS

The limited output of new cars does not anywhere near meet the demand. Rebuilt cars are selling at a premium. Never before have expert auto repair men been in such great demand and made so much money. Now is your great money-earning opportunity in the auto repair business. Every mechanic, every chauffeur, every car owner needs this great repairs quickly. These great new Auto Books New Library of Automobile Engineering.









-50c A WEEK-

Tells About
Explosion Motors, Welding, Motor Construction and Repair, Carburetors and Settings, Valves, Cooling, Lubrication, Fly-Wheels, Clutch, Transmission, Final Drive Steering Frames, Tires, Vulcanizing, Ignition, Starting and Lighting Systems, Shop Kinks, Public Garage Design, Equipment and Operation, Electrics, Storage Batteries, Care and Repair, Steam Cars, Motorcycles, Commercial Trucks, Glossary.
More than 100 blue prints of wiring diagrams.

If You Decide to Buy

Let us send you the complete six volume set of Automobile Engineering for one week's examination. Read the simple directions for repairing every automobile trouble. Six thick volumes, 5½ x 8¾ inches, flexibly bound in American morocco, 2,650 pages, 2,100 illustrations, wiring diagrams, etc. Everything in plain, everyday language, simple to understand. If you decide to keep them, send only $2 in seven days, and $2 a month thereafter until the special introductory price of $19.80 has been paid. The regular price is $30, so you save $10.20 by acting at once.

SEND NO MONEY

Don't send a penny! Your name and address in the coupon brings the six books to you at once for seven days' trial. With each set we give you absolutely free a $12 Consulting Membership, entitling you to ask our staff of automobile experts as many questions as you wish, a whole year free. *Mail Coupon NOW.*

American Technical Society
Dept. A-358
Chicago, U. S. A.



AMERICAN TECHNICAL SOCIETY
Dept. A-358 Chicago, U. S. A.

Please send me the six volume set of Automobile Engineering for seven days' examination, shipping charges collect. If I decide to buy I will send $2.00 within seven days and balance at $2.00 a month until $19.80 has been paid. Then you will send me a receipt, showing that the set of books and the Consulting Membership are mine and fully paid for. If I think I can get along without the books, I will return them, after seven days at your expense.

Name .....
Address .....
Reference .....

Digitized by Google

SCHOOLS

We sell UmakeM Outfits for Manual Training to schools throughout the world. We also sell UmakeM designs and materials separately. Check below the outfits wanted and order today.

PARENTS

The tendency now everywhere is to provide materials for young people with which they may make their own playthings. It is truly educational and develops the best that is in them. Check below the outfits wanted and order today.

UMAKEM

COMMUNITY SHOPS

Note the UmakeM sets for all ages. Organize UmakeM Shops. Enroll UmakeM Community Shop Members. Combine their orders and check below the outfits wanted, giving quantity.

ORDER TODAY

We Help UmakeM Members Make UmakeM Money

UmakeM Members

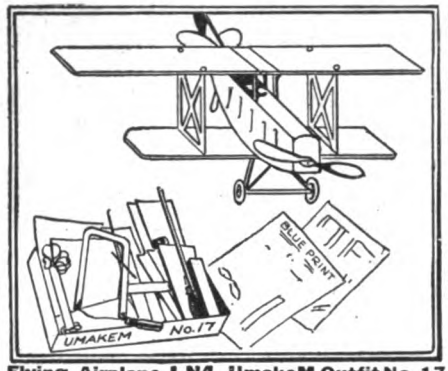
Enjoy all UmakeM benefits. Such as license to sell UmakeM toys. We will assist if you desire to start UmakeM Novelty making at home. Check below the outfits wanted and mail us your order today.

DEALERS

Dealers everywhere are selling UmakeM Outfits. Some of them are selling the UmakeM products of their customers, making double profit and creating unusual interest. Check below the outfits wanted, stating quantity and send us your order today.



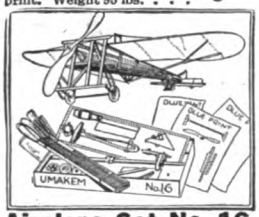
Work Bench No. 205
45 inches long, 18 inches wide. Complete material for making this sturdy bench including blue print. Weight 95 lbs. . . . $9



Flying Airplane J-N4, UmakeM Outfit No. 17
containing all wood, coverings, aluminum, steel wire, Para rubber, fittings, blue prints and full instructions, together with all necessary tools. Weight 2½ lbs. . . . $3



60-Piece Set No. 3
containing high quality tools, designs, 3 ply wood, hardware, colors, and everything needed to make items shown. Weight 7 lbs. $2



Airplane Set No. 16
A Workchest containing work table, mitre cutting board, gauge, drill, steel hammer, Model Maker's steel square, wood and all fittings for building one Bleriot Model Flying Monoplane. Full set blue prints and directions. Weight 10 lbs. $10



Circus Set No. 8
Containing 11 tools, designs, colors, special wood, complete material and instructions for making a $20.00 circus set as shown, consisting of Circus Wagon, Animal Wagon and 19 Jointed Wild and Domestic Animals. Weight 22 lbs. $10



Noah's Ark No. 7
contains tools and all materials with instructions and designs to make this 28 in. Noah's Ark and 24 animals (2 of each). Weight 20 lbs. . $5



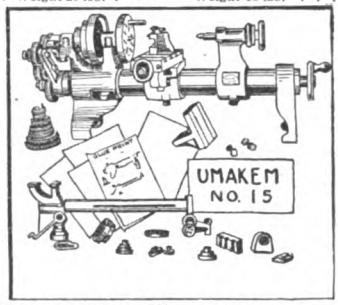
Sewing Stand No. 203
This set contains 3 ply wood, designs and hardware for making this beautiful sewing stand. Weight 13 lbs. . . . $2



Animal Set No. 4
Boxed outfit contains Steel Saw Frame, Blades, Awl, Water Colors, set of Design Sheets, 3 ply Wood, pins and washers, and complete material for making 12 jointed Wild Animals. Weight 5 lbs. $2
Set No. 5 similar but material makes 7 domestic animals. Weight 3 lbs. . $1



Toy Set No. 6
This outfit contains tools, all raw materials and fittings for making one set of above toys worth $6.00. To make more toys all you need is more raw materials. Wgt. 7 lbs. $3



Screw Cutting, Milling Lathe No. 15
Screw Cutting, Milling Lathe can be made complete from the above outfit No. 15, which includes all castings and blue prints. Size 2 ft. 11 in. x 8 in. Wt. 100 lbs. $25

Design Sheets, 10c each
No. 2 to 8 shown in No. 3 Set.
No. 9 Action Toy Village Blacksmith.
No. 112A to 112D shown in No. 4 Set.
No. 111A–111B, Domestic Animals.
No. 1A Clown on Kicking Donkey.
No. 10 Doll Furniture Set.
No. 109, 103, 123 shown in No. 6 Set.

Blueprints, 25c each
No. 140 Large Model War Tank.
No. 128 Circus Wagons shown in No. 8.
No. 135 Ark shown in No. 7.
No. 205 Work bench shown No. 205.
No. 208, 3 prints each 25c Airplane No. 16.
No. 209, 2 prints each 25c for J. N. 4 Plane.



Doll's House No. 9
Outfit contains tools, designs and all materials to make this $15.00 Doll's House. 24 in. high. Weight 25 lbs. $5

W. R. PRICE, Inc.
Dept. 2 UmakeM Building
127 Fifth Ave., NEW YORK

Check the items wanted and enclose with amount. Write name and address on bottom of page.

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit, and low price.

At Drug Stores or sent direct $1.00
Send for booklet of other styles and prices

J. C. SCHNOTER CO.
523 SIXTH AVE. *Dept. E* N. Y. CITY

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing Lists St. Louis

Don't Wear a Truss



Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.

Mr. C. E. BROOKS

Brooks' Rupture Appliance

Has automatic Air Cushions, Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.

Brooks Appliance Co, 264A State St., Marshall, Mich.

Digitized by Google

WINTER CARE OF STORAGE BATTERIES

(*Continued from page* 128)

Independent Charging

To charge a battery from 110-volt direct current with lamp bulbs for resistance, see illustration at Fig. 6. To fully charge an empty battery by this

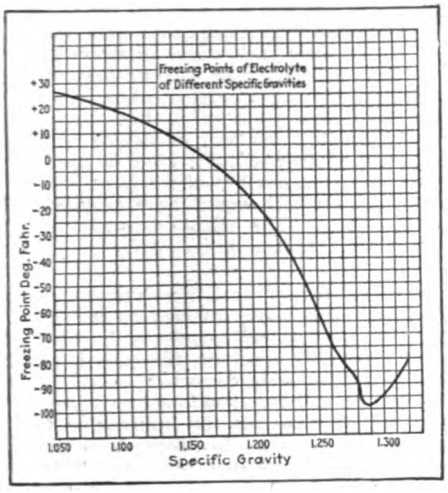


Fig. 5. Chart showing freezing point of electrolyte

method leave it connected to the circuit for a period of thirty hours, or until each cell of the battery gases freely and each cell shows a specific gravity ranging between 1.275 and 1.300. In charging with the above method great care should be exercised to always connect the positive wire from the charging source to the positive post of the storage battery.

To Find the Positive Wire

If a suitable voltmeter is not at hand dip the ends of the two wires into a glass of water in which a teaspoonful of salt has been dissolved, care being taken to keep the wires at least an inch apart. When the current is turned on fine bubbles of gas will be given off from the negative wire, and the positive wire will be free from bubbles.

Using Alternating Current

If an alternating current is available purchase a five-ampere alternating current rectifier. These rectifiers are moderate in price, consist of a small apparatus to be attached to the wall and plugged into an ordinary lamp socket, as shown in cut, and may be obtained through any electric supply company.

When charging with the rectifier the matter of connecting the positive of the charging source to the positive of the battery is not so important as it is when charging from direct current, as the rectifier, as soon as connected, establishes its own proper direction of current, provided the battery is connected to the rectifier before the alternating current is turned on.

It must be remembered that the efficiency of any storage battery decreases with drop in temperature and it is only about 50 per cent. efficient at zero temperature. For this reason the demand for current should be kept as low as possible in cold weather, lamps turned off when not needed, and care taken not to use starter to excess. If the engine is primed with ether or high test gasoline through the petcocks, the starter will perform its functions much more easily.

(*Continued on page* 137)

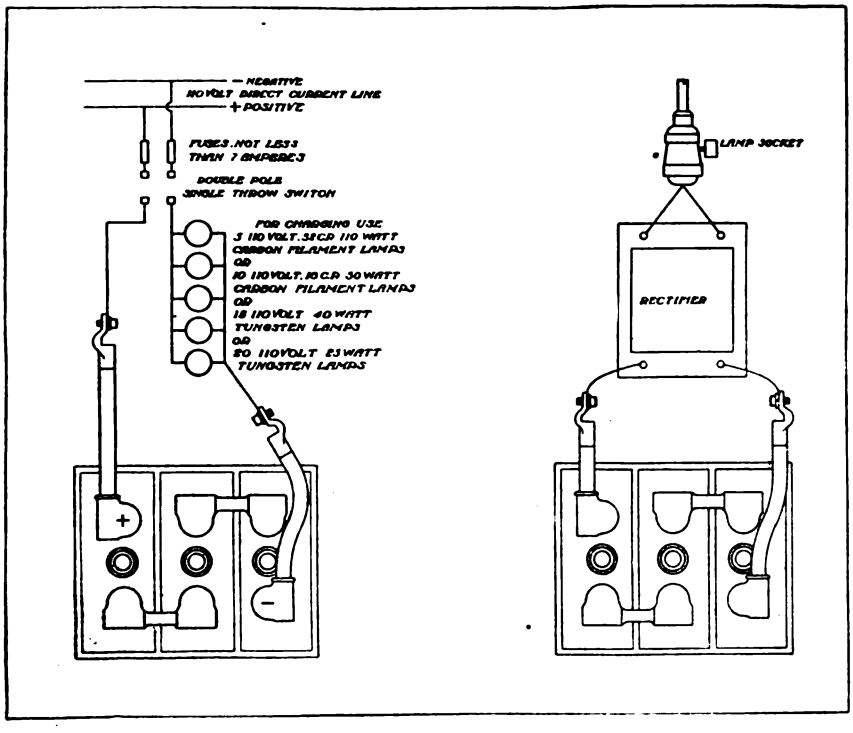


Fig. 6. Methods of charging storage battery from direct or alternating current



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-358 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D- 358
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days examination, shipping charges collect. I will send $2 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

HOME AGAIN!

Uncle Sam has released us from service. We will resume publication of "Pacific Radio News" and have the coming issue ready for distribution on Dec. 15, 1919. All subscribers on our mailing list will receive their copies.

SUBSCRIPTION RATE FOR NEW SUBSCRIBERS: $1.50 per year. 15 cents per copy.

SEND FOR A COPY TODAY

Pacific Radio Publishing Co.
50 Main Street, San Francisco, Cal.



WANTED-Railway Mail Clerks

$1100 to $2000 Year

Hundreds Needed

Sure Pay, Life Job. Pull unnecessary.

COUPON

FRANKLIN INSTITUTE
Dept. L97 Rochester, N. Y.

Sirs: Send me, without charge (1) sample of Fall Railway Mail Clerk Examination questions; (2) schedule showing places of all U. S. Government coming examinations; (3) list of other government jobs open to men and women and (4) free book describing them.

Name.....
Address.....

Digitized by Google

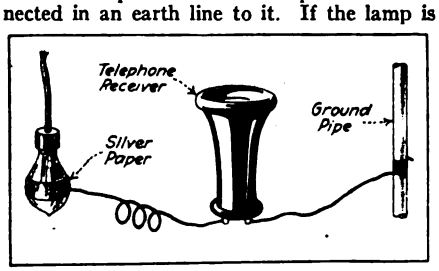
EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

Glucinum has long been considered one of the rarer metals. It was discovered by Woehler and Bressy in 1828. It is a constituent of the mineral beryl, whose purer and higher colored varieties are emeralds. It is exceedingly light, with a specific gravity of 1.60 as against 2.60 for aluminum. It forms an alloy with aluminum, reducing the weight from 5% to 30%, according to the percentage in the alloy. It is silvery white in color, harder and more resisting than aluminum and does not oxidize in the air. It makes an alloy with copper similar to aluminum bronze, yellow and sonorous. The crude beryl from which it is extracted contains 11% to 14% of the oxide, or 3% to 5% of the metal. It is found in Madagascar in quantity and also in other localities. The ore is treated at a temperature of 850° C. with sodium fluosilicate; a soluble compound, glucinum fluosilicate, is formed, which is extracted with water and precipitated with sodium. Ninety per cent of the metal can be saved. The salt formed has the formula Na_2 Gl F_4; this is the soluble compound just spoken of, dissolving in water. The silica of the mineral is not attacked, and the aluminum forms an almost insoluble compound, Na_3 Al F_3.

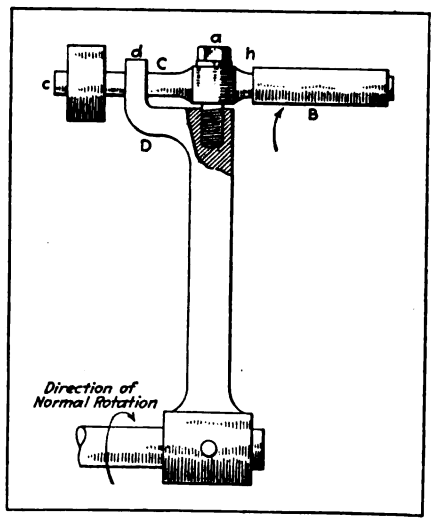
The invention of a machine for so apparently trivial a function as the saving of the filaments of cotton which are left adhering to the seeds after ginning has been noted in these columns. A recent paper by the inventor of the machine in question tells that the production of cotton in the western hemisphere has decreased in the last four years, when it was supposed that it would increase. In the rest of the world the production has fallen off, as was naturally to be expected. There is less produced in the United States than in 1907, and 60% of the product is used in home factories against 40% used in former years. It is necessary to increase the area of land devoted to its production in different parts of the world. A great development of the cotton-seed industry was noted by the speaker. Cotton-seed flour is available as a diluent of wheat flour; it contains five times the protein and fat of the cereal product. It is bright yellow in color; this will presumably operate to greatly restrict its use.

A simple experiment is illustrated in the cut, for which we are indebted to our contemporary "La Nature" of Paris. A band of silvered paper is fastened around an incandescent lamp bulb and a telephone is connected in an earth line to it. If the lamp is



supplied with an alternating current a sound will be prouuced in the telephone. If it is a direct current a sound will be produced on making and breaking the circuit. The phenomenon has been referred to the Edison effect in the original article, but a later writer has denied this.

The illustration shows a recent suggestion for a safety crank for gasoline engines. The crank arm, A, carries at its outer end a journal or pin, *a*, and the handle, B, has a hole near its center, *k* which receives the pin so that the handle can turn freely. It is held on the pin by a nut. An extension, C, of the handle carries a counter weight, c, at its end. A stud, *d*, projecting from the short arm D, only allows the handle to rotate in one direction.



If the motor back-fires, as the crank-handle starts to turn, the inertia of the counter weight, *c*, turns the handle into the plane of rotation of the crank so that there is no projecting handle to strike the wrist or hand and hurt or seriously injure the operator.

Some years ago, before self-starters were in vogue, it was claimed that automobiles injured more people when standing still, than when in motion, the broken-wrists and injuries from back-firing while cranking were so numerous.

A delicate test for the presence of ozone has been found in the use of the coal tar product, fluorescine. A mere trace of ozone will destroy the fluorescent power of this substance. If air containing a trace of ozone is shaken in a flask with some of the substance the presence of ozone will be revealed by its effect on the fluorescine. It is said to be many times more delicate than former tests, and is not interfered with by the presence in the air of chlorine or nitrogen oxides.

An acoustic method of sounding from a moving ship, Marti's method, depends on the velocity of the transmission of sound, as the noise of a detonation is echoed back from the bottom of the ocean. A shell is exploded over the side of the ship under the surface of the water. The interval between the original sound and the second sound due to the echo from the bottom is taken by a chronograph to about 1/1600 second. This gives a degree of accuracy of about one meter, a little over half a fathom. This is at a speed of 10 knots for the ship.

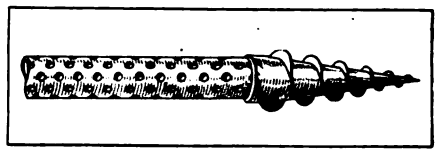
In France experiments with lacquers for aeroplane propellers have been so successful that an expert was brought from China to superintend operations in a works near Paris.

The shrinking on by the use of heat of spiders and armature parts on the electric motor armature shafts is noted in the *"London Electrician,"* as being done with much success. In some cases water or steam heat is enough—in other cases electric heating is employed. One case is cited where a very large shaft was increased in heat to only 80° C., less than the heat of boiling water, and it was possible to put a piece in position by the use of a five-ton chain hoist, where to drive it on cold would have required a 600 ton press. The slight expansion was sufficient to give it a shrinking fit.

In meteorological work absolute temperature, i. e., temperature referred to the absolute zero is often used, while with this attempt at scientific accuracy, the entirely artificial barometer scale corrected to 45° latitude has never been abandoned in favor of some definite standard. To improve on this practice it is proposed to adopt the millibar as the unit of barometric pressure. This is a pressure of 1,000 dynes per square centimeter. This would be independent of the variations in the force of gravity at different localities on the earth's surface. As the absolute zero is now determined to be at a point between 273.05° and 273.27° below zero, and as 275° below zero is accepted in practice as the absolute figure it appears that there is room here for improvement in exact scientific work.

During the war it was a subject of wonderment that the English authorities were able to predict the arrival of bombing Zeppelins, so as to be prepared for their reception. Now it is revealed that the Zeppelins were guided by directional wireless from the shore, and these signals picked up by the English on their side of the channel gave them warning long before the arrival of the attacking party.

The engraving shows a drive-well tip. It is provided with a screw, exactly such as used for corkscrews. Above the screw is the



usual perforated pipe. The idea is to screw it down into the earth instead of driving it down with a ram or sledge hammer in the old way, the way which gave the name of drive-well to the wells thus made.

A bath made up of 7 grams copper acetate and 2 grams of gelatine to 750 cubic centimeters of water can be used to give beautiful color effects to copper. With a low intensity current a blue effect results, the anode receiving it. No gas is disengaged. After bluing the piece is washed and immersed in a 5% solution of copper acetate, which treatment gradually changes the shade, so that by arresting the process at one or the other point a variety of effects can be produced. By heating the original solution while the operation is in progress other effects can be produced, such as yellow and irridescent gold. The coating is composed of gelatine and copper.

Digitized by Google

WINTER CARE OF STORAGE BATTERY

(*Continued from page* 135)

Miscellaneous Suggestions

If your battery is arranged with terminal posts for wiring connections, these must be examined occasionally to see that they are clean and free from sulphate. The thorough application of a small amount of vaseline at the metal connections to the battery posts will prevent sulphating and consequent corrosion and poor electrical contact at these points. If the electrolyte leaks from the bottom joints or wood sides of the battery case, one or more of the hard rubber cells are cracked or broken. The battery must be returned to the factory for repairs or replacement. The battery box, if of metal, must be thoroughly wiped out with a cloth saturated with ammonia to neutralize the acid and prevent corrosion. The top of the battery must be kept clean and dry to prevent a leakage of current between the terminals.

See that the battery is held securely in its metal box or other container. If necessary, pack tightly with waste to prevent the battery shaking about from jolting of the car. Tools, other metal articles, or anything of value should not be placed near the battery, as the acid fumes will corrode and destroy metal, cloth and like material. Make certain that the battery terminals cannot touch the cover of a metal battery box if such is employed. A thin sheet of wood fiber fitted inside the cover of the battery box will prevent short circuits or grounds from this cause.

Substitute for Clay in Babbitting

As a substitute for clay, which is not always obtainable, in rebabbitting bearing, boxes, another material has been found very practical and economical. It sticks well, will not blow out or soften with hot metal contact, and can be used many times over by the addition of a very small quantity of oil when softening it again. It is far better than clay or putty when either is used alone. Reduce putty with cylinder oil until it is almost as thin as the oil itself; next take some powdered asbestos (old asbestos pipe covering ground up will do) and add to the putty mixture until you get a stiff compound as dense as the putty was in its first state. Use this in any way you would clay and it will give entire satisfaction.

It is an admirable idea to wrap good tools, such as polished pliers, wrenches, etc., in oiled cloths before stowing them away in the tool compartment, as the oiled cloths prevent them from becoming rusty, which is quite likely to happen if the brightly finished surfaces are exposed for any length of time.

Learn Mechanical Drafting
Earn $35 to $100 A Week

"Get into the profession of big pay and Rapid Advancement with the help of the school that has started hundreds on the Road to Success. I am ready to help you." Roy C. Claflin, President Columbia School of Drafting.



Learn at Home in Spare Time

You don't have to stop work or leave home in order to become a trained Draftsman. Through our practical Home Study Training we teach you in your own home, and enable you to qualify as a practical Draftsman.

No Previous Training Required

Owing to the comprehensive nature of our course, you need no previous training in the subject. Though you have never done any kind of drawing before, you can become a thorough Draftsman by following our instructions.

Can Learn in Short Time by Our Methods

The reason for this is that we eliminate unnecessary theoretical work and concentrate upon the PRACTICAL problems such as confront the professional Draftsman. We do not require you to spend months of your time on "preliminary" work, but start you on REAL DRAFTING at once. That is one reason why our students "make good" so readily.

Our Graduates Get to the Top

The universal success of our graduates as Professional Draftsmen, many of whom have advanced rapidly to positions of Chief Draftsmen, is evidence of the REAL VALUE of the training given by the COLUMBIA SCHOOL OF DRAFTING. Large numbers of our students have secured excellent positions even before completing their courses. We gladly cooperate with our students and graduates in securing desirable positions, which has been easy for us owing to the many demands upon us to supply our "product" for these positions.

Draftsmen Get $35 to $100 a Week

Our graduates have shown their ability to reach high salaries RAPIDLY, owing to their practical training. They secure excellent salaries AT THE START, as high as $2,000 a year. The usual pay of Draftsmen is $35 to $100 a week.

The Demand is Greater than the Supply

The demand for properly trained Draftsmen has always been greater than the supply, but this is more so today than ever before, owing to greatly increased construction and mechanical development. The Draftsman is an essential connecting link in all engineering work. This great demand is indicated by the long lists of want ads for Draftsmen in the daily papers, especially those of industrial centers.

Specialists in Mechanical Drafting

The COLUMBIA SCHOOL OF DRAFTING not only trains Draftsmen by mail but also maintains a large local institution of the highest standing. For many years it has been the leader in SPECIALIZING on the teaching of DRAFTING. This is an obvious advantage over teaching Drafting only as a side issue.

Drawing Outfit Furnished

We supply all our students with a drafting outfit for use throughout the course. There is no extra charge for this, and it becomes your personal property when the course has been paid for in full.

Book of Particulars Sent Free

If you are interested in becoming a practical Draftsman through the thorough training of the COLUMBIA SCHOOL OF DRAFTING, whereby you can enter a Profession in which your services will always be in demand, you are invited to write us for our free book of particulars, which describes our school and methods. For your convenience you can fill out and

Mail This Coupon To-day

Columbia School of Drafting,
14th & T Sts. N.W., Dept. 1072,
Washington, D. C.

Without obligation to me, please send me full particulars of your practical home study training in Drafting.

Name .....

Address .....

City..... State.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Useful Books

Complete Practical Machinist
by Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations
Price $3.00

Metal Worker's Handy-Book of Recipes and Processes
By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations
Price $3.00

Techno-Chemical Receipt Book
Edited with Additions by Wm. T. Brannt and Wm. H. Wahl

This well-known Receipt Book is a mine of accurate information that everyone may work to great advantage. It is encyclopedic in range, yet gives only the best formulas for each preparation or operation, and thorough tests by competent men guarantee their intrinsic merit.

A compact and reliable collection of approved receipts and processes, containing thousands of receipts covering the latest, most important and most useful discoveries in chemical technology and their application in the useful arts and industries. It is indispensable to every practical man and contains 500 pages, closely printed, giving an immense amount of matter on a great variety of subjects. Every care has been taken to select the very best receipts of each kind and there are few persons, no matter in what business or trade they may be engaged, who will not find in this volume something of use and benefit to them. The library of the laboratory, factory or home is not complete without a copy of this handy and useful book of reference.

516 Pages. 78 Illustrations
Price $2.50

Friction, Lubrication, Fats and Oils
By Emil F. Dieterichs

When we realize that it is no figure of speech, but a bald statement of fact, to say that lubrication alone keeps the wheels of industry turning, then we must look respectively upon this as a question of vital importance in this mechanical age. The author, himself a chemist and an inventor and manufacturer of lubricants, wrote this manual for the mechanic and manufacturer of ordinary education, that the busiest man might learn the main facts of friction, the origin and charteristics of fats and oils, their uses, their adulterations, their practical testing and the best ways to make them serve his own particular ends.

Price $1.50

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.
Publishers of Mechanical and Industrial Books
110-116 Nassau St., New York, N. Y.

Anti-Freezing Solutions for Automobile Radiators

By Kenneth Alton

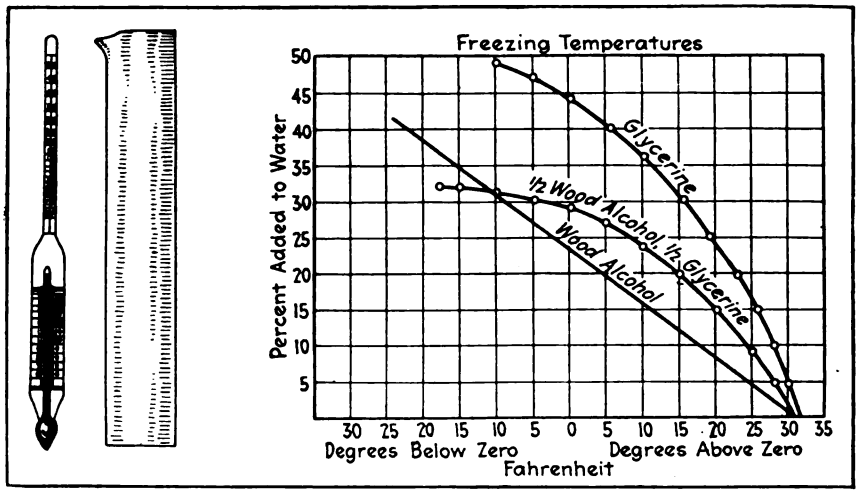
PLAIN water and alcohol solutions would be the best were it not for the ease with which such compounds boil and the rapidity with which the alcohol evaporates. We have seen that the objections advanced against calcium chloride solution because of deposition of salt crystals in the cooling system have ample foundation and that such compounds are not the best to use, the chief advantage, that of cheapness, having been eliminated by the reduction in the price of denatured alcohol. The addition of a little glycerine to an alcohol and water solution reduces liability of evaporation and when used in such quantities it has no injurious effect to speak of on rubber hose.

The tables appended show the various combinations and their freezing points and the proper proportions of the mixtures used must, of course, be governed by conditions of locality, but it is better to be safe than sorry and make the solutions strong enough for the extremes than may be expected. The writer has used both alcohol and water, and glycerine, alcohol and water solutions with good results, though considerable trouble was experienced with alkaline solutions.

The following tabulations give the relative values of solutions commonly employed:

Calcium Chloride Solutions

	Freez. Pt.
2 lb. salt, 1 gal. water	+ 18° F.
3 lb. salt, 1 gal. water	+1.5° F.
4 lb. salt, 1 gal. water	— 17° F.
5 lb. salt, 1 gal. water	— 39° F.



Alcoholmeter at left for testing specific gravity of alcohol-water solutions. Chart at right shows freezing points of various solutions

Water and Alcohol Solutions

	Freez. Pt.
Water 95%, alcohol 5% ...	+ 25° F.
Water 85%, alcohol 15% ...	+ 11° F.
Water 80%, alcohol 20% ...	+ 5° F.
Water 70%, alcohol 30% ...	— 5° F.
Water 65%, alcohol 35% ...	— 16° F.

Water, Alcohol and Glycerine Solutions

	Freez. Pt.
Water 85%, alc.-glyc. 15% ..	+ 20° F.
Water 75%, alc.-glyc. 25% ..	+ 8° F.
Water 70%, alc. glyc. 30% ..	— 5° F.
Water 60%, alc.-glyc. 40% ..	— 23° F.

Alcohol and glycerine, equal proportions.

Annealing Copper and Brass

In annealing copper and its alloys, the quickest method is a reversal of that adopted in dealing with steel. The metal, whether wire, sheet, or castings, is gradually brought to a full red heat, and then either air or water-cooled, in some cases more than one heating being desirable. This produces the greatest softness, but after being compressed by hammering, drawing or rolling, the metal again becomes hard, and the annealing process has to be repeated. Cooling in water gives the best results in most instances, but this is a point which can only be determined by experience. In any case, if not well annealed, the metal is likely to split and it is not difficult to cause damage to work through lack of proper annealing when rolling or drawing.

A little oil on the clutch thrust bearing may facilitate gear shifting by preventing clutch drags. It surely will prolong the life of that important member.

Digitized by Google

A SIMPLE PRINT TRIMMER

PHOTOGRAPHS, to show to the best advantage should be trimmed, and one cannot trim them to the best advantage unless all four sides are done at once. This result can be attained by using a plate of glass of the size of the largest print you are likely to make, and a pair of shears. If you use a plate camera, a spoiled negative from which the emulsion has been washed will serve the purpose.

When you have cleaned the plate, lay it on the table and beginning at the side nearest you, rule a series of parallel lines, half an inch apart, to within two inches of the opposite edge; then beginning on the left, rule in the same way another series at right angles with the first. Ruling a piece of paper first and placing it under the glass as a guide will make the work easier.

If you make the lines with a drawing pen and water-proof India ink you will not need to renew them for a long time. If you desire greater permanence, do the ruling with a glass cutter.

To trim your prints, hold the plate in the left hand with the ruled side down and with the fingers underneath; then slip the print between the fingers and the glass to such a position that the outer edges of the plate and two selected lines shall coincide with the desired outlines. Trim the two outer sides close to the edges of the plate; turn the print half way round, and trim the other two edges in the same way. The lines will serve as a guide not only to size, but to right angles. You can trim wet or dry plates with equal facility.

J. W. WOLFE.

NEW ISOLATED LIGHTING SYSTEM

This new system is complete in its every detail. It is operated by a Willys-Knight air-cooled sleeve valve motor, and is self-cranking, self-running and self-stopping. The complete plant consists of the engine, a directly connected generator, a simple control box and a storage battery, and last but not least, the engine burns kerosene successfully. The generator is shunt-wound for 32 volts and is designed to deliver 750 watts. Generator, armature, engine fly-wheel and crankshaft are so constructed as to comprise practically a single unit, thus eliminating separate generator bearings and resulting in greatly reduced friction. The battery which has a capacity of 160 ampere hours consists of 16 cells with nine plates to the cell, enclosed in sealed glass jars.

BORING A SQUARE HOLE

THE possibility of boring a square hole has been long thought of and many attempts have been made to accomplish this seeming impossibility. At last the boring of a square hole has been made possible with a simple, but ingenuous device invented by an Illinois man. The device will not only bore square holes, but it will produce holes with various shapes, by a simple rearrangement of its various working parts.

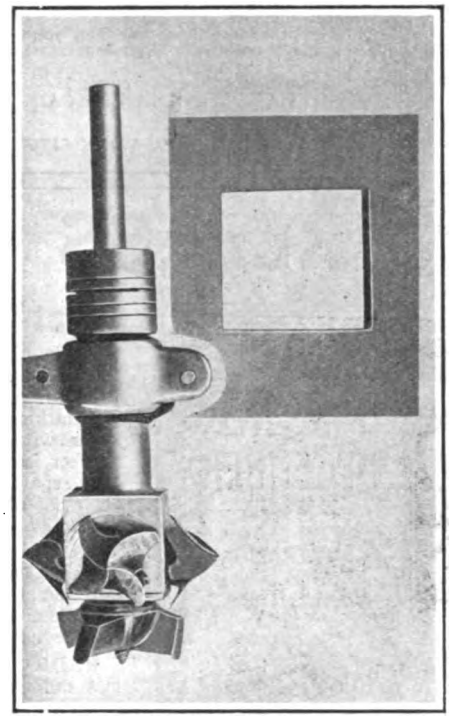


Fig. 1—Special boring head for making square holes

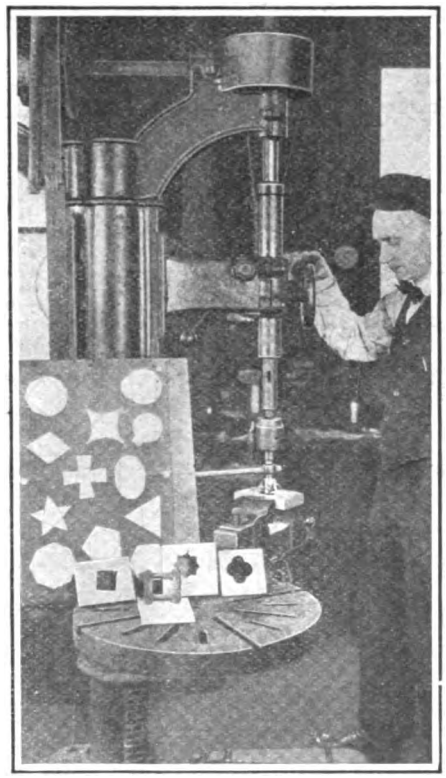


Fig. 2—How tool for boring square holes is used. A variety of work that can be done with it

The operation of the device will be seen by referring to the illustrations. Three triangular shaped cutters are arranged about a square block in such a way that their cutting edges form a square. A larger cutter is placed on the bottom of the tool and it is the duty of this cutter to lead the way for the other four cutters. Thus the bottom cutter bores the center out of the piece being cut while the four side cutters cut away the sides. By changing the shape of the side and bottom cutters it is possible to bore holes with various outlines; stars, crosses, triangles, etc.

As yet, this principle has only been applied to wood and with the present arrangement and type of cutters it would not be possible to cut metals. The need of a metal drilling device that will produce square holes is still as great as it ever was. Wood is so different in physical structure than metal that anything that will work with wood will not function on metal.

A LATHE KINK

The mechanic often has trouble in mounting a circular piece of work concentrically upon the surface plate. If the piece to be turned is not mounted in the center of the face plate the turning marks left by the lathe tool will look very bad.

To mount a piece of circular work for turning, first set the lathe in motion. Then take a piece of chalk and by holding the end on the revolving face plate, draw a circle that will have a diameter just a little larger than the work to be turned. It will then be a simple matter to mount the circular piece within the circle drawn by the chalk.

FINISHING AN ALUMINUM SURFACE

Few experimenters realize that aluminum can be planed with an ordinary wood plane. However, the plane used should be an old one which is no longer needed for other work. Before planing, the surface of the aluminum to be finished should be well covered with kerosene which is used as the cutting compound. The surface should be kept lubricated while the planing is being done. A very light cut should be taken. If the plane is set for too heavy a cut, it will be found impossible to carry on the work. The rough surface of cast aluminum should be smoothed down with a file before the planing is started.

Digitized by Google

AN EXTRAORDINARY OFFERING

A Standard Wavemeter Condenser, 0.00006 to 0.0015 mfd., $10.

The cancellation of a GOVERNMENT WAR CONTRACT has made it possible for the G. A. Company to give Experimenters this unusual opportunity—a double variable condenser built for the Signal Corps wavemeters, worth $50 at a price of $10. As a WAVEMETER condenser, a finer instrument cannot be purchased at any price. This is your chance to own a real meter. This condenser is of such a high grade type that it is specially adapted for use as a LABORATORY STANDARD for making all kinds of measurements. VACUUM TUBE TRANSMITTERS require air condensers of this type which will not break down between the plates LONG WAVE RECEIVERS must have condensers of large capacity and very low losses to operate with minimum inductance and to give loudest signals. For all these purposes, the DOUBLE CONDENSER is the best you can buy, regardless of the price you pay.

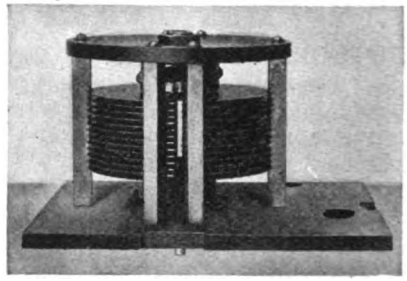
A limited number of these instruments are available. If your order comes too late, your money will be returned, immediately. The G. A. Company gives no credit slips, makes no substitutions.

0.00006 to 0.0015 mfd. condenser, $10.00, sent by express. Capacity calibration curve $1.00.

DON'T LET THIS OPPORTUNITY SLIP BY—YOU WILL NOT HAVE THIS CHANCE AGAIN

Orders accepted by mail only.

15 WEST 45th ST. **The General Apparatus Company** NEW YORK CITY



CONDENSER AS SHOWN, NEVER USED, **$10** ACTUAL VALUE OF THIS INSTRUMENT, $60

"THE 100% WIRELESS MAGAZINE"



What "Radio Amateur News" Is:

With its fifth issue RADIO AMATEUR NEWS holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO AMATEUR NEWS now leads all other wireless magazines. Take for instance the November issue with its fifty-six pages; there were fifty-four separate purely radio articles and 114 illustrations. *Over twenty-seven thousand copies were printed and circulated.*

Each issue of the RADIO AMATEUR NEWS now contains 56 pages (or more) and an artistic cover in two colors. The illustrations average 125 every month and there are from 40 to 50 up-to-date articles, some by our biggest radio scientists, in every issue.

RADIO AMATEUR NEWS is the greatest and biggest radio magazine in print today.

RADIO AMATEUR NEWS is the only INDEPENDENT monthly wireless magazine in existence. It caters to no commercial interests—it has no boss save its readers. It is "different"—it has the latest radio news. It is a scientific magazine but it caters largely to the RADIO AMATEUR—it is by and for the Amateur. It is publisht by the publishers of the ELECTRICAL EXPERIMENTER, but there are no duplications of articles in the two magazines. Both are entirely different—but both together will give you ALL the radio news of all the world. Whether you are a professor or an Amateur, get a sample copy or order it from your Newsdealer today.

Partial Contents of November Issue:

Audio Frequency Wireless Telephone By E. T. Jones

The Eaton Oscillator and Eaton Circuit Driver By William H. Priess

Why I Am Opposed to Government Radio Control By Dr. Lee de Forest

Underwater Submarine Telegraphy

Developing an Audion for the Amateur By E. T. Jones

A 170-25000 Meter Receptor By Francis B. Pray

Second Prize Award, $25.—Radio Contest

Amateur Radio Broadcast de Navy Department

Notes on R-34 Return Trip By R. F. Durrant, Lieut. R. A. F.

San Diego, Cal., from London By Alexis J. Hall

How Manufacturers Work "Formica" and "Bakelite" By J. Stanley Brown

Ideas—2nd Spasm By Thos. W. Benson

Increasing the Secondary Voltage of Your Transformer By F. E. Terman

Notes on Crystal Detectors By C. H. Byron

SPECIAL OFFER

EV. EN. 12 CUT ALONG THIS LINE

Gentlemen: Please enter my subscription for RADIO AMATEUR NEWS for the term of one year for which I enclose herewith $1.50. You will also send to me free, immediately, your great Wireless Course, containing 160 pages, 350 illustrations, size 6¾ x 10", with fine flexible cloth cover. I have added 5c extra for postage.

Name .....

Address .....

City .....

15c The Copy
$1.50 A Year Canada and Foreign $2.00 A Year

SEND 15c FOR SAMPLE COPY TODAY

56 PAGES 125 ILLUSTRATIONS

REGULAR DEPARTMENTS MONTHLY

"Radio Telephony," "Radio Constructor," "Radio Digest," "With the Amateurs," "Radio Stories," "Club Gossip," "Junior Section," "New Radio Patents," "I-Want-to-Know."

EXPERIMENTER PUB. CO., 241 Fulton St., N. Y. C.

Digitized by Google

Efficient DE FOREST Audion DETECTOR PANELS



Audion—Ultra Audion Type P-500

This is the type P-402 panel; size 7 9-16" x 7 1-16"; with apparatus as described opposite and with two switches for Audion—Ultra Audion connection and either 20-volt or 40-volt "B" battery. Enclosed in cabinet as illustrated above.

Price $24.00

ALL DE FOREST Audion Apparatus

is sold without Audion Tubes. Audion Detector Tubes, $7.00 each additional.

Here are genuine DeFOREST Audion Control Panels that offer exceptional value and are within the price range of every amateur. Remarkably efficient in service, handsome and "professional" in appearance, and designed and built for the Audion as only the makers of the Audion can build them.

Controls mounted on genuine Bakelite panels; with and without cabinets. Four-prong, heavy nickel tube receptacles; smooth-running, positive acting, adjustable rheostats; impregnated mica stopping condensers; adjustable or fixed grid leaks; Bakelite covered binding posts, with positive slotted connecting feature; positive segmentally connected nickel-plated switches. 40-volt "B" battery, composed of two 20-volt units cast en-bloc—6 to 12 months operating life. All parts perfectly finished and fully up to the DeFOREST standard. Get full information now.

Send for Catalogue E.

a 64-page book illustrating and describing these and many more DeFOREST instruments. Sent postpaid for 10 cents.

De Forest Radio Telephone and Telegraph Co.

Inventors and Manufacturers of Amateur and Commercial Radio Apparatus.

1415 Sedgwick Ave., New York City



Audion Detector Type P-401

Consists of Tube receptacle, grid leak, condenser, rheostat and binding posts for connection to tuner, "A" and "B" batteries and telephones; on Bakelite panel size 6¼" x 7½"; all enclosed in handsome quartered oak, round cornered cabinet, standard DeFOREST "Early English" finish.

Price $13.25

Panel only (Type P-400) without cabinet.

Price $10.90

Type P-402—Larger panel; size 7 9-16" x 7 1-16", including 40-volt "B" battery and cabinet.

Price $21.00

Ask your Dealer for DE FOREST Radio Apparatus

These dealers in principal cities, as well as many others not listed here, sell genuine DeFOREST apparatus. Consult local telephone directories for street addresses.

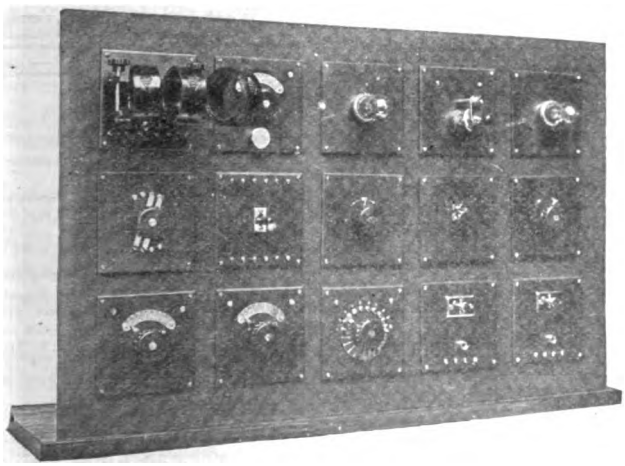
Boston, Mass.
F. D. Pitts & Co.
J. W. Poole, Inc.
Hartford, Conn.
Bauer & Co.
New York City
Bunnell & Co.
Philadelphia, Pa.
Central Elect. & Lock Co.
Quaker Light Supply Co.
Frank H. Stewart Co.
Baltimore, Md.
Maryland Elect. Supply Co.
Washington, D. C.
Geo. W. Pareso & Co.
Pittsburgh, Pa.
Doubleday, Hill Elect. Co.
Toledo, Ohio
Wm. B. Duck & Co.
Canton, Ohio
Wireless Mfg. Co.
Chicago, Ill.
A. A. Howard
St. Paul, Minn.
Pioneer Elect. Co.
Minneapolis, Minn.
Sterling Elect. Co.
Milwaukee, Wisc.
Dewey Sporting Goods Co.
St. Louis, Mo.
Linze Elect. Supply Co.
San Francisco, Cal.
Leo J. Meyberg & Co.
Los Angeles, Cal.
So. California Elect. Co.
Brode Elect. Co.
Seattle, Wash.
Ralph Krows Elect. Co.
Houston, Texas
Hurlburt Still Elect. Co.
Mobile, Ala.
Ungar Elect. Co.
Atlanta, Ga.
Haight Accessory Co.
Norfolk, Va.
Meeks Collins Elec. Co.
Montreal, Canada
Perkins Electric Co.
Toronto, Canada
Duncan & Russell

DE FOREST Unit Receiving Set

Gives You Better Apparatus at Low Cost

PICTURE below shows typical 15-panel DE FOREST Unit Receiving Set consisting of a Tuner with wave length range of 150 to 25,000 meters; a crystal and an audion detector, and a one-step amplifier. This Set is the most complete and efficient receiving apparatus ever put out under $150.00. Its cost is considerably less than that; the entire set of Units shown below totaling only $133.57.

The DE FOREST Unit Receiving Set offers the only practical system of securing accurately designed, highly efficient receiving apparatus without paying for expensive factory assembly and costly cabinets. You buy the individual units and assemble them yourself, thus becoming more expert.



You can start with a few inexpensive Units which will give you a Receiving Set of an efficient but simple type, and then build up, always fitting new Units into the system as additions to the old. No junking of old apparatus; just add to them to increase your selectivity and circuit efficiency as new developments come out.

If you are thinking of taking up wireless work, find out about the DE FOREST Unit Receiving Set before you get your apparatus. It will give you the most highly developed Radio instruments obtainable. And if you are an Amateur, Student or Experimenter, this Unit Set holds even greater possibilities for you because in using your own ingenuity in assembling the Units you will greatly broaden your Radio knowledge.

Send for the DE FOREST Catalog E, Giving Complete Descriptions

A 64-page book of Radio Apparatus which illustrates and describes many other interesting features. Sent postpaid for 10 cents.

DE FOREST RADIO TEL. & TEL. CO.

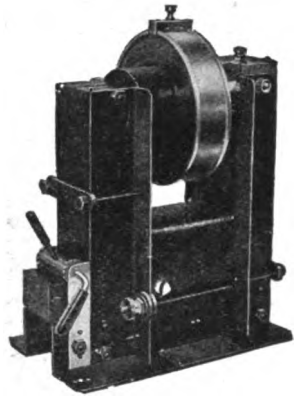
Inventors and Manufacturers of Amateur and Commercial Radio Apparatus

1415 SEDGWICK AVENUE, NEW YORK CITY

Digitized by Google

1 K. V. A. 25,000 Volt Wireless Transformer

The Thordarson Wireless Transformer is more than a transformer. It is a machine of efficiency and reliability, a piece of wireless apparatus that every amateur can be justly proud of. A Thordarson Wireless Transformer will make a "Long Distance" amateur of you. Our "20-T" bulletin describes our complete wireless transmitting apparatus.

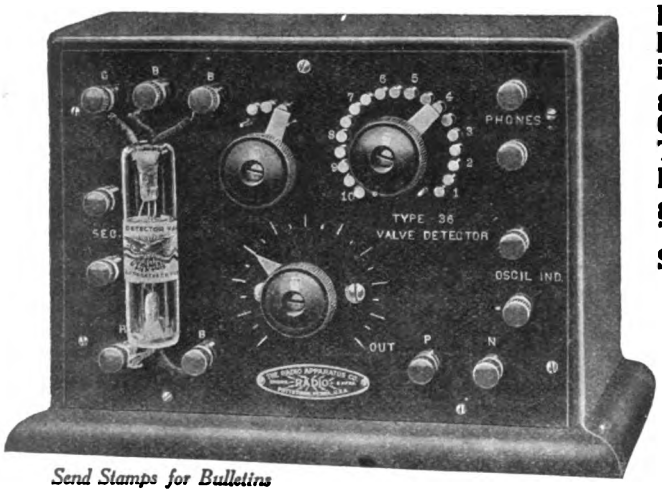


Thordarson Electric Mfg. Co.

501-515 So. Jefferson St. Chicago, Ill.

IT TALKS FOR ITSELF.

Do You Need a Good Detector?



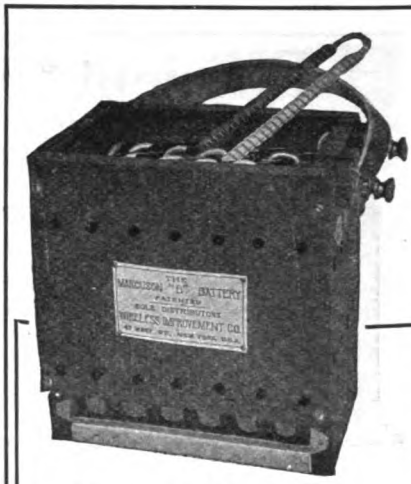
Send Stamps for Bulletins

Here is Your Ideal. Use it in Your Regenerative Circuits. Get Thunder-bolt Radio Telegraph and Telephone Sigs.

Tracolite Insulation Panel. Beautiful Mahogany Finished Cabinet. Including a High Grade Traco "B" Battery.

THE RADIO APPARATUS COMPANY,

POTTSTOWN, PENNA., U. S. A.



The Plate Battery Problem Solved!

The Marcuson "B" Battery

eliminates the use of the inefficient Dry Battery and the old-fashioned expensive Storage Battery

The Marcuson "B" Battery possesses four points of perfection,—it is light, compact, dependable, and inexpensive. The Marcuson "B" Battery can be readily charged from any D. C. lighting circuit.

40 Volts. Over all Dimensions: 6" x 6" x 4". Weight 5 lbs. Price: $12.00. The Marcuson Batteries have been in use for more than ten years by the largest Electrical Manufacturers, Cable Repair Ships, Technical Institutions, etc.

Can be replaced at lower cost than new Dry Batteries can be bought for

We are sole distributors of the Marcuson "B" Batteries.

It is but one of our many Radio products.

Simply drop us a card, and let us send you our catalogue No. Two.

WIRELESS IMPROVEMENT CO.

Radio Engineers
Manufacturers and Distributors
47 West Street New York, U.S.A.

STANDARDIZED EQUIPMENT AND MATERIALS FOR EXPERIMENTERS

TRANSMITTING ANTENNA	For LONG DISTANCE SHORT WAVE TRANSMISSION—designed for 200-meter work. Materials and instructions for 4-wire antenna 80 ft. long. For vacuum tube or spark coil sets, $5.59. For ½ k. w. transformers, $6.62. Wt. 5 lbs. Postage extra.
SHORT RANGE ANTENNA	A 100-ft. single wire antenna on which SHORT WAVE RECEIVERS give the best results. You can't copy 200-meter stations on a large antenna. Complete materials and instructions, $2.00. Wt. 3 lbs. Postage extra.
LONG RANGE ANTENNA	With a crystal detector set, will copy ARLINGTON TIME SIGNALS up to 1,000 miles. Also used for long wave telephone and telegraph reception. A 200-ft. single wire antenna for town or country use. Materials and instructions, $3.23. Wt. 4 lbs. Postage extra.
SUPER RANGE ANTENNA	Get a maximum range, copy NAUEN, LYONS, and foreign stations with this 300-ft. single wire antenna using one Audion. No masts needed for any of these antennas, as height need not exceed 30 ft. $4.65. Wt. 5 lbs. Postage extra.
	Note: Wire, lead-in and insulators, high tension cable, instrument ground wire, etc. furnished—everything for a complete antenna.
G. A. STANDARDIZED 22.5-VOLT B BATTERIES	Guaranteed to be made by the formula used for 90% of batteries bought by the U. S. Government. Operating life of Signal Corps type 3 months; Navy type, 10 months. Need no potentiometer or switch. Cheaper than flashlight cells. Signal Corps size, $1.50, wt. 1 lb. Navy size, $2.50, wt. 5 lbs. Postage extra.
CONSTRUCTION PAMPHLETS BY M. B. SLEEPER	No. 1. INDUCTANCE TABLES. Direct reading, all sizes of single layer, multi-layer, pancake, figure 8 coils. No. 2. DIRECTION FINDER. Detailed drawings of unilateral radio compass, 200 to 2,000 meters. No 3. AUDION TRANSMITTER. A single Audion telephone or telegraph transmitter, simple materials, low cost. No. 4. SUPER RANGE RECEIVER. For long wave undamped reception from foreign stations. 25c. EACH. SPECIAL OFFER BEFORE PUBLICATION, 4 for 75c. READY ABOUT JANUARY FIRST.

SEND 3c. FOR NEW CATALOG NOW BEING PREPARED. FOR RADIO, MODEL, AND AIRPLANE EXPERIMENTERS
15 W. 45th St.

G.A.
The General Apparatus Company

IF YOU ORDER FROM THE G. A. COMPANY, YOU WILL HAVE NO TROUBLE. ORDERS ACCEPTED BY MAIL ONLY
New York City

Digitized by Google

SCIENCE NOTES

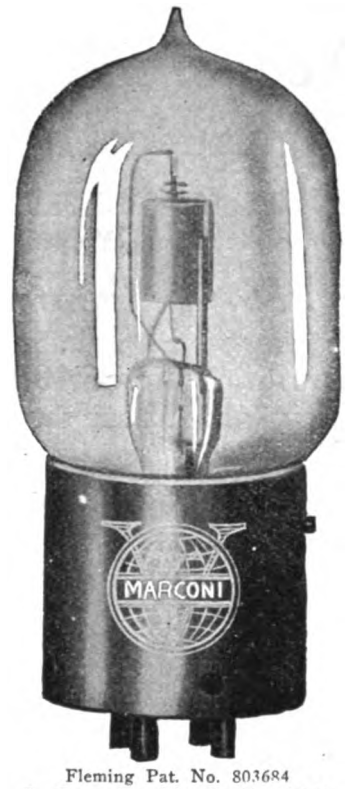
The sensibility of the human eye for light has been investigated by Drs. Coblenz and Emedson of the U. S. Bureau of Standards. A normal eye can see a star of the sixth magnitude, and they determined the energy received from such stars as being only $1.3 \times 10 - 16$ watts of energy, which is $3 \times 10 - 11$ gram-calorie. This infinitesimal amount of heat energy would require 60 millions of years to raise the temperature of a gram of water 1° centigrade.

The radium pastes used on watches and other objects to make them luminous contain about 0.4% of the radium salt. The light may be feebler but is more durable if a smaller proportion of the radium compound is employed. Radium bromide may lose as much as 5% of its luminosity per month, so as to be of but half its original power at the end of six months.

In the United States in 1919, 55 grams of radium were produced, which is half the metal in the world; in 1918 the production was 13.5 grams.

Nichrome is an alloy of nickel and chromium which has been used for some time in electric heating apparatus. It has been tried for chemical vessels with success, as it resists both sulphuric and nitric acids; 85% sulphuric acid acting on it for two months only attacked it to the extent of 0.065% and 45% sulphuric acted on it with about five times this intensity in a single month. Nitric acid acted with five times this intensity, and hydrochloric acid attacked it vigorously.

A curious proposal has been made to shoot projectiles vertically into the air with registering instruments attached to get the data of high altitudes. It is calculated that a small calibre projectile, 1.3 inch diameter, with an initial velocity of 2,500 feet would reach an altitude of about 45,000 feet in 48 seconds. This applies to the regular shaped shell. A specially shaped shell would rise over 75,000 feet in 69 seconds. A shell from a "Big Bertha" would ascend to three times the last named altitude in 125 seconds. The idea seems a curious one but the interest is in the figures. Few realize the altitudes which may be attained by projectiles. The long range gun which was used against Paris is supposed to have owed its long range in part to the rarified air, in which so much of its trajectory lay, offering but little resistance to its motion. The proposal to use captured German artillery for this purpose was made before the French Astronomical Society by M. Pluvinel.



Fleming Pat. No. 803684
De Forest Pat. Nos. 841387 879532

THE HEART OF THE WIRELESS ON THE NC 'PLANES

Also used on the Vickers Vimy Trans-Atlantic Flight

MARCONI V. T.

$7.00 each

Standardized Socket . $1.50 additional

Agreements recently effected have made vacuum tubes available for experimental use. The Marconi V. T. is the only vacuum tube. or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

A highly developed, all-around tube for use as a detector and amplifier in wireless communication. It has practically the same electrical constants as the tube used by the Allied armies and navies throughout the war in continuous wave transmission and reception.

The approximate operating life of the MARCONI V. T. is 1,500 hours.

Class I—Designed for use as a detector; operates with plate potential of 20 to 60 volts.

Class II—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.

SEND ALL REMITTANCES WITH ORDER

COMMERCIAL DEPARTMENT

Marconi Wireless Telegraph Co. of America

Sole distributors for
De Forest Radio Telephone & Telegraph Co.

Room 1868 Woolworth Building, 231 Broadway, New York

BRANCH OFFICES

Schofield Bldg. Cleveland, Ohio	Insurance Exch. Bldg. San Francisco, Cal.	301 Commercial Bank Annex New Orleans, La.
American Bldg. Baltimore, Md.	136 Federal St. Boston, Mass.	109 South 2nd St. Philadelphia, Pa.

Laboratory Signs

Attractive 8" x 10" signs printed on high quality coated white cardboard in selected wordings for the electrical experimenter.

1.—DANGER! HIGH VOLTAGE
2. EXPERIMENTAL RADIO LABORATORY NO ADMITTANCE
3. GOVERNMENT LICENSED RADIO STATION
4. DO NOT TOUCH THE INSTRUMENTS
5. PLEASE BE QUIET WHILE THE OPERATOR IS RECEIVING

15c EACH, ANY TWO FOR 25c
ALL 5 FOR 50c

Immediate Shipments, Postpaid

THE TAYLOR CO. Box 1043-E
LOWELL, MASS.

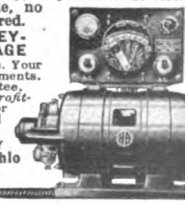
HB BATTERY CHARGING PAYS BIG PROFITS

WINTER BATTERY CHARGING BRINGS YOU $100 to $200 MONTHLY EXTRA PROFIT

Car owners demand reliable Battery Charging service. Get your HB 500 watt Charger NOW. Prepare for BIG WINTER PROFITS. Recharges 1 to 8 6-volt batteries. Cost 10c to 15c each, customer pays 75c to $1.50. No expensive repairs, burnouts or renewals. Steady, dependable service. Easy to install and operate, no mechanical knowledge required.

$15 PUTS THIS MONEY-MAKER IN YOUR GARAGE

Balance in small monthly payments. Your profits far more than carry payments. HB Absolute Money-Back Guarantee. Start to build a *big, permanent, profitable* business. We help you. For full information, tear out this ad and mail NOW.



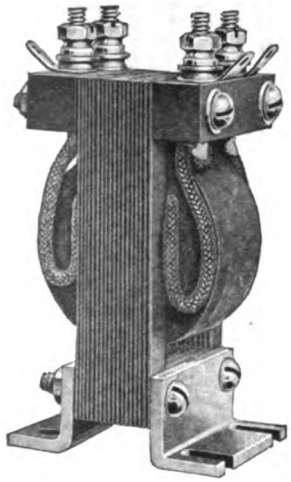
HOBART BROTHERS COMPANY
Box EE112 Troy, Ohio
Successful Mfrs. Since 1893

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Federal Radio Accessories Are Unexcelled

in Quality and Efficiency



No. 226-W
Type A
Audio Frequency
Transformer
PRICE $7.10 each

TO GET RESULTS USE FEDERAL
Write for Bulletin 101-W and 102-W

"ONE 226-W Transformer with **one** Marconi V. T. gives an energy amplification of **400** times. (Audibility amplification of **20** times.)"

"TWO 226-W Transformers with **two** Marconi V. T.'s give an energy amplification of **160,000** times. (Audibility amplification of **400** times.)"



The "Liberty"
A and N Type
52-W 2,200
ohms.
Price $12.50
per set

WE ARE DISTRIBUTORS OF MARCONI V. T. STANDARD SOCKETS, GRID LEAKS. *Send your orders to*

FEDERAL TELEPHONE AND TELEGRAPH CO.
BUFFALO, N. Y.

The efficiency and sensitiveness of Vacuum Tubes is retained or increased by repairing or replacing broken or burned out elements.

The establishment of a complete and modern high Vacuum Laboratory enables us to repair all types of tubes manufactured in the United States or abroad.

THE COST OF REPAIRING

MARCONI V. T.
WESTERN ELECTRIC
GENERAL ELECTRIC
DEFOREST
MOORHEAD
} RECEIVING TUBES $4.50

AUDIOTRONS
ELECTRON RELAYS
} $4.00

SMALL TRANSMITTING AND FOREIGN TUBES $7.50
POWER TUBES - - - - - 15.00

Burned out tubes purchased outright at .50 each.
A limited number of repaired tubes on hand, guaranteed money refunded if not satisfactory.
Same as new at $5.00 and $4.50 respectively. AGENCIES DESIRED

The Vacuum Tube Repair Co.
511 Perry Building Oakland, California

Digitized by Google

SCIENCE NOTES

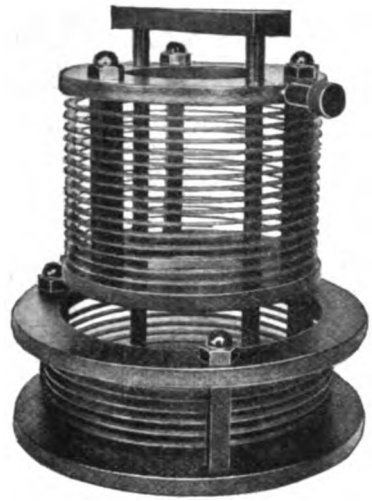
An enormous deposit of bauxite, containing from 64% to 67% of aluminum has been found in British Guiana, and has been taken up by the government. It is thought that the water power of the tropical rivers may be available for power to operate the works for producing the metal. Deposits have also been found in Dutch Guiana. Another use for bauxite has been found in the preparation of an abrasive, an artificial emery. To make it bauxite is heated with anthracite to a temperature of 2,000° C.

A compound of alumina, iron oxide and titanium oxide has been prepared by heating red bauxite with anthracite coal to a temperature of 2,000° C. It is red in color, melts at 1,700° C. and is nearly as good an abrasive as Naxos emery. It has been named corindite. Its analysis shows 69.3% alumina, 23.35% ferric oxide, 3.7% titanic oxide, 3% silica, and 0.5% carbon, the latter derived from the coal.

An unaccounted for glow has been observed on the aluminum terminal in an electrolytic rectifier. One of the electrodes was made of lead, and this one showed no glow. The solution was sodium phosphate. The same glow was obtained with other electrodes and solutions, with a very wide range of potential difference. It is still unaccounted for.

A very practical observation on electric lighting is to the effect that the lighting of rooms can often be greatly improved by cleaning the ceiling and reflectors, if the lamps are provided with such. It is stated that the cleaning of the reflectors in one case improved the illumination 25% and treatment of the ceiling some 40%. The tendency to put in new lamps it is suggested should be resisted, as only 15% improvement in the case cited was secured by so doing; the obvious method was the better.

Silicium has now been prepared in two ways, one giving a negative and the other a positive thermo-electric element, as referred to each other. The potential difference is very large; a couple can be made out of the two varieties, which will have a potential difference of 1,000 microvolts for 1° C. difference of temperature. It is essential that it is free from iron. The electro-negative variety is made by crystallization from tin or silver—the other kind by crystallization from aluminum. The metal germanium comes next to silicium in thermo-electric power.



INTERNATIONAL RADIO

TRANSFORMER

Type TXL-101 A

Price $12.00 f.o.b. Factory

A Standard Transformer modified and redesigned for amateur use. Coils are 1/16" copper, edgewise wound on bakelite supports. Assembly secured to end plates by bakelite nuts. Secondary slides on bakelite rods. This elimination of metal throughout results in maximum efficiency.

PRIMARY INDUCTANCE 12 micro henrys (Wavelengths 125 to 500 meters with .006 M. F. Cap.)

SECONDARY INDUCTANCE 40 micro henrys (Wavelengths 575 meters max. with average antenna.)

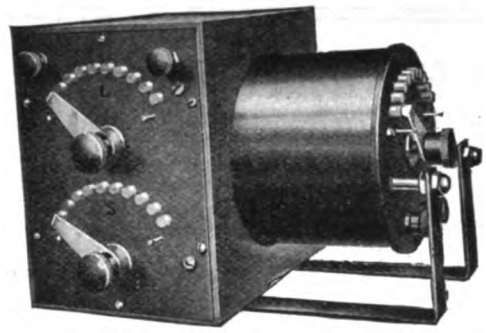
The Transformer illustrated above is only one of many newly designed radio specialties which we have ready for you. Write us for descriptive bulletins which are being issued covering all International Radio Products. Address Department No. 21.

INTERNATIONAL RADIO TELEGRAPH COMPANY

326 Broadway New York, N. Y.

A MARK OF QUALITY

RADIO ELECTRICAL APPARATUS



New type radion receiving transformer has bakelite panels, two primary and one secondary 10 point switches. Oak cabinet. Price, $12.00.

Our new Bulletin Y offers a distinctive line of radio and laboratory apparatus including transformers, spark gaps, oscillation transformers, variometers, variable condensers, etc., in fact the most complete line in America.

Bulletin R describes the Cambridge alternating current rectifier for

STORAGE BATTERY CHARGING

Send 3c. stamp for both bulletins

CLAPP-EASTHAM COMPANY

131 MAIN STREET CAMBRIDGE, MASS.

REMLER RADIO MFG. CO. 62 Post Street SAN FRANCISCO

Pacific Coast Representatives

RADIO AMATEURS—HERE IS THE VARIABLE CONDENSER YOU HAVE BEEN LOOKING FOR—AT A PRICE YOU CAN AFFORD TO PAY

The best of materials and workmanship. Bakelite end plates. Heavy aluminum plates and accurately machined spacers. Copper ribbon connection to movable plates. Extremely rigid construction.

PRICES

2 plate Vernier	$1.85	23 plate, .0005 m.f. max. capacity	$3.25
7 plate, .0001 m.f. max. capacity	2.15	31 plate, .0007 m.f. max. capacity	3.90
13 plate, .0002 m.f. max. capacity	2.50	43 plate, .0010 m.f. max. capacity	4.75
17 plate, .0003 m.f. max. capacity	2.85	63 plate, .0015 m.f. max. capacity	6.75

Include postage for one pound.

THE WIRELESS SHOP

A. J. Edgcomb

511 West Washington St., Los Angeles, Cal.

MECHANICAL DRAWING

Successfully taught by mail. Learn to make and read drawings and become a Mechanical Draftsman. Fifty cents each lesson, pay as you go. No other expense. Complete drawing outfit valued at $20.00 free with the Course. One hundred blue-print lessons. Will assist you to secure good paying position when qualified. Send for particulars and sample lessons. 50¢ Per Lesson

ALBANY INSTITUTE MECHANICAL DRAWING

Desk C, Lock Box 84, Albany, N. Y.

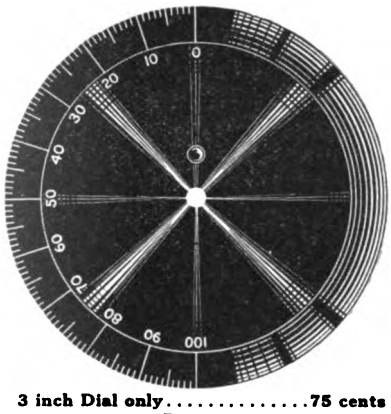
CELLULOID

SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING EXPERIMENTAL WORK, ETC.

NAPIER BROWNING CO.

105 W. 40th ST. NEW YORK CITY

Digitized by Google



3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted...$1.30 Postpaid

Bulletin No. 1 describing these parts has been sent to all who sent for our July 1st catalogue. If you have not received our catalogue send 5 cents in stamps for it and get on our mailing list for future bulletins free.

RADIO MEN

Make your apparatus up to date. Indicating dials now available at a reasonable price. These dials are fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. The edge is bevelled. The hole in the center will pass 8-32 screw and there are three holes around the center hole to fasten on knob. These holes are not shown in cut. We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

For sale at all Ragisco Agencies

A. H. Corwin & Co.

4 West Park Street Newark, N. J.

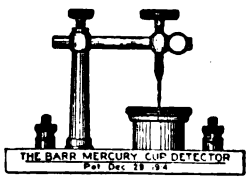
DO YOU LIKE TO SEE WHAT YOU BUY?

Don't buy blindly. Come to the busiest wireless store in New York City and see what you are getting. It is worth while to wait a day if it isn't convenient to stop in just when you want something. You can see the best apparatus from all the manufacturers, de Forest, Grebe, Arnold, Clapp-Eastham, and others. Complete instruments, parts—everything for the radio experimenter. Be sure to see our transmitting equipment before you buy any new apparatus. If you live away from New York, send 10c, for our new catalog. Our service to distant customers makes mail order buying quick and easy.

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.

235a Fulton Street New York City

THE BARR
Mercury-Cup Wireless Detector



The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Co.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct.

Instantly adjustable at a constant pressure.

For full information and price—write

The Barr Mercury-Cup Detector, Dept. C, The Wyoming, Washington, D. C.

Send for

HALCUN Radio Catalogue

Full Line of Amateur Requirements

Halcun Radio Co.

San Francisco, Calif.

Formerly Haller Cunningham Elec. Co.

PERFECTION TUNERS

WONDERFUL RESULTS-UNIQUE DESIGN

20,000 Ms—Hook up on bottom. Involute coils—Beat the Honeycomb. XDA—comes in on 1st tap—N.S.S. on 4th. Any aerial—overhead, underground or loop. Size 4¾ x 4¾ x 2½. Formica top. Nickel finish. Weight 2 lbs. 200 M. Regenerative tuner same size but with tickler coil and 10 taps P & S. Good for wireless phone and relay work. Every instrument tested by old 9xE. Send for bulletin.



TRESCO DAVENPORT, IOWA

$15.00 DELIVERED TO YOU

RUSTLESS IRON ALLOYS

MANY attempts have been made to obtain a rust proof iron or steel. Of these some were based on the production of a coating of magnetic oxide of the metal itself in a thin coating or covering. The trouble with these attempts was that the coating would crack if the metal was bent or subjected to strains. Yet the Bowers-Barff and similar processes attained a considerable vogue.

At the present time efforts are directed more in the direction of the production of an alloyed iron or steel which will resist rusting. It has been definitely found that wrought iron rusts with comparatively slowness. One of the distinguishing features of wrought iron is the presence in it of a small percentage of slag. One theory is that this is what stops it from succumbing so quickly to corrosion. To the writer a better theory seems to be that it is the absence of carbon that accounts for its resistance. Carbon and iron make a galvanic couple or little battery of particle to particle, and this would favor corrosion.

The following table gives the reactive corrosion of iron, steel and two alloys. It will be observed that the mild steel resisted about as well as the wrought iron, perhaps due to the absence of carbon in any quantity. The samples were exposed to sea-water, fresh water and to the atmosphere:

Wrought Iron	100
Mild Steel	103
3 per cent Nickel Steel	77
26 per cent Nickel Steel	31

The expensive 26% nickel alloy has been used in cases where the quantity was so small that the cost was of little import. It has even been proposed to use a still richer nickel alloy for boiler tubes; a 30% allow will outlast three sets of boiler tubes of everyday steel. In scientific instruments and apparatus an alloy containing 36% of nickel has been used a great deal. It expands but little with rise of temperature, resists corrosion and is of high strength coefficients. Such alloys have a field for use in torpedo and submarine practice. The last named alloy is called Invar metal.

Copper in small quantities retards corrosion. Less than 1% is all that can be present without injuring the metal, unless a third element is present, and nickel has proved to be the desired addition. With nickel present more copper can be added, the copper can even be taken as replacing some of the nickel, and the triple alloy is said to be twenty times more resistant

Digitized by Google

to sea water than steel. This alloy can be produced from the slag from nickel smelters; the slag contains the three metals, and from it the alloy is produced by reduction and refining.

An alloy of iron and chromium, the latter being between 10 and 15%, is also non-corroding and has received a considerable degree of utilization. It also resists corrosion by gases, and this makes it available for the valves in gasoline engines. It has been used for cutlery with great success. Care is said to be requisite in working these steels; the finishing cuts should be of little depth and the final surface should be as smooth as possible. Annealing and hardening are said to help in retaining the rustless qualities.

INDUSTRIAL USES OF TUNGSTEN

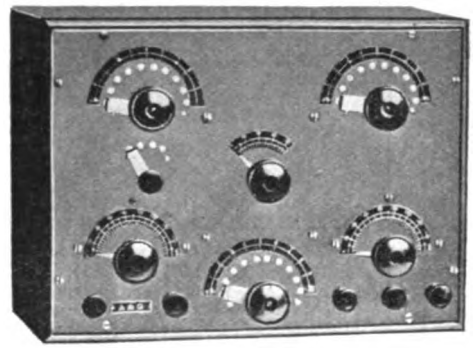
The metal tungsten has acquired an immense importance in industry. The name is Swedish and means "heavy stone." From 20,000 to 25,000 lamp filaments can be made from a pound of the metal. Its specific heat is very low, 0.03. It is very difficult to fuse, requiring a temperature of 3,200° C.—and is so hard that it could replace corundum as an abrasive. Its specific gravity—18.5—is so great that it is being thought of as a substance for projectiles, including shrapnel. It would have a long range and a very low trajectory. It is believed that the Germans intended using it for such purposes, and that the submarine the Deutschland took a consignment of it to Krupps. The ore is very scarce in Germany. There are three principal ways of making it. One is to precipitate the hydroxide from solution and reduce with hydrogen at a high heat. Another is to reduce it in the electric furnace and a third process uses the well known thermit reaction. It has three times the electric resistance of copper and is 50% stronger than iron. A trace of carbon makes it brittle. It has risen enormously in price and there is said to be a regular "tungsten fever" in South America, presumably in the same order as the Texan "oil fever."

BRITISH OUTPUT OF SHELLS

In Great Britain during the war 200 million shells and 26,430 big guns were made. In one week in August, 1918, 2,900,000 rounds were fired, and in a single day in breaking the Hindenburg line 943,300 shells were expended, the weight was 40,000 tons. The factories which turned out these great quantities of war materials are making all sorts of products, from tool work to mechanical toys and are repairing trams and doing weaving, dyeing and finishing.

UNIVERSAL RADIO APPARATUS

Has Put the Highest Developments of Radio Engineering Within the Means and Experience of Every Experimenter. There is a Universal Set Suited to Your Knowledge and Pocketbook.



UM3 COMPLETE RECEIVER, $60.00

The beginners, the advanced students, and those who use radio in connection with their business, all find, in the Universal line, the right equipment for their needs.

Type UM3 is the receiver for general spark reception from 200 to 2,500 meters. It is offered particularly to experimenters who require the best, without the price which the quality indicates.

Jewelers will find the UM3 receiver ideal for copying Arlington time signals. Only a single wire antenna is needed with this set.

Other receivers for short wave work, damped waves, and long wave undamped reception are described in the Universal catalog. A 2-cent stamp will bring you a number of surprises in the new line of Universal equipment. See this catalog before you buy your apparatus.

UNIVERSAL RADIO MANUFACTURING CORP.

DEPT. K. ELMIRA, N. Y.

POSITIONS GUARANTEED

TO EVERY GRADUATE OF OUR SCHOOL

By FOUR LARGEST RADIO CONCERNS

$125 per MONTH PLUS ALL EXPENSES

MODERN EQUIPMENT—SPECIAL SHORT COURSE

INDIVIDUAL INSTRUCTION

FINEST STAFF OF TEACHERS AVAILABLE

DORMITORY—SWIMMING POOL

CALL OR WRITE FOR ILLUSTRATED BOOKLET

Y. M. C. A. RADIO SCHOOL

Department R

159 East 86th St. **New York, N. Y.**

"BEST RADIO SCHOOL IN THE EAST"

Catalog of RADIO RECEIVING APPARATUS

MADE BY THE PIONEER COMPANY OF THE PACIFIC COAST. SEND IN A 2-CENT STAMP AT ONCE

AudioTron Sales Company

Lick Building San Francisco

15 Cells-Standard B-Battery-22.5 Volts

Signal Corps, U. S. Army for Vacuum Tubes

TYPE BA-2

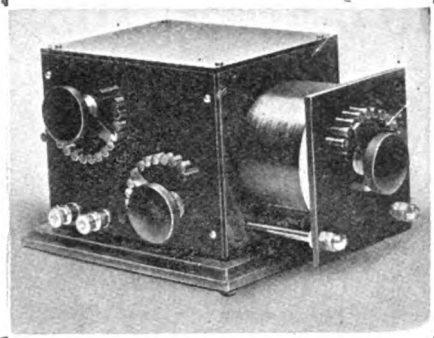
Fully Guaranteed—Worth $1.60—our price $1.00 postpaid. State your wants in Wireless Receiving and Sending apparatus. We will quote you very reasonable prices.

THE H. S. WIRELESS CO.

164 Ross Street Brooklyn, N. Y.

Digitized by Google

Buy the Best When You Buy



THE BEST COSTS YOU LESS WHEN YOU BUY FROM US.

This 200 to 2500 meter loose coupler costs $18.00. You cannot buy a better instrument if you pay more.

RADIO EQUIPMENT CO.
630V Washington St. Boston, Mass.

New Catalog of METEOR Radio Apparatus



Mailed Postpaid on Request

Quality Apparatus

Attractive Prices

Send for Catalog No. 6045E Today

Sears, Roebuck and Co., Chicago

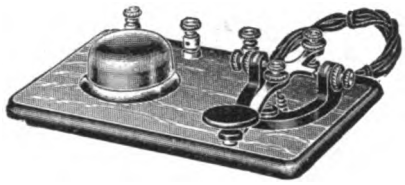
RADIO APPARATUS
on the
INSTALLMENT PLAN

Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.

J. DONALD VANDERCOOK
LOMBARD Box 442 ILLINOIS

Wireless Receiving Ban Raised

MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No.		Price
342	Telegraph Practice Set, with Battery and Cord	$3.24

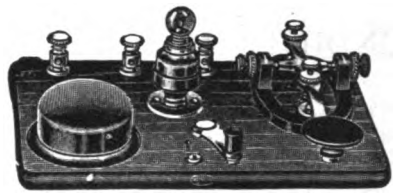
Weighs 4 lbs. packed.
Price does not include postage.

MESCO COMBINATION PRACTICE SET

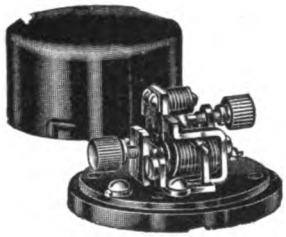
For Learning the Morse and Continental Visual and Audible Codes

This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord $4.86
Weighs 4 lbs. packed.
Price does not include postage.



MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires made to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a baronet joint.

List No.		Price
55	Mesco Radio Buzzer	$2.86

We carry a large and complete line of Standard Wireless Material recognized by experts as such with competent experienced wireless attendants in charge

Send for the New Edition of Our Catalog K28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarms Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Manhattan Electrical Supply Co., Inc.

NEW YORK: 17 Park Place BRANCHES: 110 W. 42nd St., 127 W. 125th St.
CHICAGO: 114 S. Wells St. ST. LOUIS: 1106 Pine St. San Francisco Office: 604 Mission St.

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45th STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for.....years at $1.50 per year (Canada, $1.75; foreign, $2.00). Please let this start with the..... (Date of issue) issue. I enclose $....., and according to your special offer send me copy of book checked off.

Name .....

Street .....

City .....

State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS Check off title desired here		
1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google

SCIENCE NOTES

The Pratt and Whitney Co. has been producing gauge blocks which are tested for accuracy to one millionth of an inch. There are two things to be tried, one is the flatness of the face and the other is the thickness of the block and parallelism of the faces. A plate of glass placed on the surface will show interference bands of color. If the band is curved it indicates an error in the block of one half a wave length of the light employed if its curvature is equal to its own width. If the green ray of the mercury vapor lamp is used the wave length would be .0000215 inch; as it is a simple matter to read to one-tenth the width of the band, the reading will disclose the error of one-millionth of an inch. To test the parallelism of the faces two blocks are placed close together and the plate rests on both. Regularity of the lines indicates identity of the blocks. The method is due to W. E. Hoke of St. Louis.

Attention is being given to the use of pulverized coal, and in the United States 12 million tons are pulverized per annum. In reheating steel in a furnace having an output of 168 tons per day there was a saving of 2% owing to the fact that with pulverized fuel the steel scaled very little. The reason is that the air is kept down to a much lower percentage than is possible with full size coal. One ton of steel can be melted with one-fifth of a ton of fuel. In the electric furnace the efficiency is 35%, in the producer gas furnace 48%, with pulverized fuel 55%. Fine grinding is essential and the coal after it is pulverized must be dried.

Where wood beams are to be bolted together in Sweden a corrugated washer is being used. It is 1/16th inch thick and the corrugations are 9/32nd inch deep. It is placed between the surfaces and the pieces are drawn together by a bolt with flat outside washers. The grip is given by the corrugated washer which imbeds itself in the wood under the pressure. No knots must come in the way; if present they must be removed. The joint is made twice as strong by this simple arrangement.

In France steel belts working on magnetic pulleys have been tried. The wheels are magnetized by helicoidal coils of wire. One-inch width of belt will transmit as high as 800 horsepower. They can be speeded up to 18,000 feet per minute. They are the subject of a French patent.



TWO STEP AMPLIFIER

TYPE TRIODE-B

This amplifier is a compact unit of the resonance low frequency type, and provides a maximum of amplification.

Its compactness, simplicity and efficiency render it an attractive investment to the progressive radio experimenter. The design of this instrument is such that it will not "squeal," "roar," "fry," or "howl."

IMMEDIATE DELIVERY

Particulars and price on application.

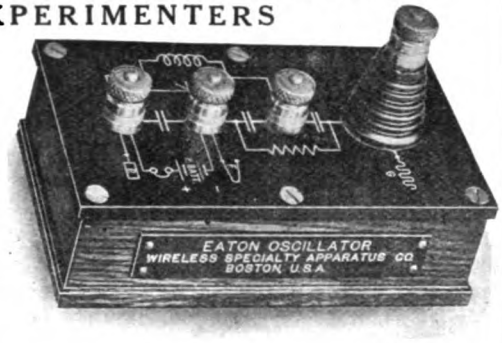
THE EATON OSCILLATOR

FOR EXPERIMENTERS

Designed to transform receiving circuits to receive arc and other undamped signals.

This instrument used in conjunction with a loose coupler or equivalent tuning inductance, a vacuum tube, and a single variable condenser, constitutes a complete system for receiving undamped signals. It requires no adjustments of any kind and yet will oscillate over a wave length range of 200 to 25,000 meters.

The simplest and cheapest way of receiving undamped signals.



PRICE $14.90. Immediate Delivery.

WIRELESS SPECIALTY APPARATUS COMPANY

Engineers, Designers, Manufacturers BOSTON, MASS., U. S. A.

Special For This Month

New type Variable Condenser. Low high frequency resistance. Mounted in seamless satin finish nickeled case. Bureau Standards scale. Furnished with calibrated curve, thus making excellent wave-meter when used in conjunction with our calibrated inductance units..... $10.00
Same condenser, unmounted, for panel use..... 7.00
Copper foil, mica dielectric Stopping Condenser 1.50
Navy Type copper plated Leyden Jars for your Transmitting Set, .002 mf. 8.00

Send for descriptive literature on latest type Receiving Cabinets, calibrated inductance units in both Litz and solid wire, parts, etc.

THE COLIN B. KENNEDY COMPANY

Special Radio and Electrical Apparatus

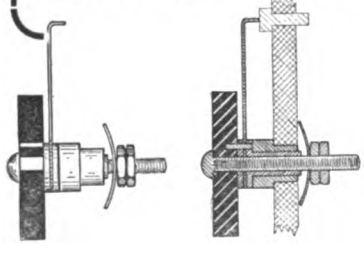
140 SECOND STREET—Phone Kearny 5980 SAN FRANCISCO, CAL.

WILCOX PANEL SWITCH

"The Best"

1½ In. Radius	Postpaid Price
Complete Switch, polished brass finish	50c
Complete Switch, nickel plated finish	60c
Knob, turned and polished	25c
Switch points, brass finish	2c
Switch points, nickel plated finish	4c







VARIOMETER PARTS

Turned from hardwood. Set as shown consisting of stator (two parts), rotor and form for winding coils .....Postpaid $2.50

Size of stator 5½" sq.
Other sizes made to order.

SET NO. TWO contains all parts for the variometer including the above and knob, scale, pointer, shaft, binding posts, wire and instructions for assembly.....Postpaid $5.00

The Wilcox Laboratories
Lansing Dept. D Michigan

Digitized by Google

SCIENCE NOTES

It is estimated that in Germany during 1918 95 million pounds of paper yarns were made, yet it is not believed that a substitute for cotton is even in sight. Home grown fibres for cloth are believed to have been largely a bluff. To make paper yarn narrow bands of paper were twisted in a machine at the rate of 5,000 to 6,000 turns were minute, and were treated with a special glue made water proof with formaldehyde. Such yarns stood twenty-four hours immersion in water. The yarn was available as a jute substitute for bags and the like. The writer remembers a time when paper twine was in somewhat limited use in this country.

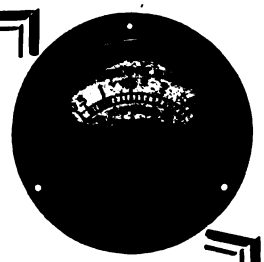
The purification of the water of the Thames is being accomplished with considerable success by chlorination. A quantity of 0.44 parts of available chlorine in one million parts of the water to be purified is sufficient. This requires 13.33 lbs. of 33% bleaching powder per million gallons. Sometimes super-chlorination is employed, liquid chlorine being used to make a solution which is added in greater quantity than in the first process, and after it has reacted and done its work sulphurous acid is added to destroy the excess of chlorine.

In England some attention is being given to the possibility of using a mixture of benzol and alcohol for motors. A mixture of 75% alcohol and 25% benzol is reported as working perfectly. The production per annum in that country of benzol is 44 million gallons per annum, but it is claimed that the output could be brought up to the volume of all the gasoline now imported. A tree, the mahwa tree, is reported from the Deccan in India, whose dried flowers yield 70 gallons of 95% alcohol per ton, which is five times the yield of potatoes.

Experiments with acetylene in explosion motors have given the following results: If the gas was taken directly from a generator it was found that 2¼ lbs. of carbide went about as far as 1½ pints of gasoline. In France eight different concerns carried out experiments. The 2¼ lbs. of carbide were taken as giving one horse-power hour.

A new tap is described in a contemporary, which is provided with spiral grooves, which operate to keep the tap clear of chips. It presents the exact appearance of a threaded twist drill, and should operate extremely well in freeing itself when cutting a thread.

Special Sale of *U. S. Army* Hot-Wire Ammeters



Imagine the increase in transmitting range one of these highly efficient Roller-Smith Hot-Wire Ammeters will bring you. A sharp wave, with maximum energy on one hump under all weather conditions; rapid adjustment to various wavelengths; increase or reduction of energy to work a certain station,—these are some of the advantages that can be yours.

Regularly $13—Our Special Price $7

These Ammeters are of the flush type and were made for the U. S. Army Air Service for use on fighting planes. The Armistice brought a cancellation of airplane contracts and these Ammeters could not be used. Each has passed the exacting Government tests and is in perfect condition. They have not been removed from their original cartons and are now ready for immediate shipment.

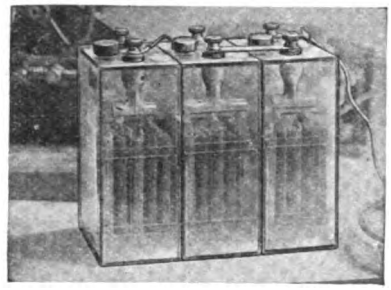
The scale reading is: 0-2.5 Amperes. Shunt giving double or triple this range, 75c extra. Only by buying a large quantity of these Ammeters are we able to sell them at almost half the usual price. This is your opportunity to procure at an unusual bargain a standard U. S. Army Air Service Hot-Wire Ammeter. The supply is limited. Better get in on this today as there is a great demand for these instruments. Remit by check or money-order. Dealers write us, we have an attractive proposition for you.

A. H. GREBE & Co. 71 Van Wyck Blvd., Richmond Hill, N. Y.

POROX STORAGE CELLS FOR

MODELS, ELECTRICAL, AND RADIO APPARATUS

Porox Storage Batteries are made up of separate 2-volt cells in PY-RA-LIN jars, designed for high efficiency, low weight, and long life. They are lighter, more powerful, last longer, and cost less than dry cells. Can be charged at home. Porox Cells are designed for the requirements of the



MODEL MAKER AND EXPERIMENTER

2 volts, 10 amp.-hrs., 3 x 1¾ x 4¼ ins. 3.75
2 volts, 15 amp.-hrs., 3 x 2⅜ x 4½ ins. 4.60
2 volts, 16 amp.-hrs., 3 x 1¾ x 6 ins... 4.60
2 volts, 25 amp.-hrs., 3 x 2⅜ x 6 ins... 5.30

Any number of cells put together for any required voltage. Batteries are also furnished in oak cases for ignition and lighting.

ALBERT MULLER,
8758 Queens Boulevard,
JAMAICA, LONG ISLAND, N. Y.

NOW 35cts EACH

MODEL LIBRARY SERIES

1. The Study of Electricity for Beginners.
2. Dry Batteries, How to Make Them.
3. Electrical Circuits and Diagrams, Part I.
4. Electric Bells, Annunciators and Alarms.
5. Modern Primary Batteries.
6. Experimenting with Induction Coils.
7. Electric Gas Igniting Apparatus.
8. Small Accumulators, How to Make and Use.
9. Model Steam Engine Design.
10. Practical Electrics.
11. Inventions, How to Protect and Sell Them.
12. Woodwork Joints, How to Make and Use.
13. The Fireman's Guide to the Care of Boilers.
14. The Slide Valve Simply Explained.
15. The Magneto Telephone.
16. The Corliss Engine and its Management.
17. Making Wireless Outfits.
18. Wireless Telephone Construction.
19. The Wimshurst Machine, How to Make It.
20. Simple Experiments in Static Electricity.
21. Small Electrical Measuring Instruments.
22. Electrical Circuits and Diagrams, Part 2.
23. Induction Coils, How to Make Them.
24. Model Vaudeville Theatres.
25. Alternating Currents, Simply Explained.
26. How to Build a 20 foot Bi-plane Glider.
27. A B C of the Steam Engine.
28. Simple Soldering, Hard and Soft.
29. Telegraphy for Beginners.
30. Low Voltage Lighting with Storage Batteries.
33. House Wiring for Electric Light.
34. Magnets and Magnetism.
36. Small Windmills and How to Make Them.
37. Collin's Wireless Plans, Part I.
38. Collin's Wireless Plans, Part 2.

In paper covers, Price 35c each post paid.

SPON & CHAMBERLAIN
Publishers of Technical Books
120-122 Liberty Street : : New York

DO YOU KNOW

the latest developments in radio? Circuits, vacuum tubes, loops, ground antennas, amplifiers, transmitters? We can furnish the information you desire, on any phase of radio communication. Three questions for one dollar.

CAPITAL RADIO LABORATORIES
Brookland Washington, D. C.

INEXPENSIVE BOOKS FOR THE EVERYDAY PRACTICAL ELECTRICIAN

Wiring a House

By Herbert Pratt. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules; in fact, just the information you need. Directions apply equally to a shop. Fourth edition. Price, 35 cents

Electric Bells

By M. B. Sleeper. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated. Price, 60 cents

NORMAN W. HENLEY PUBLISHING CO.
Dept. EE 2 West 45th Street, New York

Digitized by Google

SCIENCE NOTES

Mr. W. R. Gregg of the Weather Bureau Service from the records of past years has investigated the weather conditions on the trans-Atlantic air routes. The best western-bound routes he finds to be these three: 1. Scotland, Iceland, Greenland, Labrador. 2. Portugal, West Indies. 3. Africa near Cape Verde, Brazil. For east-bound flights the two already successfully taken he considers the best. Consulting records he found that May might average 11 favorable days for the Newfoundland-Portugal route, and 12 such days for the Newfoundland-Ireland route. For the return over the same routes only 2 good days could be looked for. In June, the good days were about half as many. In July, 1906, there were 28 good days—in July, 1907, there were only 4. He considers that in the present state of the art favorable weather is essential, and that the western journey conditions are seldom favorable. He finds little difference between summer and winter conditions.

A reinforced concrete ferry boat recently met with an accident in launching at a shipyard in India, when it fell six feet, and had a number of holes made in it as it struck the surface beneath. The sides were three inches thick. The holes were patched up and the boat was found to be as good as ever. Recently an ocean-going concrete ship went ashore but was got off and proceeded on her journey apparently uninjured.

In France sources of helium have been found in some of the thermal springs. The gas from Maizieres contains 5% to 6%—that from Sautenay as much as 10% and Bourbon Lancy 2%. The latter is about the maximum found in natural gas in this country. It is believed that the Norton process will greatly reduce the cost of manufacture compared with the Linde and Claude processes.

Metallic glucinum alloyed with 1% to 5% of aluminum is said to be superior in many respects to pure aluminum, being of better mechanical properties and also lighter. Glucinum is found as a constitutent of the mineral beryl, which in its precious variety is the emerald.

Selenium is stated to be a better vulcanizer for india rubber than sulphur. The operation takes more time, about twice as long; 0.3% to 0.5% of nitrophenol is used as an accelerator. Selenium is found in some quantity in the Argentine Republic.

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS

Official Organ: American Radio Relay League

Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work, all A. R. R. L. News, Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER

Regular price $1.50 per year, 15 cents per copy. Introductory rate: 9 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

Enclosed find $1; please enter my trial subscription to QST for 9 months.

Name_____

Address_____

"B" (storage) BATTERIES

(INEXPENSIVE—DURABLE—EFFICIENT)

These batteries are a modification of the well-known "Marcuson" Potential Batteries, which have been the standard for over ten years.

E. MARCUSON

70 CORTLANDT ST. NEW YORK, N. Y.

"ASK ANYONE WHO HAS USED IT."

SAID DENVER, COL., to VALLEY STREAM, L.I.

One of our most enthusiastic customers communicates by wireless from his home in Denver to a friend on Long Island. He uses a Brandes Headset—after exhaustive tests and comparisons. (Name on Request.)

BRANDES WIRELESS HEADSET



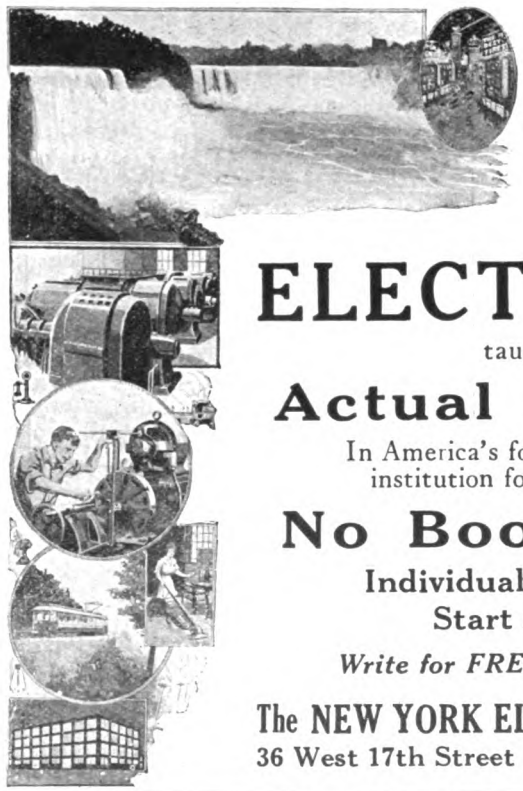
"Superior", 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. 32 Union Square, Room 822 New York Catalogue M

WIRELESS RECEIVER SPECIALISTS



Learn By Doing

Every phase of all branches of

ELECTRICITY

taught by

Actual Practice

In America's foremost and oldest institution for trade training.

No Books Used

Individual Instruction.
Start Any Day

Write for FREE 64-page catalog

The NEW YORK ELECTRICAL SCHOOL

36 West 17th Street New York City

Be sure and Read the Announcement of Everyday Engineering Series of Informative Hand Books on Pages 156-157.

Digitized by Google



NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4 H. P., 110 volts, induction, full load start - - $24.50
1/2 H. P., 110-220 volts, induction, full load start - $38.50
1/2 H. P., 110-220 volts, repulsion, for compressor $46.50
1 H. P., 110-220 volts, repulsion, with sliding base - - $67.50
2 H. P., 110-220 volts, repulsion, sliding base $108.50
3 H. P., 110-220 volts, repulsion, sliding base $124.50
5 H. P., 110-220 volts, repulsion, sliding base $164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

6 volts, 10 amp. $16.50
15 volts, 10 amp. $21.00
40 volts, 6 amp. $24.50
110 v, 2½ amp. $24.50
40 volts, 12 amp. $38.50
110 volts, 5 amp. $38.50
40 volts, 25 amp. $58.50
110 volts, 10 amp. $58.50
Moving Picture Arc Generator $85.00

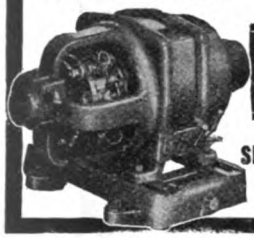
Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 R.P.M., complete with base and pulley.

½ H. P. - $42.50
1 H. P. - $59.50
2 H. P. - $72.50
3 H. P. - $84.50
5 H. P. - $102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only - $36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt. 24 volts, without switchboard $40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard $68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard - $75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard - $85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard - $85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard $110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard $125.00

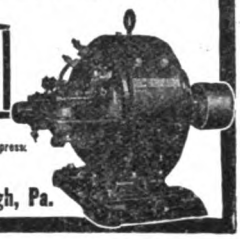
WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL 1/4 H.P. 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $19.75 EACH Reg. Value $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURER DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

Genuine Armstrong Stocks and Dies



Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.

Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.

Send direct to us if your dealer cannot supply you.

Descriptive Catalog on Request

The Armstrong Manufacturing Co
701 Knowlton Steet Bridgeport, Conn.



PREVENT WASTE
Put the Grease
where it is Needed

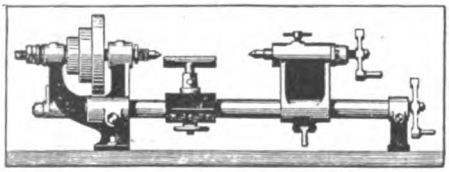
THE BRIDGEPORT
Center Thread Grease Cup

This cup will squirt more grease than any cup of the same size made.
Equip your machine, auto or boat with this new type of grease cup, one that does not leak, that cannot be cross-threaded and that forces the grease to the bearing points.
The cleanest Grease Cup made.

Send for Circular and Price List

THE GARRISON COMPANY
348 George St. Bridgeport, Conn.

THE EXPERIMENTER'S SHOP



SHOP TOOLS *and* EQUIPMENT
Rough and machined castings for 6" lathe
DESIGNS FOR MODEL BOATS
Drawings of famous ML-80 British Destroyer
Send stamp for catalog
HUHN MFG. CO., 582 Elm St., ARLINGTON, N. J.

Protect Good Tools

Keep them safe from knocks, bangs, rust—yet handy and all together. The New Utility Chest illustrated is for garage and home use, for machinists, tool makers, masons, carpenters, repairmen, etc.

19 Styles and Sizes

Write for Catalog. Prices and name of nearest dealer. Ask about "Satisfaction or Money - Back" Guarantee. If no dealer near you, write for special offer.

UNION TOOL CHEST CO., Inc.
34 Mill Street Rochester, N. Y.

UNION TOOL CHESTS



To Fasten Linoleum on Iron Stairs

USE a mixture of glue, isinglass and dextrin, which dissolved in water and heated, is given an admixture of turpentine. The strips pasted down must be weighted with boards and brick on top until the adhesive agent has hardened. Soak three parts of glue in 8 parts water, and ½ part hydrochloric acid and ¾ part zinc vitrol and let this mixture boil several hours. Coat the floor and the back of the linoleum with this, press the linoleum down uniformly and firmly and weight it for some time.

Cutlers' Cement for Fixing Knife and Fork Blade Tangs In Handles

Formula 1

	Pounds
Rosin	4
Beeswax	1
Plaster of Paris or Brickdust	1

Formula 2

Pitch	5
Wood Ashes	1
Tallow	1

Formula 3

Resin, 12; sulphur flowers, 3; iron filings, 5. Melt together, fill the handle with hot, and insert the instrument.

Formula 4

Rosin	600
Sulphur	150
Iron Filings	250

Pour the mixture, hot, into the opening of the heated handle and shove in the knife likewise heated.

In the siege of Paris in 1871, 64 balloons left the city to effect communication with the outer world. Of these 57 were successful; they carried 155 people, 9 tons of dispatches and 3 million letters. To get answers back homing pigeons were carried on the balloons, and these brought back letters photographed down to miniature size. A solitary battle of German and French balloons is chronicled; the Frenchman won.

A curious and interesting feature of the electric iron ore reducing furnace has been recently noted. The electric heat operates to reduce the iron at the expense of the carbon of the fuel; as the electricity supplies the heat no air is blown in as is the case with the blast furnace, so that only one-eighth the volume of gases is generated as in the blast furnace, but owing to the small amount of nitrogen and carbonic acid gas, one or both, the calorific value of the escaping gas is three times as great as that from the blast furnace.

Digitized by Google

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.
Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop then.

PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs. Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School
YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

MAIL PLANES TO USE NEW FUEL

A NEW fuel consisting of alcohol, benzol and ether is announced to take the place of the high-grade gasoline, which has been used widely in the Air Mail Service. The new fuel has been tested under adverse weather conditions. As soon as the new carburetors required for the proper use of this fuel are attached, all airplanes operating on mail service routes will use the new fuel.

The advantage of this fuel lies in the resulting cleanliness of the engine, reduction in the cost of upkeep and its burning cooler than gasoline, which to some extent overcomes the objection to a high-compression engine when operating at low altitudes. It requires about four-fifths as much of the new fuel for any given distance and altitude. This gives greater flying radius to the planes and will enable the De Haviland Fours to cover the New York to Cleveland route, a distance of 430 miles, in a non-stop flight. It will minimize the probability of forced landings by keeping the spark plugs and the engine cylinders clear of carbon deposits and accumulations of oil. The super-compression Liberty and Hispano-Suiza engines used in aerial mail planes are particularly well suited to this alcoholic fuel.

PRACTICAL MUFFLER FOR AIRCRAFT ENGINES

After a series of tests, a new muffler has been adopted by the French Air Service which is claimed to not only result in complete silencing but which also prevents any fire or exhaust flame reaching the air which gives it marked advantages for dirigible balloons as well as airplanes.

This consists of a long tube with a closed end forming a continuation of the exhaust manifold. The tube has a series of hollow longitudinal fins of triangular section about its exterior. Communication is made from the interior to these fins by a series of holes about ⅛ in. in diameter. Along each face of the fins a large number of louvres are cut through which the exhaust gases reach the air. By reason of the fins and the shape of the louvres a partial vacuum is formed, and a continuous suction is created along the length of each fin.

The tests made by the French gave an increase in power when using this apparatus compared with a straight manifold outlet. The action of the wind and the escape of the gases cause a continuous whistling sound, but on the demonstrating plane with two engines, each of nearly 300 h.p., it was possible to carry on a conversation as easily as in a room.

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6063-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____

Present Occupation_____

Street and No._____

City_____ State_____

USE HB BALL BEARING ELECTRIC MOTORS

Lower Power Cost — Better Power

HB Ball Bearing Electric Motors save greatly on operating cost. More economical, more dependable, better in every way than gas engine. Trouble proof, built for heavy duty. Ideal power for factory, garage and machine shop.

$20 brings you any HB Motor. Balance on easy terms.



Sizes 1 to 15 h.p. A Size to meet Your Needs.

Service Department gladly advises on your requirements. Get their advice—FREE—simply state what machinery you wish to run and type of current available. Your power system planned for best results at least cost. Pin this ad to your letterhead and mail today for full information. Ask also about HB Battery Chargers, Generators, etc.

HOBART BROTHERS COMPANY
Box EE115 Troy, Ohio
Successful Manufacturers Since 1893

Digitized by Google

Stop Forgetting — Memory the Basis of All Knowledge

The Key To Success

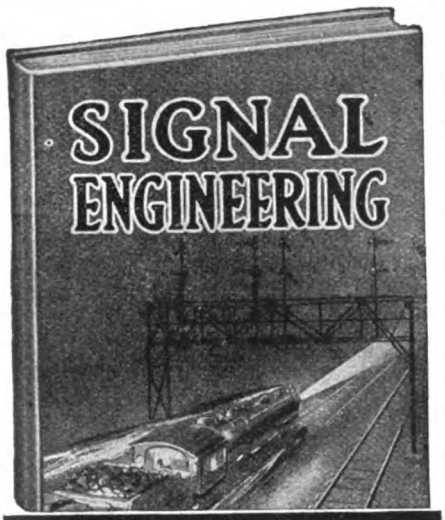
The secret of business and social success is the ability to remember. I can make your mind an infallible classified index from which you can **instantly** select thoughts, facts, figures, names, faces. Enables you to **concentrate, develop self-control, overcome bashfulness, think on your feet, address an audience.** Easy. Simple. The result of 20 years' experience developing memories of thousands.



Prof. Henry Dickson, Principal

Write Today for free booklet "How to Remember" and **Copyrighted Memory Test**, also how to obtain my FREE book, "How To Speak In Public."

Dickson School of Memory, 1740 Hearst Bldg., Chicago, Ill.



You Can Get Big Money

There are two things that count most in any position—the work itself and the pay envelope at the end of the month. Signal Engineering is one of the most interesting professions in the world—besides that it pays BIG MONEY. **Now**—at the approach of a new era of railroad expansion—big jobs are waiting the men **who claim them first.** Never before—perhaps never again will the chances for rapid advancement be so great. The railroads are willing—eager to pay large salaries to men trained Signalmen. They need such men and are looking for **you.** Before others come, with high ambitions—determined to seize the best—**you** start to fit yourself for a position of independence and financial ease.

FREE BOOK
on Signal Engineering

Our Free Book on Signal Engineering (Fully Illustrated) tells you all about this wonderful profession—still uncrowded—presenting golden opportunities. Master our course at home in your spare time. Jobs waiting—looking for you. $2,500 a year is an ordinary salary for a Signal Engineer.

SEND COUPON! Put your name and address on the coupon, or a letter or post card **Now** and get the FREE BOOK on Signal Engineering. It will tell you how you can get the training you need in order to become a Signal Engineer. You are under no obligation in sending for Free Book. Do it **Now.**

DEPARTMENT OF SIGNALING
Department 1778
1810 Wilson Ave., Ravenswood Station, Chicago

Department of Signaling
Dept. 1778, 1810 Wilson Ave., Ravenswood Station, Chicago
Gentlemen:—Please send me absolutely free and prepaid your big new book on Signal Engineering. Also full particulars about your great special free outfit offer. It is distinctly understood that I assume no obligations of any kind.

Name .....
Address .....
Age ..... *Occupation* .....

Earn $35 to $100 a Week
BECOME A PROFESSIONAL PHOTOGRAPHER



Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:



MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free
Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog.
N. Y. INSTITUTE of PHOTOGRAPHY
Dept. 20 141 W. 36th St., N. Y. City

SPEED LATHE $7.00 Complete
Swing 7 inches 24 inch Metal Bed



Head has a three speed cone. Spindle has No. 1 Morse taper shank centers. ⅝ hole through spindle. 3½ inch face plate is furnished. Tail stock has a screw feed spindle and No. 1 Morse taper center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. 30 inch bed if wanted.
M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

MODEL AND MACHINE WORK
INVENTIONS DEVELOPED
SMALL DEVICES MANUFACTURED
Before you make a decision, communicate with
KAUFMAN MACHINE CO.
1357 Odell Street New York

MR. INVENTOR! Let us assist you with that idea that you can't just work out, or let us construct a model of your patent. We develop ideas, and are experts in MODEL and EXPERIMENTAL work. We specialize in designing and building special LABOR SAVING MACHINES. Or perhaps your device is ready for manufacturing. If so, get in touch with us. It would be to our mutual advantages.
ELK MFG. CO., INC.
1926A Broadway, New York



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.
MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.



PHONOGRAPHS $4 FROM MANUFACTURER UP
24 different styles, $4.00 up; $150 style, $40; $100 style, $35; $50 style, $13.
Plays Victor, Columbia and Edison Records.
Mail Orders Filled Promptly. Send for Catalogue.
DEALERS WHOLESALE.
LUCKY 13 PRODUCTS CO.,
3 East 12th St., New York.

KLEAN-E-Z SUSPENSORY
FORM FITTING FOR ALL MEN
LINEN (MESH)
$1.50



PRICES
Balbriggan $1.25
Linen (Mesh) $1.50
Fine Glove Silk $2.00
Heavy Silk (Mesh) $2.50
ALL SIZES
One Extra Sack
At your dealers or sent postpaid on receipt of price.
A. R. CHISHOLM CO., New York, N. Y.
Suite 597 1328 BROADWAY

VARIOUS WAYS OF STARTING GAS ENGINES

NOT every motorist, as he presses his starter pedal, stops to think how fortunate he is that the process of cranking the engine has been so simplified for him. Electric starters were developed because the old method of cranking by hand proved intolerable to the exacting American motorist. Yet hand starting of an automobile engine is child's play compared with the methods necessary to start some other types of engines.

When a tractioner starts the engine of his big "caterpillar" he fits a bar into one of a series of sockets in the big engine's flywheel and rocks the engine up to compression. No one can spin these monsters. Rarely can they be rocked past compression, but are usually rocked backward up to compression, where, thanks to generous priming and a hot spark, they usually fire and the wielder of the pinch-bar pulls it from the starting socket hastily. The petty officer on a submarine chaser relies upon compressed air to start his unwieldy engines. He, too, must prime copiously and has the additional responsibility of an auxiliary engine, hand-started to pump the air.

A most picturesque but risky method is ordinarily used to start airplane engines. The mechanic shouts: "Switch off; throttle open!" as he approaches the propeller, and is answered in kind by the pilot at the switch. He then spins the great wooden blades by hand to charge the cylinders with gas. Having worked up a warm perspiration, even on the frostiest mornings, he springs clear and shouts: "Contact; throttle closed!" The pilot indicates that he has closed the switch and throttle by repeating the signal and the mechanic once more approaches the propeller. Gingerly this time, however. With a single swift motion he twirls the blade through an arc of more than 90 degrees and steps quickly away from and to the side of the murderous whirling stick.

A 150-horsepower engine is about all any but a Samson can swing. When heavier engines, culminating in the 400-horsepower Liberty, made their appearance, new methods had to be devised. At first the blade was pulled over compression by running past it, giving it a smart pull in passing. Sometimes two men with hands joined were required. As many as three were required to do the preliminary "winding up" or charging. More than one unwary mechanic was sucked into the whirling circle of the propeller and injured before a safer method was devised.

Owing to their added weight and complication, electric starters were not considered seriously except on seaplanes

Digitized by Google

during the war, but an ingenious auxiliary magneto was contrived. This magneto was operated by a small hand crank in the pilot's cockpit. The engine was charged in the usual way, whereupon the mechanic stepped back, shouting "Clear!" The pilot then closed the switch and turned the crank on the starting magneto a few times. The charged cylinders received a shower of white-hot sparks and failure to start promptly was exceptional. With the Dixie starting magneto a lone pilot might start a 400-horsepower engine unaided, a thing previously impossible, unless the engine is equipped with an electric starter or an air starting mechanism.

The same company has greatly simplified the starting of big truck and tractor engines by applying the impulse starter to the regular Dixie magneto. This contrivance comprises a driving coupling, which, with the engine idle, is not solid as the conventional coupling is. When the engine is cranked, the first motion merely compresses a spring, with the magneto stationary. At a predetermined point a trigger is tripped and the magneto twirls around at high speed for part of a revolution. This naturally generates a hot starting spark, even though the engine may be turned over very slowly. Two or three snaps of this sort generally suffice to start the engine and no auxiliary battery or coil is required. When it starts running, centrifugal force acting on weights locks the coupling solid, so that it drives as the ordinary rigid coupling and there can be no change in time of sparking.

Blueing Iron or Steel.—Dissolve 4½ ozs. of hyposulphite of soda in a quart of water and 1⅛ ozs. of acetate of lead in another quart of water. Mix the two solutions and heat until boiling. Immerse the clean and bright pieces of iron or steel to be colored. The metal becomes a rich blue color which is more lasting than the color produced by tempering.

Bronzing Cast Iron.—Clean the metal and polish it smooth. Apply a coat of sweet or olive oil evenly over the surface and heat the iron, taking care that the temperature does not rise sufficiently to burn the oil. Just as the oil is about to decompose, the cast iron will absorb oxygen and this forms a brown oxide skin that is so hard it will admit of a high polish, giving the iron surface the appearance of bronze.

When testing the air pressure in your tires do not overlook the spares. It will be very aggravating if you have a puncture and find your spare is not inflated. Besides, it is much easier to inflate it with an air hose connected to a power compressor in the garage than with a hand pump on the road.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 903 Bogue Bldg., Indianapolis

DRAFTING

Inventions and Ideas Developed!

Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE

A. G. HAGSTROM

116 Nassau St. New York City
Telephone Beekman 4589

Telegraph Pictures

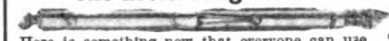
BY ELECTRICITY

A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.

L. J. LEISHMAN CO. Dept. L, Ogden, Utah



The Everlasting Iron Match



Here is something new that everyone can use. This lighter embodies two constant necessities, pencil at one end and lighter at the other end. Its convenience appeals to all—no larger than an ordinary pencil or fountain pen—finished in highly polished nickel—just the thing you and your friends have been longing for—an ideal birthday present—price within reach of all—handy to operate—saves matches, time, money and temper. Order one for each member of the family. Their practicability was thoroughly demonstrated by their unlimited use by our soldiers abroad during the world war. Sent anywhere for one dollar,—don't hesitate, enclose one dollar and enjoy the wonderful benefits of this lighter.

Paragon Electric Co. 329 E. 5th Street, N. Y.

NATIONAL TRADE DENTAL SCHOOL

506 S. Wabash Ave., CHICAGO, ILL.

LEARN MECHANICAL DENTISTRY—DEMAND UNLIMITED

Earn $1200 to $4000 yearly in mechanical dentistry. A big and growing demand everywhere for mechanical dentists—like a gold mine, unexplored. Attend this school any time of the day or evening; be taught individually and learn by actual practice, without book study. Our System, the most complete in the world, is used exclusively in this school. We are constantly called upon to fill high-salaried positions. Why not qualify for one? Be fair to yourself; find out more about exceptional opportunity we offer. Visit the school or write for booklet B.

Mathematics Made Easy



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.

Dept. U, L. J. LEISHMAN CO., Ogden, Utah

Small Investors Wanted



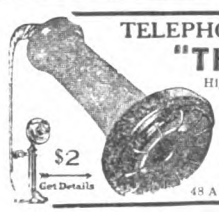
To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.

For full particulars address

Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.

TELEPHONE SUFFERERS!

"THERAPHONE"



$2 Get Details

High Power Osteopathic Receiver Earpiece is tuned to the ear. It can't confuse nor fatigue. Absorbs shocks, improves the Hearing and conserves time. For Busy, Deaf, Nervous, Privacy and Noises. Guaranteed to suit. (Check or C. O. D. $2.00 Export $2.20). No Agents.

The Evolution Phone Co., Inc.
48 A Greenwich Ave., New York



Boys! Win an Auto-Wheel

In This Interesting Contest

TO THE BOY who can think of the most interesting uses for the popular AUTO-WHEEL COASTER, for earning money and for play, we shall award one of our large models absolutely FREE. It's a mighty generous prize for a few minutes' work. And the following eleven valuable prizes will be given to those sending in the next best uses:

Camera, Camping Tent, Mess Kit, Scout Knife, Fleetwing Steering Sled, Compass, Ingersoll Watch, Axe, Bank, Electric Flashlight, Poncho.

INFORMATION ABOUT CONTEST

1. Any boy or girl not over 15 years may compete.
2. Contest will be judged by three men well-known in the Boy Scout organization.
3. Write to Business Idea Dept., Buffalo Sled Co., for pamphlet explaining the Contest, and colored catalog telling all about Auto-Wheel.
4. At end of letter write names of three Coaster Wagon Dealers in your town. If any carry the Auto-Wheel put an "x" after name.

YOU CAN DO IT. Any live boy who knows how to get fun and earn money out of a good, strong coaster wagon, has a fine chance to get the Auto-Wheel as a prize. **Here are a few pointers:** The Auto-Wheel is a wagon for work or play. It's built for strength and speed. Has roller bearings, steel axles and tires, body white ash, maple gear.

If there's an Auto-Wheel dealer near you, he'll gladly let you see the Auto-Wheel Coaster in his store, and he'll give you some good ideas for your letter. CONTEST CLOSES NOVEMBER 30, 1919.

HERE'S YOUR CHANCE. GET BUSY.

Buffalo Sled Co.,
159 Schenck Street,
N. Tonawanda, N. Y.

In Canada:
Preston,
Ontario.





SPECIAL KON-VER-TER SLIDE RULE

The original KON-VER-TER slide rule has over 8,000 graduations and over 1,800 letters and figures, will handle anything in Arithmetic, Algebra, Geometry or Trigonometry. Is 5.4 inches in diameter and in use all over the world, is much simpler to operate than others of similar construction. Eventually you will get the KON-VER-TER—get it now and save money. Plain Utility rules $1.00; Special De Luxe white ivory celluloid $2.50. Leatherette case 50c extra.

J. C. HAMILTON & CO.,
Dept. F-7 Water St., Boston, U.S.A.

Learn in Spare Time to be a CIVIL ENGINEER

Earn $1500 to $5000 Yearly



Here's your big chance to become a full-fledged Civil Engineer! With this set of books you can fit yourself to make big money, in the greatest outdoor profession on earth! Offer fully explained in coupon. Good only within boundaries of the U. S. and Canada.

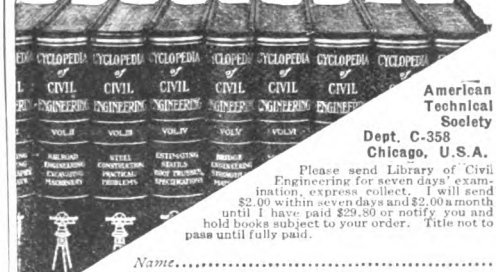
Great Books Shipped FREE

50c a Week if you keep them after 7 days' FREE TRIAL.

Nine big leather-bound volumes; 3900 pages, 7x10 inches; 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying; highway construction; railway engineering; earth work; specifications; estimating contracts; bridge engineering; masonry; reinforced concrete; water supply; sewers and drains; water power equipment; irrigation engineering—etc., etc. Written in simple language—every point made plain.

Consulting Service Free

A $12 Consulting Membership solves your difficult problems for a whole year. FREE with the set of books. SEND NO MONEY—JUST THE COUPON!



American Technical Society
Dept. C-358
Chicago, U.S.A.

Please send Library of Civil Engineering for seven days' examination, express collect. I will send $2.00 within seven days and $2.00 a month until I have paid $29.80 or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....

Address.....

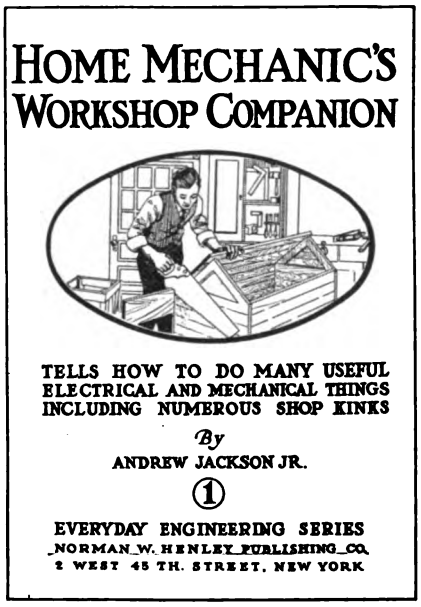
Reference.....

Digitized by Google

The Everyday Engineering Series of Handbooks

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man—the Mechanic and the Radio Experimenter

ILLUSTRATED BY SPECIAL DRAWINGS AND PHOTOGRAPHS



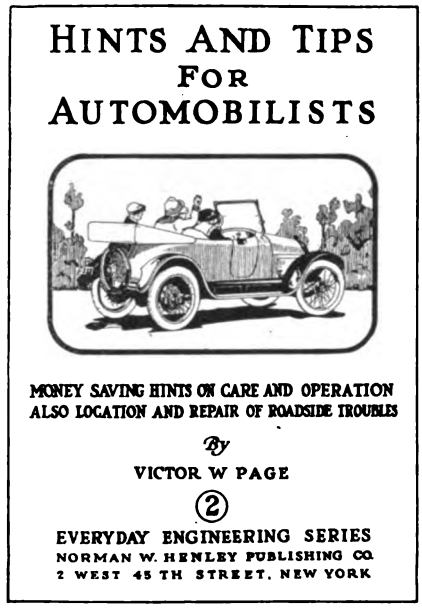
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.

This treatise includes a compilation of useful suggestions that cannot fail to interest the handy man and while it is not intended for mechanical experts or scientists, it will prove to be a veritable store of information for any one who desires to rig up a small shop where odd jobs can be carried on.

The subject matter is divided in five parts as follows:

Chapter 1—The Home Workshop and Its Equipment. Chapter 2—Special Tools and Shop Expedients. Chapter 3—Useful Home Appliances. Chapter 4—How to Do Things Electrical. Chapter 5—Helpful Recipes and Formulae. The illustrations are especially clear and all suggestions are further amplified or made more easy of comprehension by hundreds of thumb nail sketches made by the author.

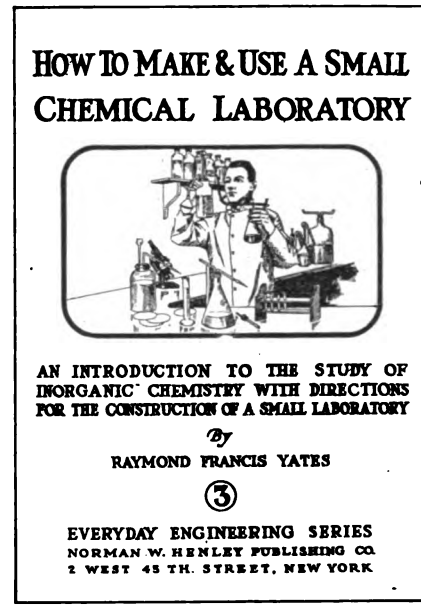


For the Automobile Owner or Driver

This volume is replete with interesting facts compiled by an expert from a mass of information furnished by the Service Departments of leading automobile makers on operation, upkeep, lubrication, location of troubles and simple repairs of automobile parts. The instructions given are concise and to the point and no information that will help in the everyday operation of automobiles is omitted.

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints and a brief simple exposition of location and remedy of roadside troubles apt to occur under ordinary operating conditions.

To permit of logical presentation, the subject matter is divided into four chapters. Chapter 1 deals with the Control and Operation; Chapter 2, Systematic Inspection and Lubrication; Chapter 3, Power Plant and Auxiliary Groups; Chapter 4, Automobile Care and Maintenance Suggestions.



For the Student Chemist and Experimenter

The treatise covers all of the essentials of elementary chemistry. The law of definite proportions, solutions, crystalloids, colloids, electrolysis, etc., are explained. The second part of the book is devoted to chemical and electro-chemical experiments. Only those experiments that will tend to broaden the readers' knowledge of chemistry in general have been chosen.

The third part of the book describes the construction and fitting out of the home chemical laboratory. Directions for the construction of the many simple pieces of chemical apparatus are given. A chemical balance, ring stand, electric furnace, etc., are described in detail, with working drawings. The manipulation of chemical glassware is also treated.

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.

A SPECIAL OFFER TO READERS OF

ANY ONE OF THE ABOVE VALUABLE WORKS WILL BE

FILL OUT THE SPECIAL BLANK ON PAGE 148 OF THIS ISSUE. CHECK OFF THE TITLE DESIRED AND MAIL TO

Digitized by Google

Should be in Every Experimenter's Library

All of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest

RADIO BOOKS CONTAIN MANY WIRING DIAGRAMS

SOLDERING & BRAZING



A USEFUL HANDBOOK FOR MECHANICS

By
RAYMOND FRANCIS YATES

④

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work —something that he may heretofore have forgotten.

Hard soldering, for some reason, is not generally known. Hard soldering, however, is very important and must be used in all cases where soft solder does not possess sufficient strength. Hard soldering and solders are thoroughly covered in the book. Nothing has been omitted that will enable the mechanic to apply hard solder successfully.

Brazing and all of its important ramifications are treated in detail. Brazing, like hard soldering, is a process little understood by many mechanics. The book "Soldering and Brazing" is divided in five parts as follows: Part I—Soft Soldering; Part II—Hard Soldering; Part III—Brazing; Part IV—Heating Devices; Part V—Soldering Notes.

RADIO HOOK-UPS



A BOOK OF THE MOST ADVANCED CIRCUITS OF RECEIVERS, AMPLIFIERS AND TRANSMITTERS FOR DAMPED AND UNDAMPED WAVE WORK:

By
M. B. SLEEPER

⑤

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuits for tuning coils, loose couplers, capacity coupling, variometers and other equipment for receiving long and short damped and undamped waves; damped, undamped and modulated wave transmitters using buzzers, spark coils, transformers, arcs and vacuum tubes, telephone transmitters, laboratory oscillators, vacuum tube characteristic measuring circuits, wave-meters, and audibility meters—in short, diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details. Spaces are also provided for notes on the results obtained with each diagram. This arrangement, coupled with the skillful selection of the circuits, makes Radio Hook-ups an essential to every radio experimenter or operator.

DESIGN DATA FOR RADIO TRANSMITTERS & RECEIVERS



SIMPLE METHODS FOR DESIGNING APPARATUS ACCORDING TO ADVANCED AND APPROVED PRACTICE

By
M B SLEEPER

⑥

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH STREET, NEW YORK

For the Radio Engineer and Student

Far from being a collection of formulas, Design Data takes up in proper sequence the problems encountered in planning all types of receiving sets for short, medium, and long wave work, and spark coil, transformer, and vacuum tube transmitters operating on 200 meters.

Where formulas are difficult, tables have been worked out so that values can be found without the use of mathematics. The few formulas given are so simple that any school boy can solve them. The subjects are so arranged that, having decided upon the type of receiver or transmitter to be built, the reader can locate immediately the problems and solutions required.

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION

EVERYDAY ENGINEERING MAGAZINE, 2 W. 45th ST., NEW YORK CITY

Digitized by Google



DUCK'S No. 13 264 Pages
Electrical and Wireless **Catalog**
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

THE NEED OF THE HOUR
Wireless Operators for the Merchant Marine.
Start your boy in a profession worth while
Complete Beginners, Wireless Set, $15.00
Comprising Loose-Coupler, 2,000 Meters; pair 2,000-Ohm Phones, Fixed Condenser, Galena Detector, and instructions book; these are separate instruments and *Guaranteed;* the best value on the market to-day. Note:—We do special Cabinet and Metal Work for Engineering Students; correspondence invited.
Radio Equipment Company
1525 North Fawn Street - Philadelphia

Electrical Engineering
Bachelor of Science Degree in 3 Years
A large, experienced faculty of 45 experts will train you thoroughly and quickly at this progressive school. An efficient combining of theory and practice in laboratory, class room and shop.
Institute of Electrotechnics
Junior and Senior divisions. Entrance requirements 8th grade and 2 years high school respectively. Trains intensively for early graduation as an electrotechnician. **Also one year practical electricity and one year Mechanical and Electrical Drafting Courses.** No special educational requirements. Fall term now open. "Earn While You Learn" if you like; one-half day school, one-half day paid employment. R. O. T. C. (optional) athletics. Students' Fraternity House. Room and board at cost. Glee Club.
NEW TERM OPENS JAN. 2
Write **now** for latest bulletins and booklet "Succeed Through Electricity." Mention age, education and course of interest.
SCHOOL OF ENGINEERING OF MILWAUKEE
127-37 3 Broadway Milwaukee, Wis.

OPPORTUNITIES FOR INVENTORS

THE equipment section of the engineering division of the Army Air Service is anxious that inventors and designers in general and members of the society in particular lend their efforts in the development of certain airplane equipment. Among these is a gasoline tank which will withstand a salvo of 30 calibre ammunition, equally mixed, service, tracer, incendiary and armor-piercing bullets, fired at a range of 30 yards and at the most vulnerable angle. There are to be ten consecutive tests on as many tanks without fire occurring. The weight should be kept as low as possible, the maximum limit being 75 per cent more than standard tank weights.

Air bag floats, landing skids, etc., to prevent the machine from capsizing when landing in water and to keep it afloat after landing constitute other problems requiring solution. Such devices should present as small an amount of wind resistance surface as possible, should be light and readily detachable.

A mobile independent cranking device, mounted on a small motor truck, is also desired. The device should be electrically driven and arranged so that it can be backed up to the front end of an airplane and attached to the propeller by a flexible arm. The electric motor is then used to crank the engine, causing it to begin firing. When the engine picks up, the device should be automatically thrown out of connection with the propeller.

A gasoline supply gauge is needed which will be responsive, serviceable and accurate to the last half gallon. It may be mounted on the tank, although it should preferably be mounted on the dashboard. This gauge must, of course, register under conditions existing in airplane service where the center line of the tank changes rapidly from one to another of practically every plane that it is possible to assume, and is frequently 180 deg. out of its normal position for comparatively short intervals of time.

At present portable canvas hangars for field service do not weather winds or rainstorms well enough to be practical, and they are generally too small. The improved hangar should be capable of housing four De Haviland planes with working space. They should provide for the necessary electric lighting and small machine work.



THE MIDGET SLIDE RULE will solve any problem in addition, subtraction, multiplication, division and proportion. A Log-Log Scale gives any root or power of any number. Gives Logarithms, Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six decimals. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book 16 pages, 12 illustrations, is sent with each rule. Diameter 4 in. Made in two models: Metal (white coated steel), **$1.00**; White Celluloid **$1.25**. Leather Case **50c** extra. Your money back if you are not satisfied. Send for Catalogue of Slide Rules. **Gilson Slide Rule Co., Niles, Mich.**

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a ypung man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

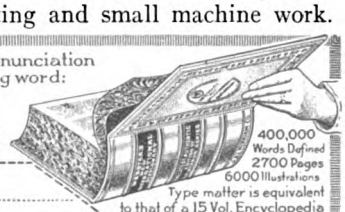
TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6062-B, SCRANTON, PA.
Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER
☐ Electrician
☐ Electric Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Heavy Electric Traction
☐ Electrical Draftsman
☐ Electric Machine Designer
☐ Telegraph Expert
☐ Practical Telephony
☐ MECHANICAL ENGINEER
☐ Mechanical Draftsman
☐ Ship Draftsman
☐ Machine Shop Practice
☐ Toolmaker
☐ Gas Engineer
☐ CIVIL ENGINEER
☐ Surveying and Mapping
☐ MINE FOREM'N OR ENG'R
☐ ARCHITECT
☐ Architectural Draftsman
☐ PLUMBING AND HEATING
☐ Sheet Metal Worker
☐ Navigator
☐ CHEMICAL ENGINEER
☐ SALESMANSHIP
☐ ADVERTISING MAN
☐ Window Trimmer
☐ Show Card Writer
☐ Outdoor Sign Painter
☐ RAILROADER
☐ ILLUSTRATOR
☐ DESIGNER
☐ BUSINESS MANAGEMENT
☐ Private Secretary
☐ BOOKKEEPER
☐ Stenographer and Typist
☐ Cert. Pub. Accountant
☐ Traffic Management
☐ Commercial Law
☐ GOOD ENGLISH
☐ STATIONARY ENGINEER
☐ CIVIL SERVICE
☐ Railway Mail Clerk
☐ Textile Overseer or Supt.
☐ AGRICULTURE ☐ Spanish
☐ Poultry Raising ☐ French
☐ Automobiles ☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

WEBSTER'S NEW INTERNATIONAL DICTIONARY
G. & C. MERRIAM CO., SPRINGFIELD, MASS. REGULAR AND INDIA-PAPER EDITIONS
Whatever your question;—be it the pronunciation of Bolsheviki; the spelling of a puzzling word: the location of Zeebrugge, the meaning of blighty, ace, tank, etc., this Supreme Authority contains an accurate, final answer.



Please send me specimen pages and FREE POCKET MAPS Per E. Eng.
NAME_____
ADDRESS_____

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
Owen Building, Washington, D. C.

Free Book on PATENTS

Write today for a Free Copy of "How to Obtain a Patent." Contains valuable information and advice to investors. Tells how to secure Patents. Send model or sketch of your invention for opinion of its patentable nature—Free. (20 years experience.) Talbert & Talbert, 4368 Talbert Bldg., Washington, D. C.

How to obtain a Patent



The Book for Inventors and Manufacturers
SIXTH EDITION
By return mail FREE.
Write LACEY & LACEY
Dept. S. Washington, D.C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

PATENTS
Record your invention. Upon request, I will forward to you my form "Fixing the Essential Dates of Invention", together with full information concerning its use and the best way to secure patent protection. Prompt, personal efficient service, by an attorney-at-law, having over twelve years experience in patent matters. Reasonable pre-war charges.
B. P. FISHBURNE,
321 McGill Bldg., Washington, D. C.

Making Your Invention a Financial Success
How best to dispose of your invention
What kind of agreements to make for your protection
What kind of offers and mistakes to avoid
Valuable tables and other data
By M. G. Delaney, an experienced Inventor, in
The Inventor's Manual of Valuable Information
$1.00 per copy, postpaid
Additional information and Table of Contents will be mailed on request.
G. E. Perry Co., Publishers, 1328 Broadway, New York

96-Page Book Catalogue Sent Free

WE have just issued a 96-page Book Catalogue listing about 2,500 of the most recent Scientific and Technical books. This is all the more welcome by reason of the fact that both the publishing and importing of books have been very much upset by the war, and many books can only be supplied with great difficulty. This catalogue will be sent to any address in the world, free on request.

Manuscripts Considered for Publication

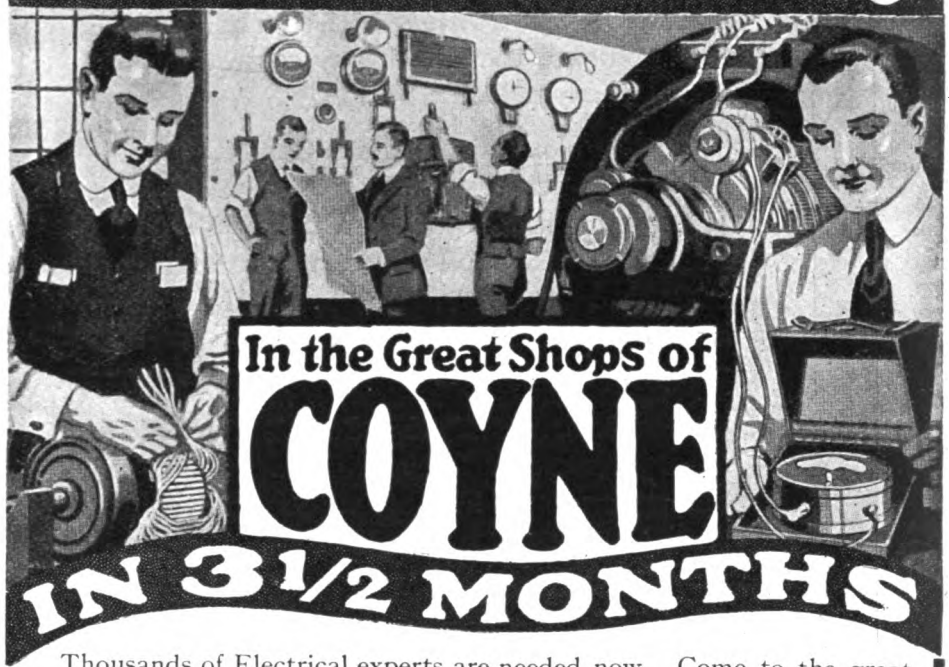
The Book Publishing Department of the SCIENTIFIC AMERICAN will be glad to give an examination of any manuscript of Scientific or Technical nature. Submit as much of matter as possible, including illustrative material. There was never a better field for books of this nature than at the present time.

Scientific-American Publishing Company
Woolworth Building 235 Broadway, New York

EVERYDAY ENGINEERING MAGAZINE SERVICE DEP'T

Readers of this magazine are invited to write for any information relative to procurement of supplies, technical or practical books, tools, etc., they need to carry on their experimental work most efficiently. Our Service Dept. manager can render you valuable aid if you avail yourself of this privilege. All inquiries will receive prompt attention, and to insure proper service, the writer should enclose a stamped self-addressed envelope or postal card.

Learn Electricity



Thousands of Electrical experts are needed now. Come to the great shops of Coyne and let us train you quickly by our sure practical way backed by 20 years of success.

Earn $125 to $300 a Month

Come to Coyne where experts train you on the actual apparatus. You work on everything from the simple bell to the mighty Generators, Electrical Locomotives and Power Plants. Everything to make you a Master Electrician. Look at the picture taken from life in our shops.

Become an Expert in 3½ Months

No need of taking 1 to 4 years to become an expert. We have proved this in thousands of cases. We are the only school teaching by the original Coyne methods, which means no books, no classes—all practical training.

Earn Your Way. Our employment department will help every ambitious man to earn a part of his expenses—without charge.

Bennett W. Cooke, Director
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 16X 39-51 E. Illinois Street
CHICAGO, ILL.

LEARN DRAFTING

The country needs hundreds of skilled Draftsmen in all lines at big salaries.

Coyne is the only school in the country that gives you the advantages of big shops full of construction and machinery. This makes our drafting courses practical, just like the job you'll have when you graduate. You can't get this in any other school.

WE TEACH ELECTRICITY, DRAFTING, MOTION PICTURE OPERATING AND PLUMBING

We teach all these professions in such a thorough, practical way that when you finish you can step right into a position of responsibility and big pay.

Fill out the coupon *now* and send it for our big free book of information. It tells what others are doing and have done, what you can do.

Be sure and check the trade that interests you. Do it now.

COYNE SCHOOLS
Dept. 16X 39-51 E. Illinois St.
CHICAGO, ILL.

Please send me that big free book. I'm interested in:

☐Electricity ☐Drafting ☐Plumbing
Motion Picture Operating

Name .....

Address .....

Digitized by Google

Camel CIGARETTES

CAMELS supply in a lavish way everything you ever hoped to find in cigarettes! Camels are so unique in quality, in flavor, in full-bodied-mildness, in refreshing satisfaction that you should not delay your pleasure an instant! *Try Camels out to the limit*—then compare them with any cigarette in the world at any price!

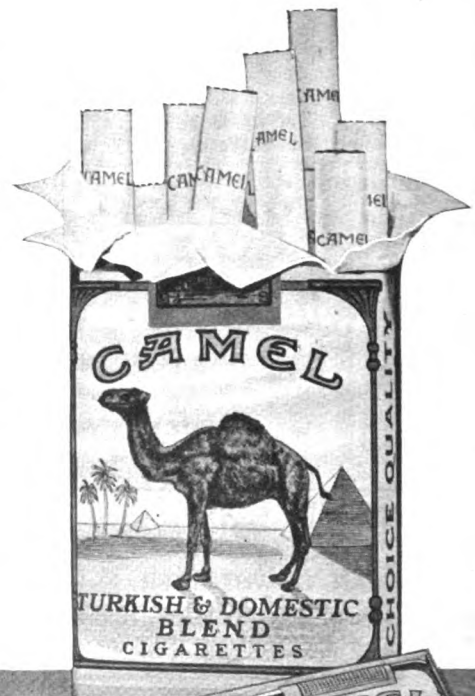
Quality alone would make Camels distinctive. But, behind quality is Camels expert blend of choice Turkish and choice Domestic tobaccos. *This blend is a revelation to cigarette smokers!* You'll prefer it to either kind of tobacco smoked straight, it is so mellow, so delightful.

Prove conclusively that Camels are made to meet your most exacting demands; that you can smoke them liberally without tiring your taste! And, know yourself that Camels leave no unpleasant cigaretty aftertaste or unpleasant cigaretty odor!

Quality will make you keen for Camels!

R. J. REYNOLDS TOBACCO COMPANY
Winston Salem, N. C.

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.





Digitized by Google

CONTENTS

Vol. 8 JANUARY, 1920 No. 4

WHAT TO DO WHEN THE MOTOR STALLS..... 169
By Victor W. Pagé

THE R. O. G. BIPLANE FLIER..... 177
By H. C. Ellis

FITTING AND ADJUSTING CONNECTING ROD BEARINGS..... 179
By Victor W. Pagé

THE CHEMISTRY AND PHYSICS OF FLAME..... 182
By W. C. Dumas

THE CONSTRUCTION OF THERMO-ELECTRIC CELLS..... 183
By Roy Franklin Heath

THE EVERYDAY MOTORIST..... 184

A CARDBOARD MODEL PASSENGER STEAMER... 186
By Edward Beal

WELL-DESIGNED CRYSTAL DETECTORS..... 187

AVIATION BRIEFS..... 188

THE HYDRODROME, A NEW GLIDING CRAFT CAPABLE OF A SPEED OF 70 MILES PER HOUR..... 189

A FILE REST AND INDEX HEAD FOR A SMALL LATHE..... 190

A WELL-DESIGNED LATHE TOOL HOLDER..... 192

A BORING BAR HOLDER..... 192
By S. C. Swansen

A NEW SCREW-CUTTING LATHE..... 193

A TWO-PASSENGER SEAPLANE..... 195
By C. E. Muller

THE AMERICAN SOCIETY OF EXPERIMENTAL ENGINEERS..... 197

A MODEL OF THE NORTH DAKOTA..... 198
By Charles A. Myers

SOME NEW DEVELOPMENTS IN AVIATION..... 202

ELECTRICAL PROGRESS DIGEST..... 206

EVERYDAY ENGINEERING SHOP CONTEST..... 208

CALIBRATING PRESSURE GAUGES..... 209
By E. Bachman

A MECHANICAL VACUUM CLEANER..... 210
By E. H. Williams

MAGIC IN METAL CASTING..... 212
By Raymond Francis Yates

EVERYDAY SCIENCE..... 215
By Prof. T. O'Conor Sloane

A MODERN ELECTRICALLY PROPELLED DREADNAUGHT BATTLESHIP..... 217
By Brewster Beach

A RADIO TELEPHONE TRANSMITTER..... 222
By M. B. Sleeper

INTERESTING DECISIONS REGARDING TRADE MARKS..... 225

MANUFACTURING DETAILS OF THE B BATTERY.. 226

A LIGHT-WEIGHT AIRPLANE TRANSMITTER... 228

NOTES ON RADIO ANTENNAS..... 229

THE RADIO DEPARTMENT..... 230

THE WORK OF THE BUREAU OF STANDARDS.... 232

NEW DETECTOR AND AMPLIFIER UNITS..... 235

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street **New York City**

Editor RAYMOND F. YATES
Managing Editor VICTOR W. PAGÉ
Radio Editor M. B. SLEEPER

Contributing Editor
PROF. T. O'CONOR SLOANE

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Offices
E. M. CLEMENT, 320 Wayne Avenue, East Oakland, Calif.
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Southern Representative
H. W. ENGLISH, P. O. Box 339, Birmingham, Ala.

Published Monthly by
EVERYDAY MECHANICS COMPANY, INC.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $1.50 a year in the United States and possessions. Canada, $1.75; Foreign, $2.00 a year.

Copyright, 1920, by Everyday Mechancis Co., Inc.

Are You a Good Workman?

MEN who dabble around in home shops like to be called mechanics. Some of them are deserving of the name and some are not. A man may possess a considerable knowledge of mechanics and yet his fingers may be so awkward that he is not able to manipulate tools successfully. The writer knows of a young man who has an extensive knowledge of chemistry, and yet has been accused of being a blacksmith in the manipulation of chemical apparatus. Genius does not always find its way to the finger tips.

MANY men are natural born mechanics; some have to be trained; some simply cannot be trained. Probably one of the greatest essentials of a good workman is accuracy. Without accuracy, nothing of value can be accomplished. The eye, no matter how "mechanical," can never replace measuring instruments. That is one great mistake made by many young men training themselves for a mechanical career; they rely too much upon their eyesight, and are quite forgetful of its natural limitations. Moral: If the eyesight were accurate enough, there would never have been a need for scales and micrometers.

THE scond great essential of a good workman is neatness. True, some mechanics can produce wonderful work in an untidy shop, but there are few. Neatness always helps to develop accuracy as well as efficiency. A poorly kept shop is often an indication of the nature of the work that the shop produces. Moral: A neat shop is a great aid to good work.

THE third essential of the good workman is patience. Patience is a virtue of the good mechanic. The man in a hurry cannot hope to be a mechanic worthy of the name. Of all faults of beginners that of impatience is the greatest and the most difficult to overcome. It is the cautious, calculating mechanic who accomplishes noteworthy work. Many men picture what they are working at in their mind's eye, and they are so anxious and impatient to see the finished article that they rush through the job of producing it in the most haphazard way. A set of castings received one day must be machined and assembled the next—or the same day. Moral: A good mechanic is patient.

RAYMOND FRANCIS YATES,
Editor.

Digitized by Google

FREDERICK J. DRAKE & CO.
1014 Michigan Avenue
Chicago, Ill.

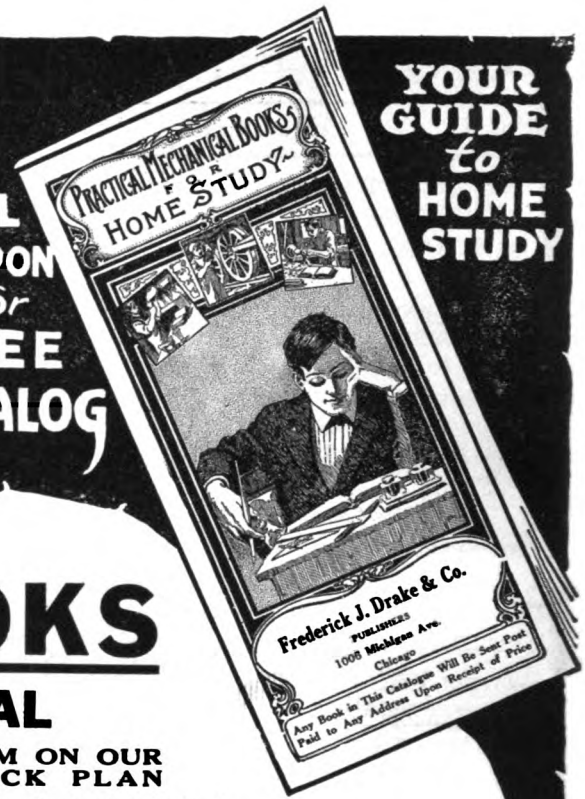
GENTLEMEN:—Please send me free, postage paid, your illustrated catalogue which lists and describes over 100 Practical Mechanical Books for Home Study.

My name is.....

and my address.....

.....

MAIL COUPON for FREE CATALOG



YOUR GUIDE to HOME STUDY

FOR HOME STUDY

DRAKE'S BOOKS

PRACTICAL MECHANICAL

They Raise Pay Checks

ORDER THEM ON OUR MONEY-BACK PLAN

Drake's practical mechanical books for home study are written in non-technical language by acknowledged experts,—for electricians, engineers, telephone men, machinists, automobilists, carpenters, plumbers, sign and card writers, in fact for all mechanics and skilled workers. Drake books are as easy to read as the pay checks which they so often increase. Order direct from this page. Send the price of any book listed below—we'll send the books postpaid—you keep them five days—if not entirely satisfied return the books and your money will be refunded in full.

Marine and Stationary Engineers

Complete Examination and Answers

By **Swingle, M. E.**, 400 pages, 212 illustrations. Pocket size, leatherette.....**$2.00**

Concise, thoroughly reliable. Covers every phase of marine and stationary engineering. Gives latest and most improved answers for steam boiler engineer examinations.

Brookes' Automobile Handbook

1918 edition revised by **Manly.** 700 pages, illustrated, 400 pages on new equipment. Pocket size, leatherette.....**$2.00**

Contains practical information for owners, operators and automobile mechanics. Covers both gasoline and electric automobiles. Gives remedies for road troubles—motor, carburetor, ignition, battery, clutch, and starting troubles, charts, tables and diagrams. Sure to save time and money.

Practical Gas and Oil Engine Handbook

Special references to Diesel and other new oil engines. By **Brookes.** 270 pages, 81 illustrations. Pocket size, cloth..**$1.00**

Full of practical information on the care, maintenance and repairs of gas and oil engines. An invaluable guide on construction, operation and maintenance of stationary, portable and marine gas and oil engines. Fuel and fuel consumption carefully analyzed in non-technical terms.

Operators' Wireless Telegraph and Telephone Handbook. 1918 Edition

By **Laughter.** 210 pages, with illustrations of wireless installation on U. S. war ships and ocean liners, cloth.....**$1.00**

A complete treatise of this important subject, from construction and "tuning up" to study of rules of naval stations with all codes, abbreviations, etc. Written so any layman can understand.

Steam Boilers, Their Construction, Care and Operation, With Questions and Answers

By **Swingle, M. E.** 305 pages, 170 illustrations. Pocket size, leatherette.....**$2.00**

Goes carefully into boiler construction, setting, and operation. Has valuable tables and rules for calculating boiler strength, heating surface and horsepower. Evaporation tests explained. All modern boiler room equipment given particular attention.

Wooden Boat and Ship Building

A Practical Course by **Richard M. Van Gaasbeek.** Bound in cloth, profusely illustrated.....**$1.50**

A complete instruction book for carpenters. Every step of boat and wooden shipbuilding clearly explained. Right up to date. Just off the press.

Electric Motors, Direct and Alternating

By **Prof. Moreton, B.S., E.E.,** written in non-technical language, 250 pages, illustrated, pocket size, limp cloth....**$1.00**

Covers the principles, construction and maintenance of all types of electric motors—treats fully of troubles, their cause, location and how to remedy them.

Automobile Starting and Lighting

By **Manly.** 302 pages, fully illustrated. Pocket size, cloth..**$1.00**

Changes in starting and lighting brought down to 1918. Every device on the market covered in manner easy to understand. Invaluable for repair man and car owner.

Oxy-Acetylene Welding and Cutting

Electric and Thermit Welding. By **Manly.** 215 pages, illustrated. Cloth.....**$1.00**

Fully describes annealing, tempering, hardening, heat treatment, and restoration of steel, and gives much practical information on the uses and characteristics of various metals. Hand forging and welding included.

Twentieth Century Machine Shop Practice

By **Brookes.** 650 pages, 400 illustrations. Cloth.....**$2.00**

The latest and most practical book for machinists, engineers and others interested in 100% efficient use of machinery and machine tools in a modern machine shop. Covers everything from simple Arithmetic to applied mechanics.

The Ford Motor Car and Truck and Tractor Attachments

By **Manly.** 256 pages, fully illustrated. Pocket size, limp cloth.....**$1.00**

Gives complete instructions on every feature of Ford cars, with particular attention to adjustments and repairs, upkeep and care. Truck and tractor attachments fully covered.

The books listed above are only a few of the many in our catalogue, which you will receive promptly after filling out and mailing us the coupon above. For quick action order direct from this page—cross name of each book wanted and send in with the price quoted. We prepay postage and send books on our money-back plan.

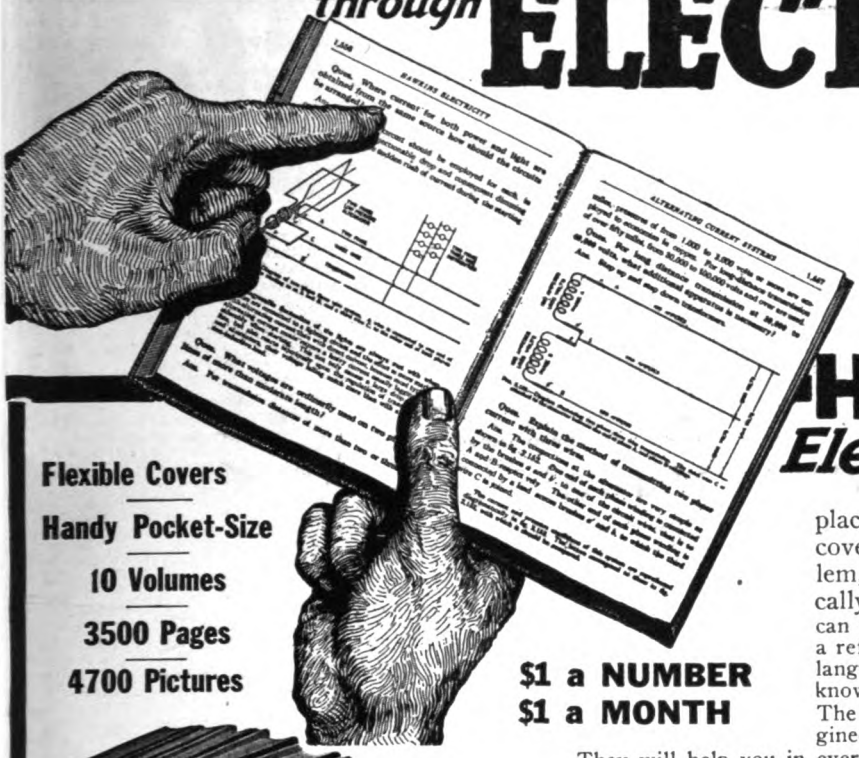
At All Bookstores, or

FREDERICK J. DRAKE & CO.
PUBLISHERS
1014 Michigan Ave. CHICAGO

Order direct from this page —
ON OUR MONEY-BACK PLAN.

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS Electrical Guides

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know **instantly**

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each), Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....
Occupation .....
Employed by .....
Residence .....
Reference .....Jan.

SEND NO MONEY - USE THE COUPON

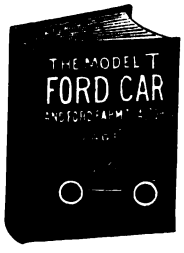
Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

EVERY PRACTICAL MAN'S LIBRARY SHOULD CONTAIN THE FOLLOWING BOOKS

The Modern Gasoline Automobile, Its Design, Construction, Operation.

By Victor W. Pagé, M.S.A.E. This is the most complete, practical and up-to-date treatise on gasoline automobiles and their component parts ever published. In the new revised and enlarged 1920 edition, all phases of automobile construction, operation and maintenance are fully and completely described and in language anyone can understand. 1,000 pages. 1,000 illustrations. **Price, $4.00**



The Model T Ford Car, Its Construction, Operation and Repair, Including the Fordson Farm Tractor. The F. A. Starting and Lighting System and the Worm Drive 1-Ton Truck.

By Victor W. Pagé. This is the most complete and practical instruction book ever published on the Ford car and the Fordson Tractor. Illustrated by specially made drawings and photographs. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and operating principle made clear to everyone. 425 pages, 150 illustrations. **Price, $1.50**

How to Run an Automobile.

By Victor W. Pagé. This treatise gives concise instructions for starting and running all makes of gasoline automobiles, how to care for them, and give distinctive features of control. Describes every step for shifting gears, controlling engines. 178 pages. 72 illustrations. **Price, $1.25**

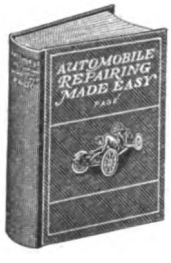
Automobile Welding with the Oxy-Acetylene Flame.

By M. Keith Dunham. Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understanable by everyone. 167 pages, fully illustrated. **Price, $1.50**

Abrasives and Abrasive Wheels.

By Fred B. Jacobs. A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantage in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering. 340 pages, 200 illustrations. This is an indispensable book for every machinist. **Price, $3.00**

Automobile Repairing Made Easy.



By Victor W. Pagé. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism. Written in a thorough but non-technical manner. This book also contains Special Instructions on Electric Starting, Lighting and Ignition Systems. Tire Repairing and Rebuilding. Autogenous Welding, Brazing and Soldering, Heat Treatment of Steel, Latest Timing Practice, Eight and Twelve-Cylinder Motors, etc., etc. You will never "Get Stuck" on a Job if you own this book. 1,000 specially made engravings on 500 plates. 1,056 pages (5½x8). 11 folding plates. **Price, $4.00**

Machine Shop Arithmetic.

By Colvin-Cheney. Most popular book for shop men. Shows how all shop problems are worked out and "why." Includes change gears for cutting any threads; drills, taps, shrink and force fits; metric system of measurements and threads. Used by all classes of mechanics and for instruction in Y. M. C. A. and other schools. Seventh edition. 131 pages. **Price 60c**

Steel: Its Selection, Annealing, Hardening and Tempering.

By E. R. Markham. This work was formerly known as "The American Steel Worker," but on the publication of the new, revised edition, the publishers deemed it advisable to change its title to a more suitable one. This is the standard work on hardening, tempering, and annealing steel of all kinds. This book tells how to select, and how to work, temper, harden, and anneal steel for everything on earth. It is the standard book on selecting, hardening, and tempering all grades of steel. 400 pages. Very fully illustrated. Fourth edition. **Price, $3.00**

Saw Filing and Management of Saws.

By Robert Grimshaw. A practical hand book on filing, gumming, swaging, hammering and the brazing of band saws, the speed, work, and power to run circular saws, etc. A handy book for those who have charge of saws, or for those mechanics who do their own filing, as it deals with the proper shape and pitches of saw teeth of all kinds and gives many useful hints and rules for gumming, setting, and filing, and is a practical aid to those who use saws for any purpose. Third edition, revised and enlarged. Illustrated. **Price, $1.25**

Brazing and Soldering.

By James F. Hobart. The only book that shows you just how to handle any job of brazing or soldering that comes along; it tells you what mixture to use, how to make a furnace if you need one. Full of valuable kinks. The fifth edition of this book has just been published, and to it much new matter and a large number of tested formulas for all kinds of solders and fluxes have been added. **Price, 35c**

Drafting of Cams.

By Louis Rouillion. The laying out of cams is a serious problem unless you know how to go at it right. This puts you on the right road for practically any kind of cam you are likely to run up against. Third edition. **Price, 35c**

House Wiring.

By Thomas W. Poppe. Describing and illustrating up-to-date methods of installing electric light wiring. Intended for the electrician, helper and apprentice. Contains just the information needed for successful wiring of a building. 125 pages, fully illustrated, flexible cloth. **Price, 75c**

Electric Wiring, Diagrams and Switchboards.

By Newton Harrison, with additions by Thomas Poppe. This is the only complete work issued showing and telling you what you should know about direct and alternating current wiring. It is a ready reference. The work is free from advanced technicalities and mathematics, arithmetic being used throughout. It is in every respect a handy, well-written, instructive, comprehensive volume on wiring for the wire-man, foreman, contractor or electrician. Second revised edition. 303 pages, 130 illustrations. Cloth. **Price, $2.00**

High Frequency Apparatus, Its Construction and Practical Application.

By Thomas Stanley Curtis. The most comprehensive and thorough work on this interesting subject ever produced. The book is essentially practical in its treatment and it constitutes an accurate record of the researches of its author over a period of several years, during which time dozens of coils were built and experimented with. 248 pages. Fully illustrated. **Price, $2.50**

The Lathe—Its Design, Construction and Operation, With Practical Examples of Lathe Work.

By Oscar E. Perrigo. A new revised edition, and the only complete American work on the subject, written by a man who knows not only how work ought to be done, but who also knows how to do it, and how to convey this knowledge to others. It is strictly up-to-date in its descriptions and illustrations. A number of difficult machining operations are described at length and illustrated. The new edition has nearly 500 pages and 350 illustrations. **Price, $3.00**

Henley's Twentieth Century Book of Recipes, Formulas and Processes.

Edited by Gardner D. Hiscox. The most valuable techno-chemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work. New edition. Cloth. **Price, $4.00**

Starting, Lighting, and Ignition Systems.



By Victor W. Pagé. A practical treatise on modern starting and ignition system practice. This practical volume has been written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. It can be understood by anyone even without electrical knowledge. Nearly 500 pages. 297 specially made engravings. New Edition. **Price, $2.50**

☞ **Any of these books sent prepaid on receipt of price. FREE—Our new 1920 Catalog of Practical Books sent free on request**

THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. **2 West 45th Street, New York**

Please mention Everyday Engineering Magazine

Digitized by Google

Everything New About Shop Work!



Examine Them Free

The sixth edition of Modern Shop Practice is now off the press. Let us send you the six volumes for seven days' free examination—not a penny in advance. See how 27 mechanical engineers, designers, and specialists in shop methods have given you the benefit of their vast experience. Read what they say about production, metallurgy, welding, tool making, tool design, die making, metal stamping, foundry work, forging, pattern making, mechanical and machine drawing, speed lathes, planers, metal drillers, grinders, milling machines, stamping machines, die presses, etc. Then after free examination, send the books back unless you are convinced they will raise your pay.

Jump Ahead

The more you know about machine shop practice, the more money you will earn. Don't depend on your hands alone to earn your pay.

Make your head work for you. Equip yourself with knowledge that designs machinery, that does the *big* work. These six massive volumes tell everything you want to know about every phase of shop work. Written in clear, non-technical language.

Only 7c a Day

These six magnificent volumes are flexibly bound in American Morocco, gold stamped. Contain 2300 pages, 2500 illustrations, photographs, drawings, explanatory diagrams, tables, etc. Up-to-date labor saving methods that big manufacturers have spent thousands of dollars to learn. Facts that you can use in your everyday work at once. Examine the books free. Then if satisfied, pay for them at rate of 7c a day.

No Money in Advance

Not a cent in advance. See the books in your own home first. Read them for seven whole days before you decide. Make no deposit—assume no obligation. If you are not more than satisfied—send them back and you won't owe a cent. If you are sure they will raise your pay—send only $2.80 within seven days and then $2 a month until the special introductory price of $19.80 has been paid. (Regular price $30.) With each set we give you Free a year's Consulting Membership in the American Technical Society. (Worth $12.) Mail coupon for the books now. Send no money.

AMERICAN TECHNICAL SOCIETY
Dept. M-351 **CHICAGO, U. S. A**

AMERICAN TECHNICAL SOCIETY
Dept. M-351, CHICAGO, U. S. A.

Please send me the six-volume set of "Modern Shop Practice" for seven days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within seven days and balance at $2 a month until $19.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine, and fully paid for. If I think I can get along without the books, I will return them at your expense after seven days.

Name.....

Address.....

Reference:.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Learn Mechanical Drafting

Earn $35 to $100 A Week

"Get into the profession of big pay and Rapid Advancement with the help of the school that has started hundreds on the Road to Success. I am ready to help you." Roy C. Claflin, President Columbia School of Drafting.



Learn at Home in Spare Time

You don't have to stop work or leave home in order to become a trained Draftsman. Through our practical Home Study Training we teach you in your own home, and enable you to qualify as a practical Draftsman.

No Previous Training Required

Owing to the comprehensive nature of our course, you need no previous training in the subject. Though you have never done any kind of drawing before, you can become a thorough Draftsman by following our instructions.

Can Learn in Short Time by Our Methods

The reason for this is that we eliminate unnecessary theoretical work and concentrate upon the PRACTICAL problems such as confront the professional Draftsman. We do not require you to spend months of your time on "preliminary" work, but start you on REAL DRAFTING at once. That is one reason why our students "make good" so readily.

Our Graduates Get to the Top

The universal success of our graduates as Professional Draftsmen, many of whom have advanced rapidly to positions of Chief Draftsmen, is evidence of the REAL VALUE of the training given by the COLUMBIA SCHOOL OF DRAFTING. Large numbers of our students have secured excellent positions even before completing their courses. We gladly cooperate with our students and graduates in securing desirable positions, which has been easy for us owing to the many demands upon us to supply our "product" for these positions.

Draftsmen Get $35 to $100 a Week

Our graduates have shown their ability to reach high salaries RAPIDLY, owing to their practical training. They secure excellent salaries AT THE START, as high as $2,000 a year. The usual pay of Draftsmen is $35 to $100 a week.

The Demand is Greater than the Supply

The demand for properly trained Draftsmen has always been greater than the supply, but this is more so today than ever before, owing to greatly increased construction and mechanical development. The Draftsman is an essential connecting link in all engineering work. This great demand is indicated by the long lists of want ads for Draftsmen in the daily papers, especially those of industrial centers.

Specialists in Mechanical Drafting

The COLUMBIA SCHOOL OF DRAFTING not only trains Draftsmen by mail but also maintains a large local institution of the highest standing. For many years it has been the leader in SPECIALIZING on the teaching of DRAFTING. This is an obvious advantage over teaching Drafting only as a side issue.

Drawing Outfit Furnished

We supply all our students with a drafting outfit for use throughout the course. There is no extra charge for this, and it becomes your personal property when the course has been paid for in full.

Book of Particulars Sent Free

If you are interested in becoming a practical Draftsman through the thorough training of the COLUMBIA SCHOOL OF DRAFTING, whereby you can enter a Profession in which your services will always be in demand, you are invited to write us for our free book of particulars, which describes our school and methods.

COLUMBIA SCHOOL OF DRAFTING
Dept. 1076—14th and T Sts.
Washington, D. C.

For your convenience you can fill out and

Mail This Coupon To-day

Columbia School of Drafting,
Dept. 1076, 14th & T Sts. N.W.,
Washington, D. C.

Without obligation to me, please send me full particulars of your practical home study training in Drafting.

Name .....

Address .....

City..... State.....

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.

Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop then. PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs. Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School

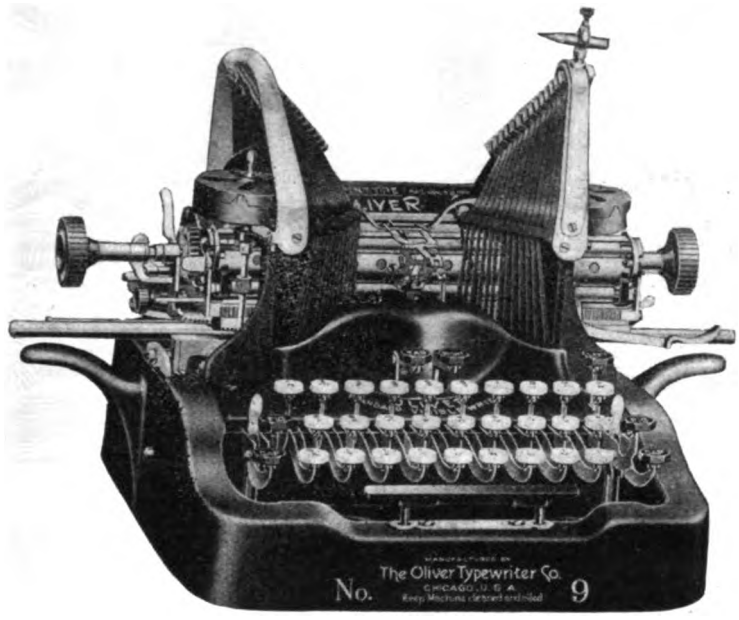
YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

FREE TRIAL

Keep It For $3.00 Per Month



Or Return It At Our Expense

The Oliver Typewriter—Was $100—Now $57

The Guarantee of a $2,000,000 Company that it Is the Identical Model

Be your own salesman and earn $43. You get the identical typewriter formerly priced $100—not a cent's alteration in value. The finest, the most expensive, the latest Oliver Model. Old methods were wasteful. Our new plan is way in advance. It is in keeping with new economic tendencies. It does away with waste. Inflated prices are doomed forever.

During the war we learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Brand New—Latest Model

Do not confuse this with offers of earlier models, rebuilt or second-hand. Note the signature of this advertisement. This is a $2,000,000 concern.

We offer new Olivers at half price because we have put typewriter selling on an efficient, scientific basis.

You can now deal direct—sell to yourself, with no one to influence you. This puts the Oliver on a merit test.

You Save $43 Now

This is the first time in history that a new standard $100 typewriter has been offered for $57. Remember, we do not offer a substitute model, cheaper nor different. But the same splendid Oliver used by the big concerns. Over 700,000 Olivers have been sold.

We ship direct from the factory to you. No money down—no red-tape. Try the Oliver Nine at our expense. If you decide to keep it, send us $3 per month. If you return it, we even refund the outgoing transportation charges. You are not placed under the slightest obligation. That's our whole plan.

We rely on your judgment. We know you don't want to pay double. And who wants a lesser typewriter? You may have an Oliver for free trial by checking the coupon below. Or you may ask for further information.

An Amazing Book

Ali the secrets of the typewriter world are revealed in our startling book entitled "The High Cost of Typewriters —The Reason and the Remedy"—sent free if you mail the coupon now. Also our catalog. Order your free-trial Oliver—or ask for further information at once.

Canadian Price, $72

THE OLIVER TYPEWRITER CO.
C-40 Oliver Typewriter Bldg., Chicago

NOTE CAREFULLY—This coupon will bring you either the Oliver Nine for free trial or further information. Check carefully which you wish. (24-02)

Mail This Coupon Now!

THE OLIVER TYPEWRITER CO.,
C-40 Oliver Typewriter Bldg., Chic

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep I will pay $57 at the rate of $3 per month. The title to remain in until fully paid for.

My shipping point is.....
This does not place me under any obligation to buy. If I choose to return Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The I Cost of Typewriters—The Reason and the Remedy," your de luxe cat and further information.

Name .....

Street Address .....

City .....State .....

Occupation or Business .....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



Face the Facts-

Training Brings Real Money

There are too many bookkeepers and clerks—not enough Expert Accountants. Training makes the difference. Only by training can you win the bigger job.

You—yourself—must decide whether tomorrow you will be a plodding bookkeeper or clerk or an independent executive. The worker market has plenty of $800 employees—but altogether too few qualified to handle the **$3,000, $5,000** and **$10,000** positions.

Why Accountancy Training Is So Valuable Today

New Income and Excess Profit taxes have brought home to literally thousands of firms the necessity of accurate records. American business is branching out in all directions—foreign and domestic—and with this tremendous expansion has come a keen appreciation of the importance of preventing waste and misdirected energies—of developing better methods of Cost Accounting. Positions are open today in every community for auditors, comptrollers, cost accountants, credit men, and public accountants at salaries ranging from $2,500 to $12,000, and even higher. Face the subject squarely. **Where men are scarcest**—there must trained experience demand highest salaries. Fit yourself for this most profitable of professions and tomorrow's success will take care of itself.

Applying the Success Formula

W. A. Thompson was once a bookkeeper—today he is Comptroller of the Allis Chalmers Mfg. Co. In less than 3 years through I. A. S. training he made the jump.

Arnold O. Link rose from Assistant Bookkeeper to Office Manager through the study of our course in Accountancy—**increasing his salary 500%.**

E. W. Brickell was a clerk when he began his I. A. S. training—today he is General Auditor of the Everwear Hosiery Company.

These stories are not the exceptions—if you will mail the coupon below for our book, "Stories of Success," you will find hundreds of similar examples. They prove, without a shadow of a doubt, that you **can** learn through the home study method—that I. A. S. trained men actually **are** holding big executive, auditing and cost positions.

Executive Positions Always Open to the Trained Accountant

Big business simply cannot get enough of men with trained accountancy experience. The accountant is executive timber. His work gives him a bird's-eye view of the whole business. The accountancy trained man dominates. No matter what your present position or education—if you have the gritty determination to make good—I. A. S. training will bridge the gap for you between youn present position and high salaried independence—training that may be secured in spare time without giving up your present work.

Study at Home Under the Guidance of Experts

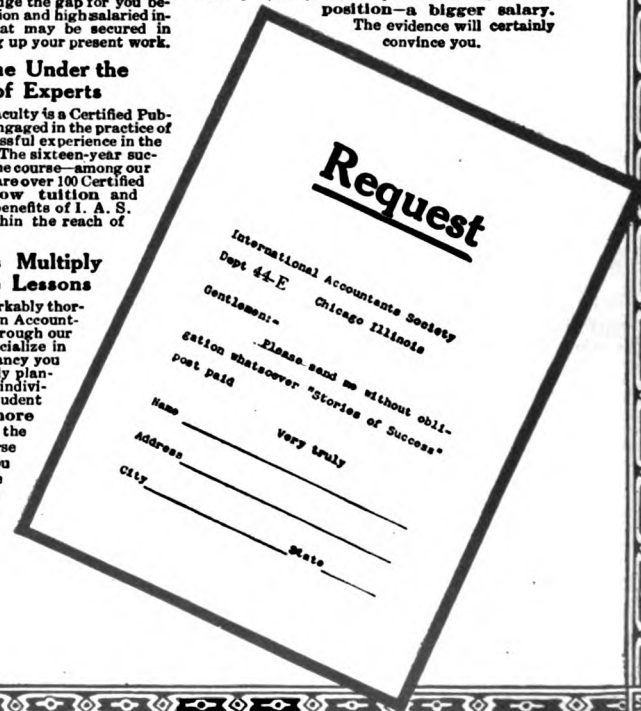
Every member of our faculty is a Certified Public Accountant actively engaged in the practice of his profession with successful experience in the teaching of Accounting. The sixteen-year successful record backs up the course—among our students and graduates are over 100 Certified Public Accountants. Low tuition and easy terms place the benefits of I. A. S. home study training within the reach of every ambitious man.

Elective Features Multiply the Value of the Lessons

In addition to a remarkably thorough practical training in Accountancy you are enabled through our elective feature to specialize in any branch of Accountancy you may prefer. Scientifically planned lessons fitted to the individual needs of each student enable you to save more than six months in the completion of your course—make it possible for you to cash in on the value of your training just that much sooner.

Two Big Books "Stories of Success" and "How to Learn Accounting"—FREE

Get these books—at once. They describe in a simple, straight-forward way the opportunities in higher accountancy today—show how hundreds of others have won better positions—tell how you, too, can fit yourself for a better position—a bigger salary. The evidence will certainly convince you.



INTERNATIONAL ACCOUNTANTS SOCIETY
a department of the Tanner-Gilman Schools Incorporated
DEPARTMENT 44-E, 2626 S. Michigan Ave., CHICAGO, ILL.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 8 JANUARY, 1920 NUMBER 4

What To Do When the Motor Stalls

A Helpful Exposition for the Man Who Operates His Own Car, Dealing With Common Automobile Power Plant Troubles and How to Locate Them

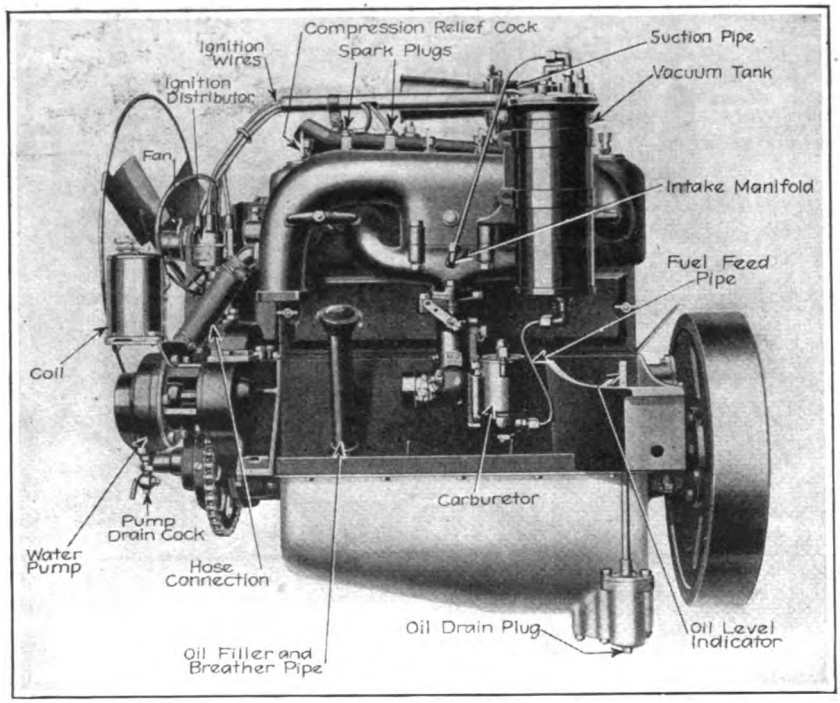
By Victor W. Pagé, M. S. A. E.

EVEN though the automobile of to-day has been perfected to a high degree, the mechanism has not been developed to the point that it is entirely free from trouble on the road, though any trouble that cannot be easily located and remedied by the average automobile operator is a rare one that is usually the direct result of neglect or abuse. Obviously, it is not possible to consider all the things that might happen to an automobile motor in a limited discussion of this character, but the common troubles that are apt to occur in everyday operation of an automobile can be touched on to some extent and suggestions given for their systematic location and cure that should be helpful to the automobilist, or to anyone interested in automotive vehicles.

The internal-combustion motor, which is the power plant of nearly all automotive apparatus, such as cars, trucks, tractors, motorcycles, motor boats and airplanes, is composed of a number of distinct groups, which in turn include distinct components. These various appliances of any group are so closely related to each other that defective action of any one may interrupt the operation of the entire power plant. Some of the auxiliary groups are more necessary than others, and the power plant will continue to operate for a time even after the failure of some important parts of some of the auxiliaries. The gasoline engine in itself is a complete mechanism, but it is evident that it cannot deliver power without some means of supplying gas to the cylinders and igniting the compressed gas charge after it has been compressed in the combustion chamber. From this, it is patent that the ignition and carburetion systems are parts of the power plant just as essential as the pistons, connecting rods, or cylinders of the motor. The failure of either the carburetor or igniting means to function properly will be immediately apparent by faulty action of the entire power plant.

To insure that the motor will continue to operate it is necessary to keep it from overheating by some form of cooling system and to supply oil to the moving parts to reduce friction. The cooling and lubrication groups are not so important as carburetion and ignition, as the engine would run for a limited period of time even should the cooling system fail or the oil supply but a defect in the cooling or oiling system would not be noticed so readily.

The careful driver will always inspect the motor mechanism before starting on a trip of any consequence, and if inspection is carefully carried out and loose parts tightened it is seldom that irregular operation will be found due to actual breakage of any of the components of the mechanism. Depreciation of mechanism due to natural causes matures slowly, and sufficient warning is always given when parts begin to wear, so satisfactory repairs may be promptly made before serious derangement or failure is manifested.



Typical automobile power plant showing location of parts of auxiliary systems

A Typical Engine Stoppage Analyzed

Before describing the points that may fail in the various auxiliary systems it cease. It would only be a few minutes, however, before the engine would overheat if the cooling system was at fault, and the parts seize if the lubricating system should fail. Any derangement in the carburetor or ignition mechanism would manifest itself at once because the engine operation would be affected,

Digitized by Google

will be well to assume a typical case of engine failure and show the process of locating the trouble in a systematic manner by indicating the various steps which are in logical order and which could reasonably be followed. In any case of engine failure the fuel supply, ignition system and motor compression should be tested in the order given. If the ignition system is working properly and there is a decided resistance in the cylinders when the hand starting handle is turned, proving that there is good compression, one may suspect the carburetor. The usual cause of engine trouble is failure of either the fuel supply or the spark. A sudden motor stop may mean lack of gasoline or the breaking of an important ignition wire, such as the primary wire leading to the timer or the secondary cable from ignition coil to the distributor.

The gasoline feed pipe may be clogged or broken, the fuel supply may be depleted, or the shut-off cock in the gasoline line may have jarred closed. The gasoline filter may be filled with dirt or water which prevents passage of the fuel.

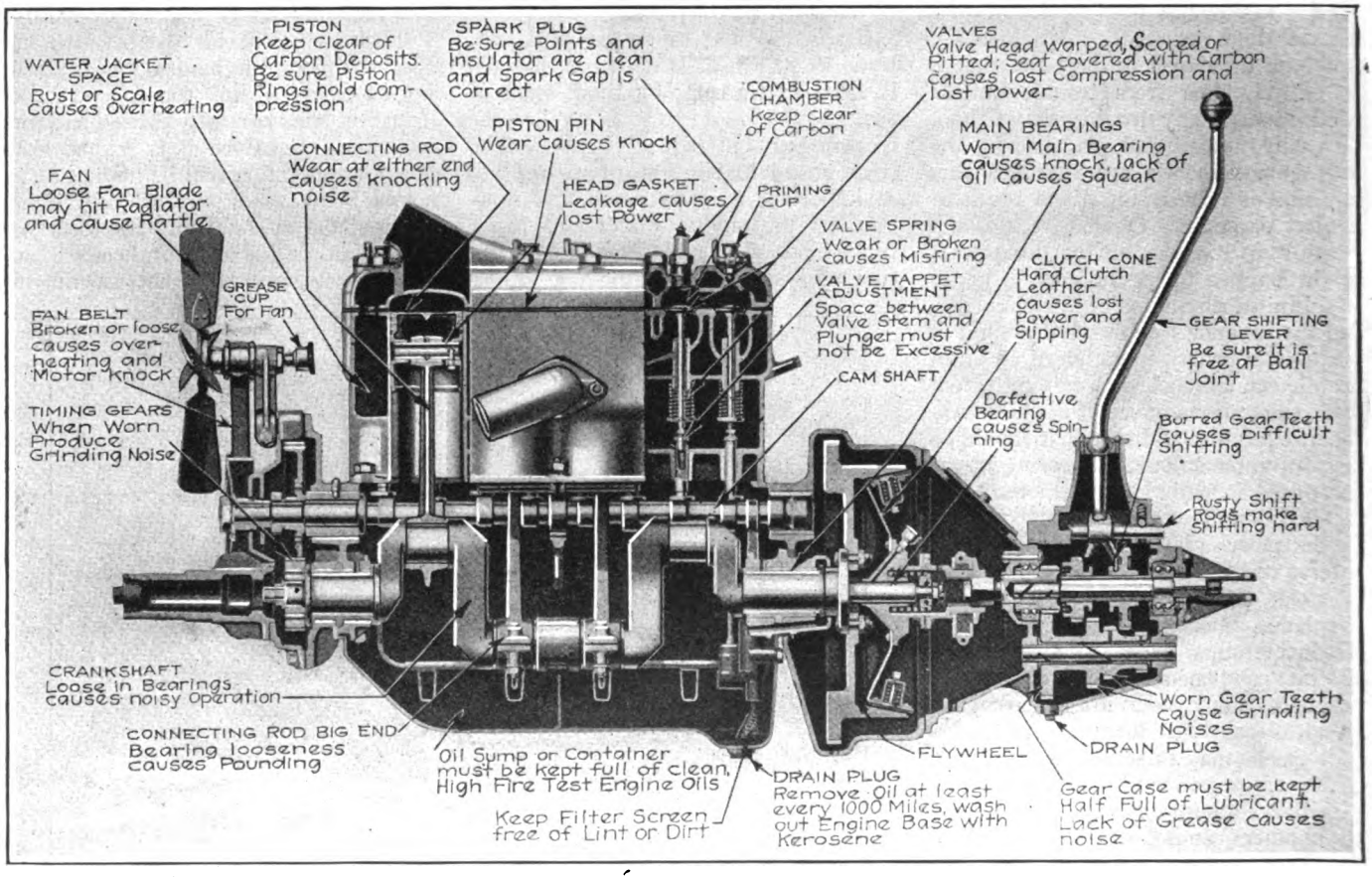
The defects outlined above are common, and if the main gasoline tank or vacuum tank is found to contain fuel and the pipe line to be clear to the carburetor, it is safe to assume the vaporizing device is at fault. If fuel continually runs out of the mixing chamber the carburetor is said to be flooded. This condition results from failure of the shut-off needle to seat properly or from a punctured hollow metal float or a gasoline-soaked cork float. It is possible that not enough gasoline is fed to the float chamber. If the passage controlled by the float-needle valve is clogged or if the float is badly out of adjustment, this contingency would be probable. When the carburetor is examined and the float bowl cover removed, if the gasoline level appears to be at the proper height, one may suspect that a particle of lint or dust, or fine scale, or rust from the gasoline tank has clogged the bore of the jet in the mixing chamber.

Conditions That Cause Failure of Ignition System

If the first test of the motor had showed that the compression was as it should be and that there were no serious mechanical defects and there was plenty of gasoline at the carburetor, this would have demonstrated that the ignition system was not functioning properly. If a battery is employed to supply current the first step is to take the spark plugs out of the cylinders and test the system by turning over the engine by hand. If there is no spark in any of the plugs, this may be considered a positive indication that there is a broken main current lead from the battery, a defective ground connection, a loose battery terminal, or a broken connector. If none of these conditions are present, it is safe to say that the battery is no longer capable of delivering current. If there is no spark at the plugs, but the timer functions properly, this shows that the primary winding is as it should be and that the fault must be looked for in either the wires comprising the secondary circuit, or at the plugs.

The spark plugs may be short circuited by cracked insulation or carbon and oil deposits around the electrode. The secondary ignition wires may be broken or have the defective insulation which permits the current to ground to some metal part of the frame or motor. The battery strength should be tested with volt or ampere meter to determine if the voltage and amperage are sufficient. Storage-battery capacity is usually gauged by a hydrometer reading, while dry cells are judged by their amperage. A storage battery should show at least a gravity of 1.280°, or if tested with a volt meter, 2 volts per cell which will be 6 volts for the usual car battery. Dry batteries that indicate less than six amperes per cell are not considered reliable or satisfactory for ignition service.

If there is no spark at the plugs the trouble may be due to weak current source, broken timer wires, or defective connections at the commutator or timer

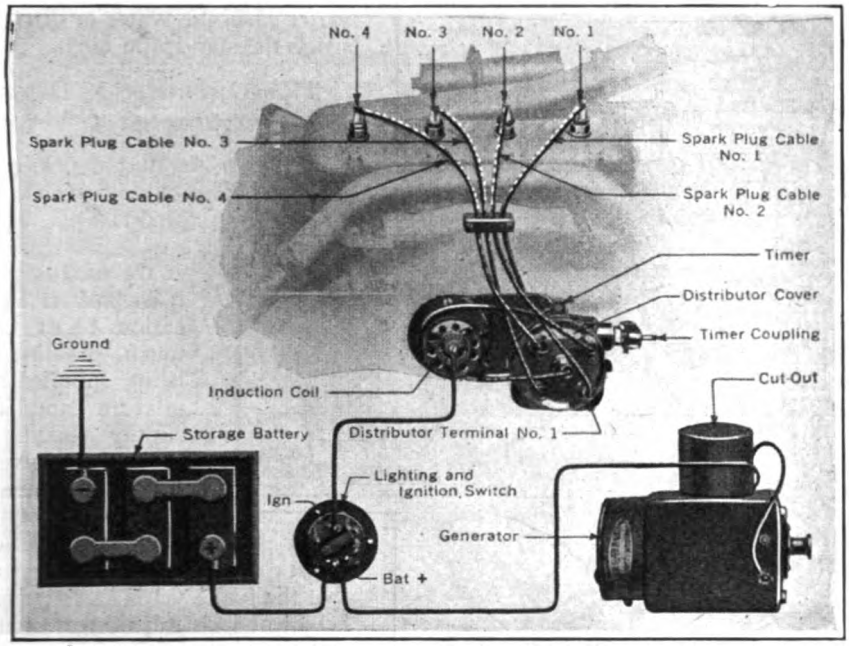


Modern unit power plant showing parts of engine and gearbox liable to give trouble and common difficulties and their indications

Digitized by Google

contact points. The electrodes of the spark plug may be too far apart to permit a spark to overcome the resistance of the compressed gas, even if a spark jumps the air space when the plug is laid on the cylinder. If no spark is produced at the plugs the secondary wire may be broken, the primary wire may make contact with some metallic portion of the chassis before it reaches the switch, the carbon collecting or current distributing brushes may be broken or not making contact; the contact points of the make-and-break device may be out of adjustment; the wiring may be attached to wrong terminals; the distributor filled with metallic particles, carbon, dust or oil accumulations; the distributor contacts may not be making proper connection because of wear, and there may be a more serious derangement, such as a burned out secondary winding, or a punctured condenser in the coil, which are rare.

There are a number of defective conditions which may exist in the ignition group that will result in "skipping" or irregular operation, and the following is the logical order in which the various points should be inspected—the parts which demand inspection oftenest are considered first: Weak source of current due to worn out dry cells or discharged storage batteries; weak magnets in magneto, or defective contacts at magneto; dirt in distributor or poor contact at breaker box or at collecting brushes. A dirty or cracked insulator at a spark plug wil cause short circuit and can only be detected by careful examination. The following points should also be checked over when the plug is inspected: Excessive space between electrodes, points too close together, loose central electrodes, or loose point on plug body, soot or oil particles between electrodes, or on the surface of the insulator.



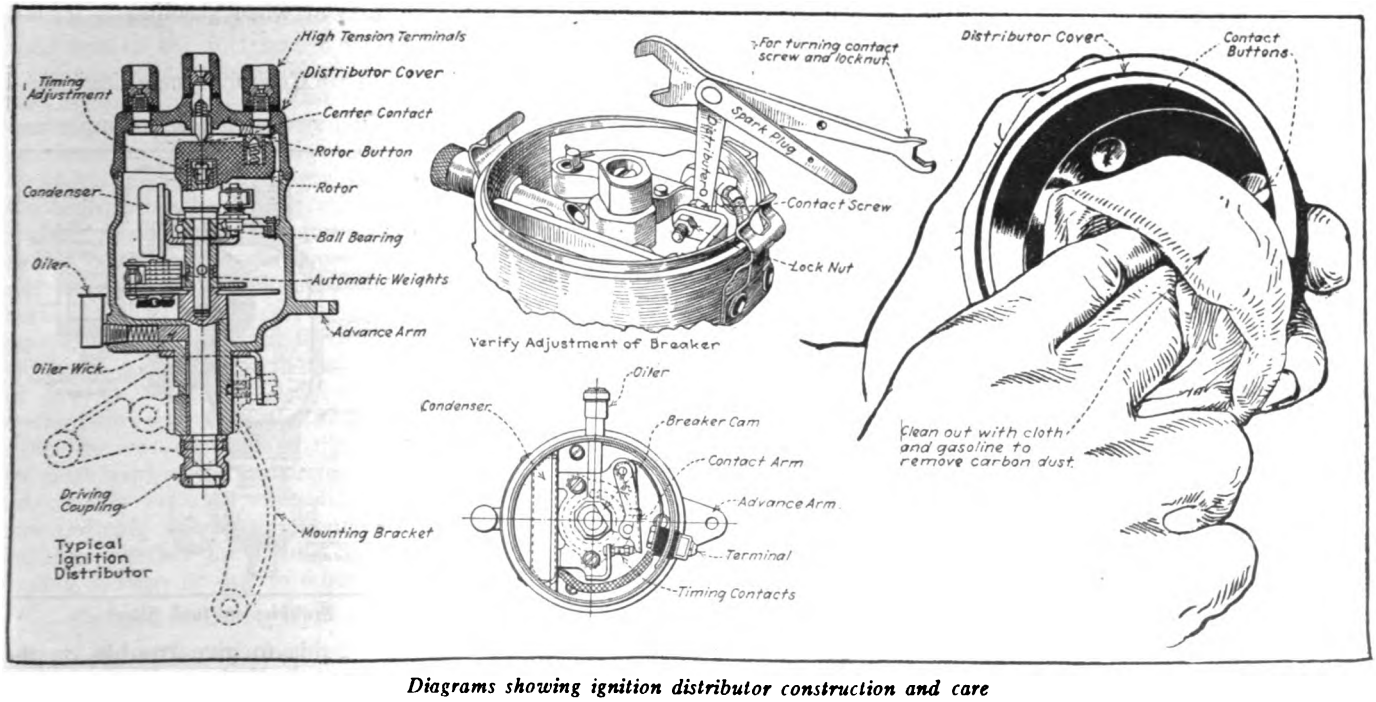
Modern ignition system parts

When testing a dry battery, the terminals should be gone over carefully to make sure that all terminal nuts are tight and that there are no loose or broken cell connectors. The wiring at the coil, timer and switch should be inspected to see that all connections are tight and that the insulation is not chafed or cracked. Defective insulation will allow leakage of current, while loose connections make for irregular operation. In testing a storage battery care should be taken to remove all the verdigris or sulphate from the terminals before attaching the testing wires. If a magneto is used there may be a short circuit in the ground wire or a poor connection at either switch lever or switch key.

The timer or distributor used with a battery-ignition system may be dirty and if the device wabbles or has loose bearings the primary contact is apt to be very poor. The insulating ring at the timer or distributor, or the fibre or hard-rubber bushings at magneto or timer may allow loss of current if they are cracked.

Ford Has Vibrator Coils

In the Ford cars a vibrator coil is employed and the trembler platinum contact points should be examined for

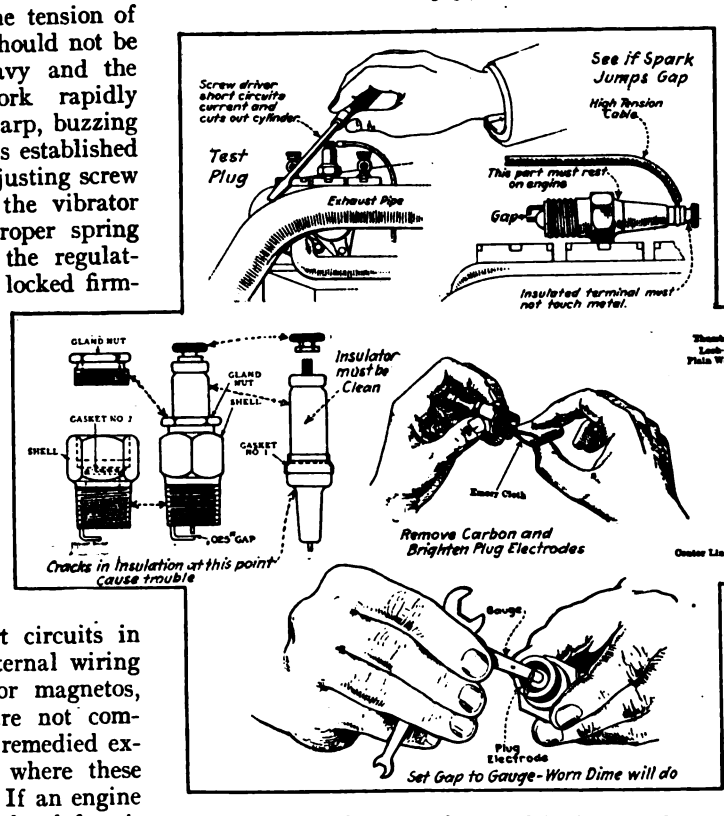


Diagrams showing ignition distributor construction and care

Digitized by Google

pits or carbonized particles that would interfere with good contact. If defective, they should be thoroughly cleaned and the surfaces of the platinum point on both vibrator spring and adjusting screw should be filed smooth to insure positive contact. The tension of the vibrator spring should not be too light or too heavy and the vibrator should work rapidly enough to make a sharp, buzzing sound when contact is established at the timer. The adjusting screw should be tight in the vibrator bridge and when proper spring tension is obtained the regulating screw should be locked firmly to prevent movement.

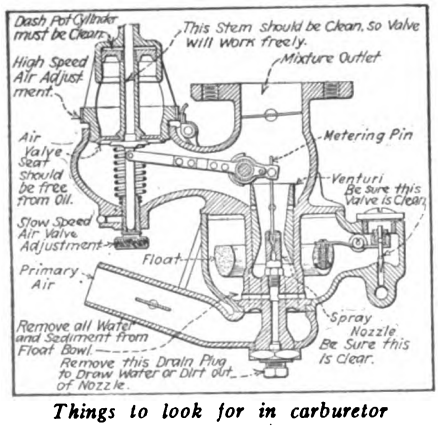
If the vibrator operates satisfactorily, but there is a brilliant spark between the vibrator points and a poor spark at the spark plug, one may assume that the coil condenser is punctured. Short circuits in the condenser or internal wiring of induction coils or magnetos, which fortunately are not common, can seldom be remedied except at the factory where these devices were made. If an engine stops suddenly and the defect is in the ignition system, the trouble is usually never more serious than a broken or loose wire. This may be easily located by inspecting the wiring at all the terminals, especially the ground wire at battery or its point of attachment to the frame. Irregular operation or misfiring is harder to locate because the trouble can only be found after the many possible defective conditions have been checked over, one by one.



Showing how to locate defective spark plugs and what to do to cure the trouble

Common Defects in Fuel Systems

Defective carburetion often causes misfiring or irregular operation. The common derangement of the components of the fuel system that are common enough to warrant suspicion and the best methods for their location follows:



Things to look for in carburetor

First, disconnect the feed pipe from the carburetor and see if the gasoline flows freely from the supply source. If the stream coming out of the pipe is not the full size of the orifice it is an indication that the pipe is clogged with dirt or that there is an accumulation of rust, scale or lint in the strainer screens of the filter. It is also possible that the fuel shut-off valve may be wholly or partly closed. If the gasoline flows by gravity, the liquid may be air bound in the tank, while if a pressure-feed system is utilized the tank may leak so that it does not retain pressure; the check valve retaining the pressure may be defective or the pipe conveying the air or gas under pressure to the tank may be clogged.

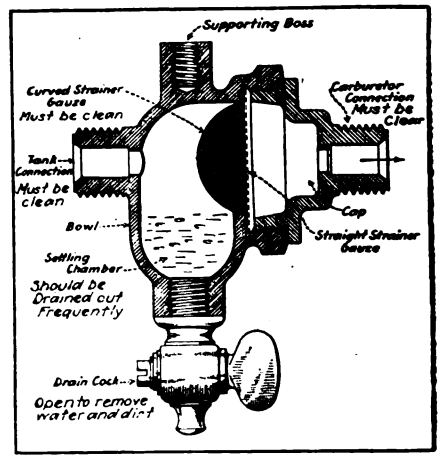
If the gasoline flows from the pipe in a steady stream the carburetor demands examination. There may be dirt or water in the float chamber, which will constrict the passage between the float chamber and the spray nozzle, or a particle of foreign matter may have entered the nozzle and stopped up the fine hole therein. The float may bind on its guide, the needle valve regulating the gasoline-inlet opening in bowl may stick to its seat. Any of the conditions mentioned would cut down the gasoline supply and the engine would not receive sufficient quantities of gas. The air-valve spring may be weak or the air valve broken. The gasoline-adjusting needle may be loose and jar out of adjustment, or the air-valve spring-adjusting nuts may be such a poor fit on the stem that adjustments will not be retained. Air may leak in through the manifold, due to a porous casting, or leaky joints because of poor gaskets and dilute the mixture. The air-intake dust screen may be so clogged with dirt and lint that not enough air will pass through the mesh. Water or sediment in the gasoline will cause misfiring because the fuel feed varies when the water or dirt constricts the standpipe bore.

When Carburetor Is Out of Adjustment

It is possible that the carburetor may be out of adjustment. If clouds of black smoke are emitted at the exhaust pipe it is positive indication that too much gasoline is being supplied the mixture and the supply should be cut down by screwing in the needle valve on types where this method of regulation is provided, and by making sure that the fuel level is at the proper height and air adjustment correct in those forms where the spray nozzle has no means of adjustment. If the mixture contains too much air there will be a pronounced popping back in the carburetor. This may be overcome by screwing in the air-valve adjustment so the spring tension is increased or by slightly opening up the gasoline-supply regulation needle. When a carburetor is properly adjusted and the mixture delivered the cylinder burns properly, the exhaust gas will be clean and free from the objectionable odor present when gasoline is burned in excess.

Defects in Cooling System Outlined

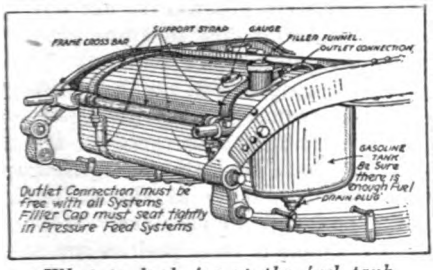
Cooling systems are very simple and are not liable to give trouble on the road as a rule if the radiator is kept full of clean water and the circulation



Troubles in fuel filter

Digitized by Google

is not impeded. When overheating is due to defective cooling the most common troubles are those that impede water circulation. If the radiator is clogged or the piping or water jackets filled with rust or sediment the speed of water circulation will be slow, which will also be the case if the water pump or its driving means fail. Most automobile cooling systems are so closely proportioned to the actual requirements



What to look for at the fuel tank

that the stoppage of a cooling fan will be enough to cause the engine to overheat. Any scale or sediment in the water jackets or in the piping or radiator passages will reduce the heat conductivity of the metal exposed to the air, and the water will not be cooled as quickly as though the scale was not present.

The rubber hose often used in making the flexible connections demanded between the radiator and water manifolds of the engine may deteriorate inside and particles of rubber hang down that will reduce the area of the passage. The grease from the grease cups mounted on the pump-shaft bearing to lubricate that member often finds its way into the water system and rots the inner walls of the rubber hose, this resulting in strips of the partly decomposed rubber lining hanging down and restricting the passage. Keep the fan belt tight and be sure fan is properly oiled.

Overheating is often caused by some condition in the fuel system that produces too rich mixture. Excess gasoline may be supplied if any of the following conditions are supplied: Bore of spray nozzle or standpipe too large, auxiliary air-valve spring too tight, gasoline level too high, loose regulating valve, fuel-soaked cork float, punctured sheet-metal float, dirt under float control shut-off valve or insufficient air supply because of a clogged air screen. If pressure feed is utilized there may be too much air pressure in the tank, or in gravity feed, the float controlled mechanism operating the shut-off in either the vacuum tank or the dash or the float bowl of the carburetor may not act quickly enough. Steaming radiators indicate overheating, but do not indicate whether the trouble is in the cooling system or due to other causes.

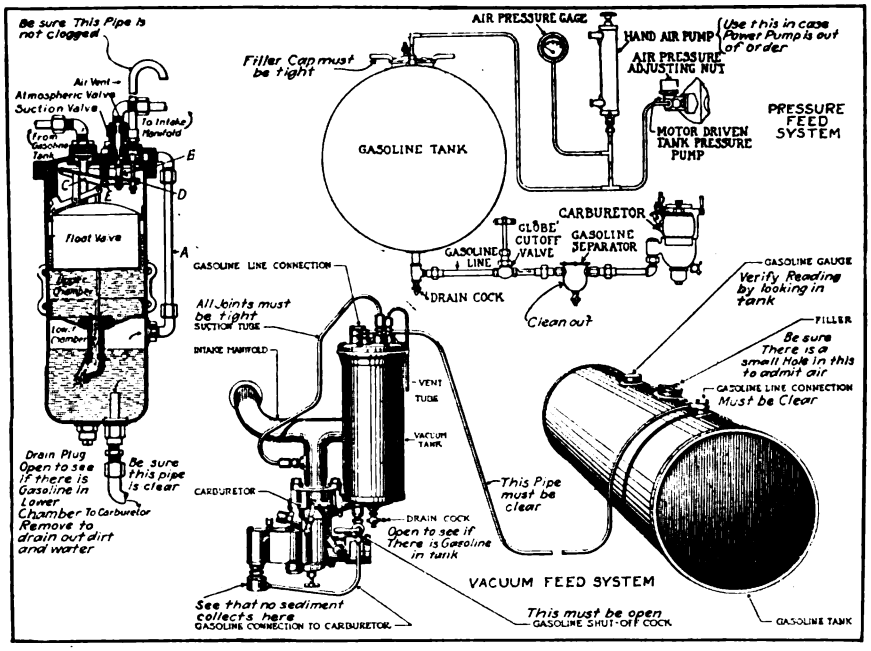
Defects in Oiling Systems

While troubles existing in the ignition or carburetion groups are usually denoted by imperfect operation of the motor, such as lost power, and misfiring, derangements of the lubrication or cooling systems are usually evident by overheating, diminution in engine capacity, or noisy operation. Overheating may be caused by poor carburetion as much as by deficient cooling or insufficient oiling. When the oiling group is not functioning as it should the friction between the motor parts produces heat. If the cooling system is in proper condition, as will be evidenced by inspection of the parts and the water supply in the radiator, and the carburetion group appears to be in good condition, the overheating is probably caused by some defect in the oiling system.

The conditions that most commonly result in poor lubrication are: Insufficient oil in the engine crank case or sump, broken or clogged oil pipes, screen at filter filled with lint or dirt, broken oil pump, or defective oil-pump drive. The supply of oil may be reduced by a defective inlet or discharge-check valve at a plunger pump or worn gear pumps. A clogged oil passage or pipe leading to an important bearing point will cause trouble because the oil cannot get between the working surfaces. The indicating gauge on the dash may not show oil feed because the pipes leading from them to the engine are full, or because the conductor is clogged with oil wax. This gives sufficient warning, however, and the oil pipe may be easily cleared by removing it and blowing it out with air or steam under pressure. It is well to remember that much of the trouble caused by defective oiling may be prevented by using only the best grade of lubricant, and even if all parts of the oiling system are working properly oil of poor quality will cause friction and overheating. The most common trouble is a clogged filter screen which can be prevented by draining out the old oil from the crank case periodically, cleaning out with kerosene and supplying new oil. In some motors this should be done every 500 miles the car is run, in others a cleaning out every 1,000 miles is sufficient.

Causes of Poor Compression

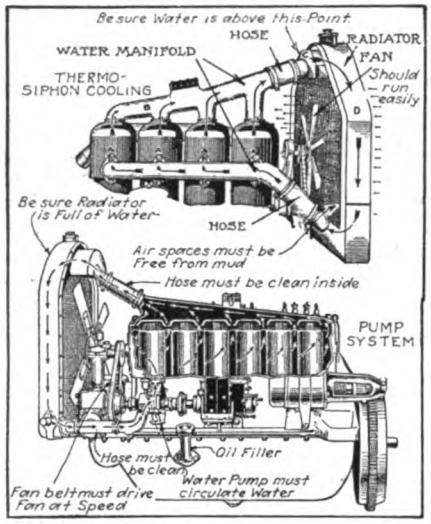
If the ignition system and carburetor appear to be in good working order, and the hand crank shows that there is no compression in one or more of the cylinders, it usually means some defect in the valve system. If the engine is a multiple-cylinder type and one finds poor compression in all of the cylinders it may be due to the rare defect of improper valve timing. This may be caused by a gear having altered its position on the cam shaft or crank shaft, because of a sheared key or pin having permitted the gear to turn about a half of a revolution and then having caught and held the gear in place by a broken or jagged end so that cam shaft would turn, but the valves open at the wrong time. If but one of the cylinders is at fault and the rest appear to have good compression the trouble may be due to a defective condition either inside or outside of that cylinder. The external parts may be inspected easily, so the following should be looked for: A broken valve, a warped valve head, broken valve springs, sticking or bent valve stems, dirt under valve seat, leak at valve-chamber cap or spark-plug gasket. Defective priming cock; cracked cylinder head (rarely occurs); leak through cracked spark-plug insulation; valve plunger stuck in the guide; lack of clearance between valve-stem end



Typical fuel systems. At top, the pressure feed system; below, the popular vacuum feed system

Digitized by Google

and top of plunger caused by loose adjusting screw which has worked up and kept the valve from seating. The faulty compression may be due to defects inside the motor. The piston head may be cracked (rarely occurs), piston rings may be broken, the slots in the piston rings may be in line, the rings may



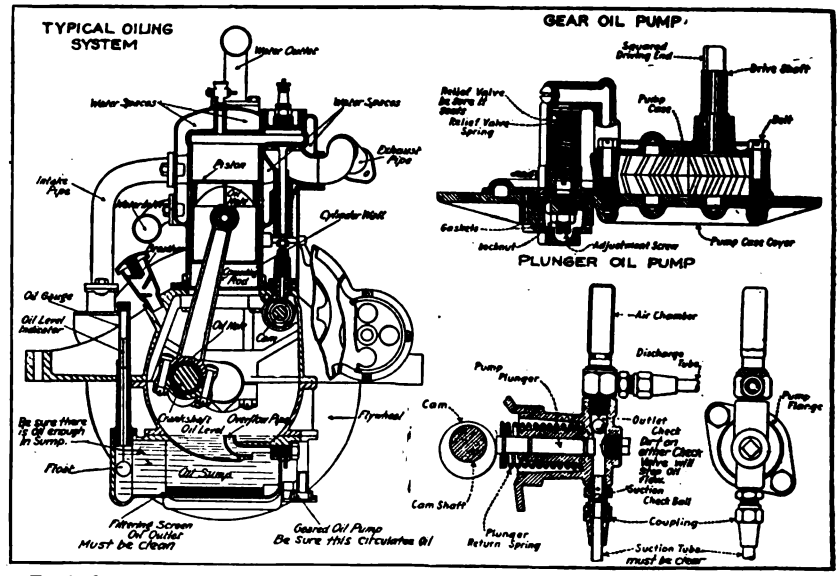
Water cooling system parts

have lost their elasticity or have become gummed in the grooves of the piston, or the piston and cylinder walls may be badly scored by a loose wrist pin or defective lubrication. If the motor is a type with separate head it is possible that the gasket or packing between the cylinder and combustion chamber may leak, either admitting water to the cylinder or allowing compression to escape.

Some Causes of Noisy Operation

There are a number of power plant derangements which give positive indication because of noisy operation. Any knocking or rattling sounds are usually produced by wear in connecting rods or main bearings of the engine, though sometimes a sharp metallic knock, which is very much the same as that produced by a loose bearing, is due to carbon deposits in the cylinder heads; overheating from loose fan belt or poor water supply; or premature ignition due to advanced spark-time lever. Squeaking sounds invariably indicate dry bearings, and whenever such a sound is heard it should be immediately located and oil applied to the parts thus denoting their dry condition. Whistling or blowing sounds are produced by leaks, either in the engine itself or in the gas manifolds. A sharp whistle denotes the escape of gas under pressure and is usually caused by a defective packing or gasket that seals a portion of the combustion chamber or that is used for a joint as the exhaust manifold. A blowing sound indicates a leaky packing in crank case. Grinding noises in the motor are usually caused by the timing gears and will obtain if these gears are dry or if they have become worn. Whenever a loud knocking sound is heard careful inspection should be made to locate the cause of the trouble. Much harm may be done in a few minutes if the engine is run with a loose connecting rod or bearings that would be prevented by taking up the wear or looseness between the parts by the means of adjustment provided.

As a general rule the average motorist is not sufficiently informed mechanically to undertake repairs of worn motor parts, and whenever repairs of a mechanical nature are necessary it will be much more satisfactory and cheaper to have them done by experienced mechanics or repairmen. Ordinary adjustments may be attempted by even the inexpert, but it should be remembered that nothing should be changed without a good reason existing for making the alteration. It is not proposed to discuss the various causes of noisy operation at length because the defective conditions which are evidenced by noisy action can usually be remedied only by skilled labor. The common defects of the auxiliary groups have been mentioned in detail, however, because these troubles may occur on the road and it is well for the motorist to be familiar with the common derangements that may result in irregular engine operation or loss of power.



Typical engine oiling system and two forms of pumps used in circulating the oil

Summarized Hints for Locating Engine Troubles

First, see if the motor is getting fuel. See if there is gasoline in the carburetor. See that there is gasoline in the tank. Examine shut-off valve at tank. Prime carburetor and see that spray nozzle passage is clear. Be sure throttle will open. Prime cylinders by putting about a teaspoonful of gasoline in through pet cock or spark plug opening. Adjust carburetor if necessary. Drain out gasoline filter in pipe line or drain carburetor float bowl to remove water or dirt.

Make sure that a spark occurs in each cylinder as follows: If using battery and single coil system, get commutator rotor on contact. Put switch in "on" position. See that breaker points work. Examine adjustment of points and make sure they contact when cam follower is not raised by cam and that they separate when it is. Test condition of battery. Take out spark plug, lay it on the cylinder and, with switch on and rocking timer cam to separate breaker points, see if spark occurs. Be sure to adjust gap between plug points to almost 1/32" before replacing in cylinder. If plug cannot be tested in a positive manner because of construction, try another plug (from a cylinder that does work). Examine all wires for proper position, good connections, breaks and short circuits. See that commutator is timed correctly. If magneto or magneto and battery with non-vibrating coil is used: Disconnect wire from spark plug, hold end about 1/8 inch from cylinder. Have motor cranked briskly and see if spark occurs. Examine adjustment of interrupter points. See that wires are placed correctly and not short circuited. Take out spark plug and lay it on the cylinder, being careful that base of plug only touches the cylinder. Mave motor cranked briskly and see if spark occurs. Check timing and see that distributing brush is making contact.

If ignition and fuel supply is found to be steady, make sure that all cylinders have compression. To ascertain this, open pet cocks of all cylinders except the one to be tested, crank over motor and see that a strong opposition to cranking is met with once in two revolutions. If the motor has no pet cocks, crank and notice that opposi-

Digitized by Google

tions are met at equal distances, two to every revolution of the starting crank in a four-cylinder motor, or take out the spark plugs of all cylinders except the one to be tested. If compression is lacking, examine the parts of the cylinder at fault in the following order, trying to start the motor whenever any one fault is found and remedied. See that the valve push rods do not touch valve stems for more than approximately ½ revolution in every 2 revolutions, and that there is not more than 1/64 inch clearance between them. Make sure that the inlet and exhaust valves seat. To determine this, examine the spring and see that it is connected to the valve stem properly. Take out valves and see that there is no obstruction, such as carbon, on the seat. See that valve works freely in its guide. Listen for a hissing sound while cranking motor for leaks at other places, such as due to poor fitting piston rings. Remember that a cylinder that has poor compression will not work reliably or give full power because it does not suck in a full charge of gas, and besides the explosive power is less.

ARTIFICIAL WOOD FROM WASTE

WHEN sawdust is mixed with a binding material to which other ingredients, giving weight, color, hardness, moulding property, etc., are added, compositions can be obtained which may be used for parquetry, terra cotta imitation, table tops, floorboard-coating, wood cements, etc. Patented and unprotected recipes of these compositions are very numerous. The employment of sawdust in the manufacture of products that are used for furniture, wall and ceiling decoration has gained an important place among the industries of the world. Many of the beautiful panels and friezes of the Italian Renaissance and French Baroque one admires in modern mercantile and private palatial buildings are made of artificial wood, and without having found so practical and lucrative a utilization of waste wood as these moulded decorations, many architectural designs of inner decorations could not be carried into practice, except by spending prohibitive sums for carvings.

The following mixtures may be taken to represent typical examples of artificial wood preparations:

Messieurs Latri, of Paris, use resinous sawdust mixed with fresh ox blood, the paste being pressed by an hydraulic press into heated steel moulds. The product is capable of filling the finest depressions of the mould; it may be coloured, and can be worked in every respect like wood itself.

Harra's Imitation Wood consists of sawdust cellulose, and an albuminous binding material, the resulting paste being also capable of being pressed into moulds or applied like wood carvings.

In Hurtig's Wood-composition sawdust is mixed with sodium silicate (ordinary waterglass) and milk of lime; common curd soap and water being added to wet the ingredients. The composition for low relief and high relief is improved by adding casein to the above mixture for producing a low relief, and mashed potato, infusorial earth and pitch for high relief paste.

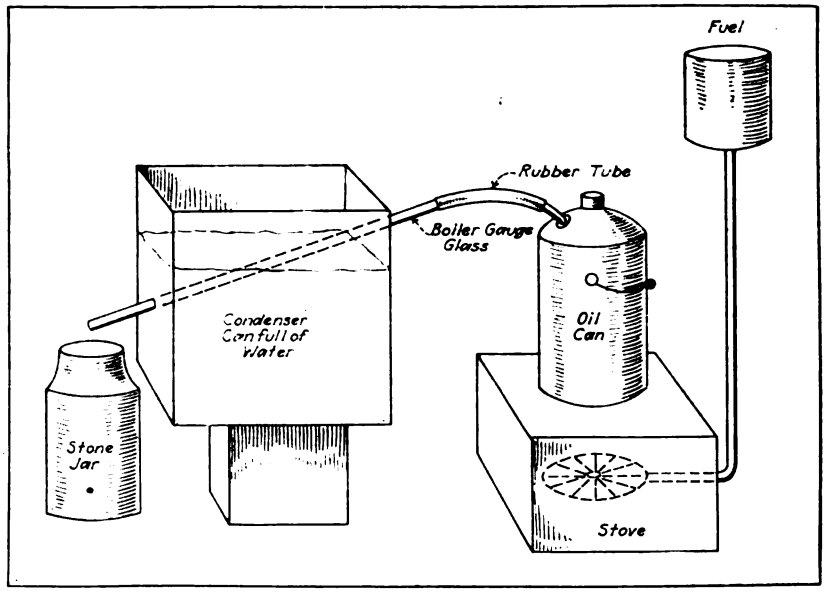
A Water Distiller

By R. D. Galt

WITH the great use of motor cars and the increasing demand from day to day, there arises several questions for the small town garage to contend with. One of these, if not the most important, nevertheless one to be considered, is the battery trade. All the larger cars are equipped with storage batteries for ignition and lighting and now the Ford also will be equipped likewise. One of the necessary articles needed to supply this branch of the garage business is distilled water and for some of the smaller towns, this affords a trying question.

During the past year I have known of several garages who were faced by a situation something like this. Distilled water could be bought in some of the larger cities for as low as five cents a gallon, but the cost of transportation by rail to the retailer was near fifty cents, bringing the cost of the water when delivered to near sixty cents a gallon. Readers can readily see what water would weigh and the expense of shipping if the water was shipped any great distance. But notwithstanding this, water has to be kept on hand to furnish the trade, and in order to do this, a water distiller made on the lines of the accompanying drawing will be found serviceable and economical.

A small one burner gas or oil stove is used for heating the water. Water to be distilled is placed in a common one gallon oil can and the spout allows the steam to escape. For a condenser, a five gallon oil can that the oil companies use for shipping gas and oil may be used by cutting it into two parts at the middle. In the lower half cut two holes on opposite sides, one a little below the other, and place a piece of steam guage glass through these holes. After the glass has been put in, shellac may be run around it to keep it from leaking. Then a rubber tubing small enough to fit tightly about the spout of the can and into the glass gauge will connect the two, allowing the steam to pass into the condenser where cold water about the glass will cause it to form into drops of water. A stone or glass jar set under the end of the glass gauge will collect the finished product. The water in the condenser, if changed every hour or so will keep the distilled product forming rapidly. The only expense is the gasoline or kerosene, which amounts to about five cents per gallon of water, and in the mean time the small garage is as efficient as the large, and operates as cheaply, keeping home trade at home.



Simple method of distilling water to use in storage battery electrolyte

Take care not to adjust the brakes too close when car is without load. If you do the brakes may bind when car is loaded, the springs deflected and the wheel base slightly extended. Rough roads will augment the trouble and intermittent dragging of the brake may result if the bands fit tightly.

Digitized by Google

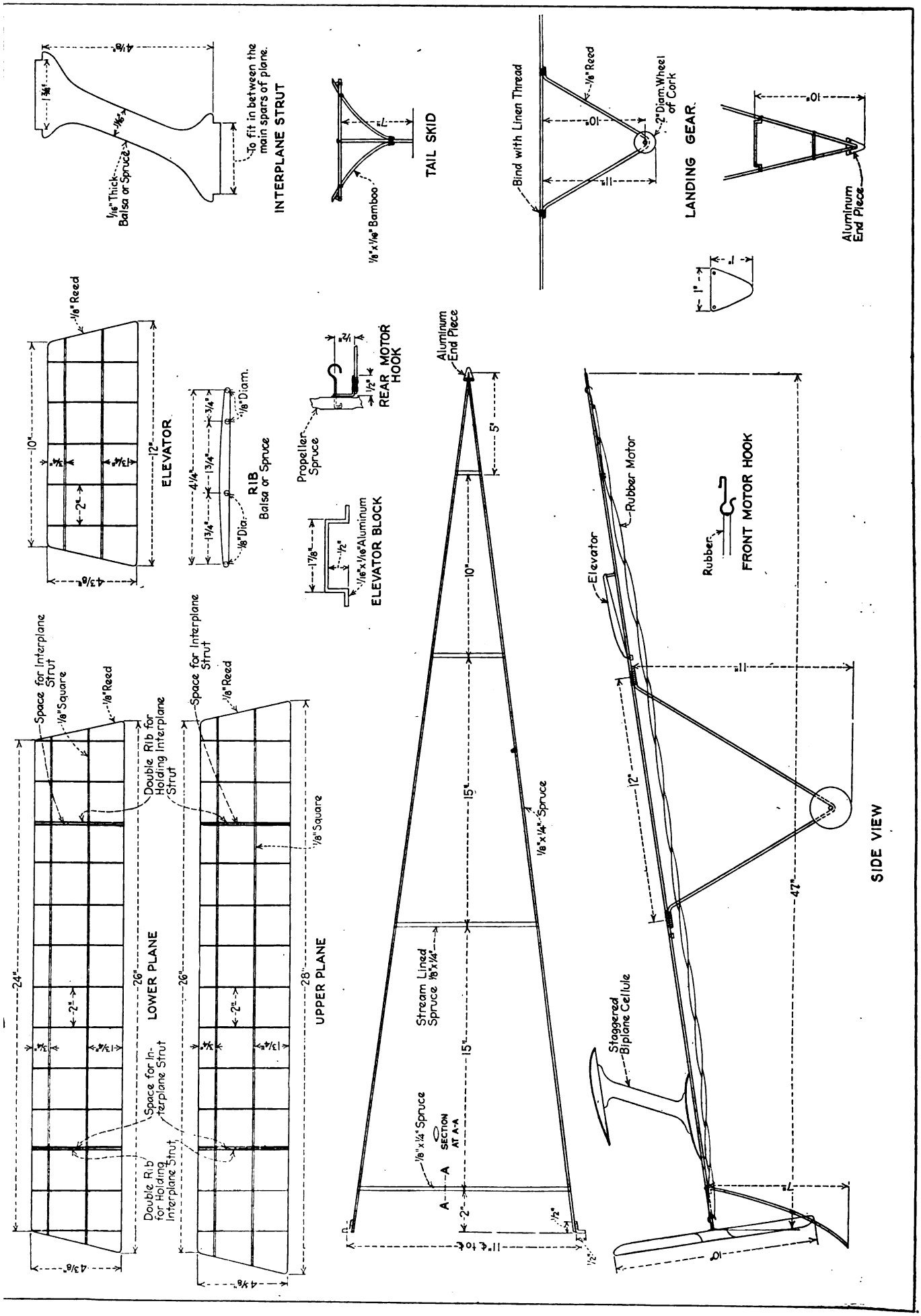


Fig. 1. Constructional details of the R.O.G. biplane model flier giving dimensions of important parts

Digitized by Google

The R. O. G. Biplane Flier

A Modification of the Simple A Frame Flying Model That is Provided With Double Aerofoils and Wheeled Landing Gear

By H. C. Ellis

BEFORE attempting to construct this Model, study the drawings carefully. This machine, should not weight over seven and one-half ounces when completed if care is taken in the construction. The bracing wires shown in photographs should be used only if the frame shows a tendency to buckle when motors are tightly wound.

Fuselage

The fuselage is the A frame type and consists of two longerons 45x1⅛" ¼" spruce. Three crosspieces of the same material ⅛"x¼" are used and placed at distances shown in the drawing, and bound with strong linen thread and glued. The crosspieces are given a stream line section to lighten them and also to reduce their resistance. The elevator block is of aluminum 1/16" x 1/16" x 3½ inches long or this can be of reed or bamboo or any light stiff wire. It is bound and glued as shown near the apex of the triangular framework.

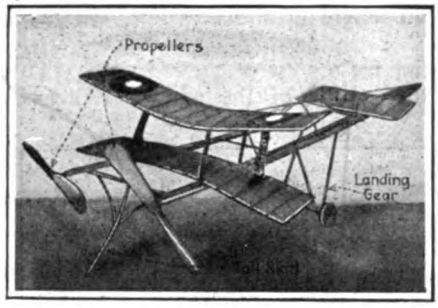
The rear skid is of bamboo 1/16" x ⅛". This is made high enough to keep the propellers from touching the ground. The landing gear is made of ⅛" reed, shaped as shown in the drawing by bending it over a gas or candle flame. Bind and glue to the fuselage aproximately as indicated. The frame hooks are made of a piece of 1/16" drill rod bent and bound to the fuselage or may be attached to an aluminum piece set in the apex of the frame. The axle is a piece of 1/16" drill rod nine inches long. On the Model described and illustrated the writer used cork wheels two inches in diameter, these being lighter than other types. Obviously any type of wheel may be used, such as the aluminum disc or wooden type which may be purchased from any model supply house and which are shown at Fig. 5.

Main Planes

The ribs of the main planes and elevator are the same size. They are not, as you will notice, built up but are cut from a piece of balsa or spruce 1/16" thick. The rib should be laid out full size as it is reduced on the drawings. Care must be taken when cutting these ribs out to be sure to have them all the exact size and all the holes for the wing beams, which are ⅛" dowels must be in line as there are a number of ribs to be made, a metal pattern may be cut and drilled to act as a jig to insure uniformity in ribs. It will be noticed in the drawing that the third ribs from each end of the wing tips are doubled. These ribs are placed 1/16" apart to act as a socket for the struts. The struts are cut from spruce 1/16" thick to the shape shown. They are then sanded with fine sand paper and after they are finished, they are given one coat of Dope.

After all the ribs are placed on the wing beams and are properly spaced according to the drawing they are glued and allowed to dry. After the glue is dry, the edges, which are ⅛" reed are put on. This is done by tying the reed back over the wing beams with strong thread and glueing it to the ribs. The wing tips are bent to the shape shown by passing them over a gas or candle flame. Care should be taken so as to make all the tips the same shape. After the glue is dry the thread may be cut away. The elevator is built up in the same way except that the double ribs are left out.

Fig. 2. Rear view of the R.O.G. biplane flier



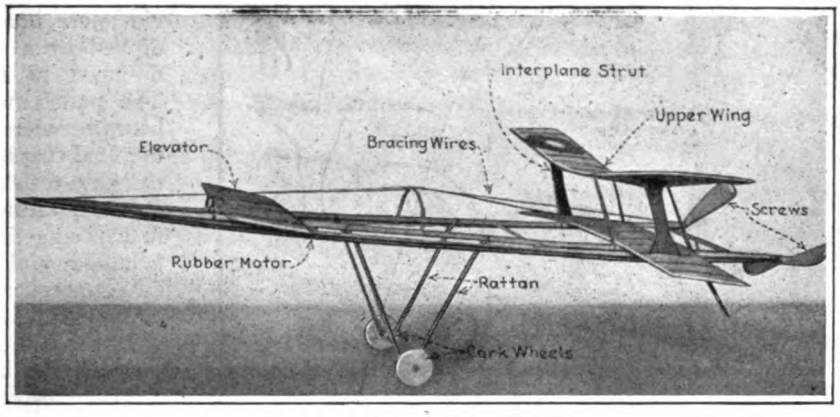


Fig. 3. Side view of model biplane flier showing relative placing of parts

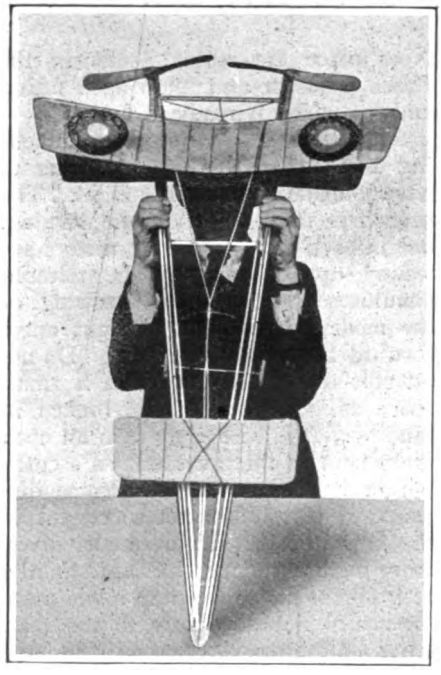


Fig. 4. Plan view of R.O.G. biplane flier

Covering and Doping

Bamboo paper is used for covering the wings. Cover the bottom first and allow to dry. After it is dry the extending edges may be trimmed off. Then cover the top side. Care must be taken to have the paper lay even and without any wrinkles. After the wings are covered and the glue is perfectly dry, the Dope is applied. This is best done with a small, soft brush as a stiff brush is liable to puncture the paper covering. This Dope can be purchased from any model supply house. Four ounces is the quantity required to dope the wings properly. Apply the dope evenly, first on the top and then the bottom side. Then place wing away to dry.

Propellers, Shafts and Bearings

The propellers are ten inches in diameter. As these are the most difficult

Digitized by Google

part of the model to make it is better to buy them from a model supply house. The bearings are made of 1/16" thick brass and are 3/16" wide. They are bent to the shape shown. A 1/16" hole is drilled through them to take the propeller shaft which is a 1/16" piece of drill rod bent to the shape shown in the drawing. The bearings are then securely bound to the fuselage with linen thread and glued. The motor hooks are of 1/16" drill rod.

The motive power consists of 40 feet of 1/8" flat rubber for each motor. This rubber should be looped over the hands into 12 even strands. Place one end in the propeller hook and the other end into the motor hook. The motor hook is then placed into the frame hook at the front of the fuselage. The motor hooks may be removed from the frame hooks and placed in the winder. The propellers must turn out in opposite directions and rotate so their entering edges cut the air first.

Assembling and Flying

After the main planes and elevator are thoroughly dry, the model is ready to assemble. Place the propellers through their respective bearings and attach the rubber motors as described. Now take the smaller plane, which is the bottom one and cut the paper out between the double ribs with a sharp knife on the top only, for the struts to enter the space provided for them. Do the same with the larger one, but cut out only on the bottom side. Now place the two struts in the sockets of the lower plane, and then into the sockets of the upper plane as shown in the photograph. Place a large rubber band around the main plane at the point where the struts are inserted so as to hold them in position against the frame members. Now place them on the fuselage and pass a strip of rubber around the bottom plane and around each longeron of the fuselage. The elevator is fastened on the fuselage in the same way. Be sure and have the front edge of same resting on the elevator block.

The model should be launched from the hand before flying it from the ground. Have an assistant hold the propellers at the bearings, the model hooks into a double winder and stretch the motors twice their length. Turn the handle of the winder 100 times. Now place the motor hooks in the frame hooks or aluminum apex fitting and the model is ready to fly.

Some practice is required in launching a model of this type in order to have it make a successful flight. The propellers must be held from turning, one in each hand, after the motors are wound up. They must be released simultaneously with the throwing of the model upwards at a slight angle forward from above the head. Do not attempt to fly this model in a small space as it is liable to be broken in landing. It is best to fly it in an open grass land as the grass acts as a cushion in landing. Do not become discouraged if you are not successful in the first attempt. If the model dives, move the main planes forward slightly. If it climbs at too steep an angle move the main planes slightly to the rear. After a little practice you will find the best position for the main planes to make a successful flight. After the model is properly balanced, it may be launched from the ground after winding the motors 250 times with the winder. Select a hard and level surface to launch it from.

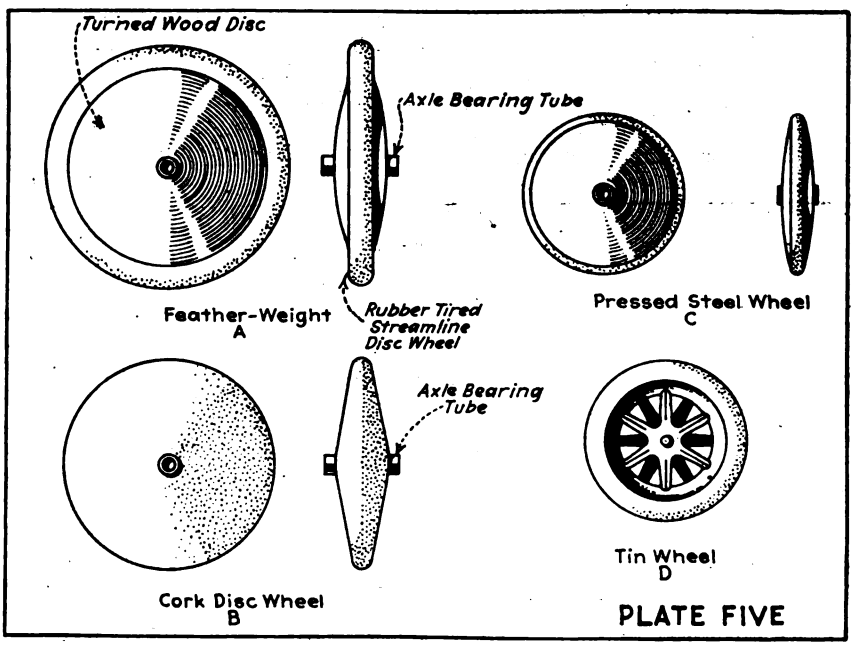


Fig. 5. Types of wheels suitable for model airplanes are made of wood or metal

Moisture Absorption Through Varnish Same For Different Species of Wood

IN experiments made by the Forest Products Laboratory, it was found that varnishes do not entirely prevent the transmission of moisture into wood, but merely retard it, and that apparently there is no difference in moisture absorption through the coating due to the species of wood used.

The panels used in the experiments were of yellow birch, basswood, red gum, African mahogany, white ash, white pine, Sitka spruce, southern yellow pine, bald cypress, incense cedar, white oak, western yellow pine, Port Oxford cedar, and sugar pine.

Three coats of high-grade spar varnish were applied to four panels of each species. Two panels of each species were brush-coated and two were dipped by a special dipping machine designed to secure an even coating. The panels were allowed to dry 72 hours between coats and 10 days after the final coat before they were given the moisture-resistance test.

The moisture-resistance test consisted in exposing the panels for 17 days to a humidity of 95/100 per cent., or in an atmosphere practically saturated with moisture.

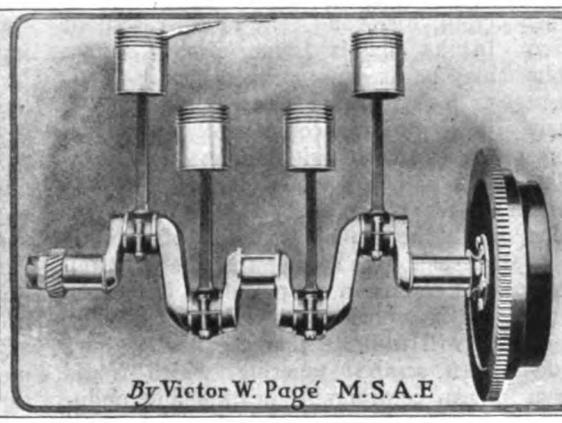
At the end of this test, it was found that all the brush-coated panels had absorbed between 5 and 6.5 grams of moisture per square foot of surface, and the dipped panels between 4 and 5 grams. Such variations in amount of absorption as appeared could easily have been due to inequalities in the application of the varnish. It was quite noticeable that the dipping process produced a more moisture-resistant coating than brushing.

Copperite Alloy

COPPERITE is a new high-speed alloy. It is said to be an alloy of zinconium and nickel. It has a bright silvery lustre and a specific gravity much lower than other alloys used for high-speed work. Copperite contains no carbon or iron, and consequently is not a steel. Its melting point is only about 1150 deg. C., and owing to the fact that the alloy remains in a liquid state for a considerable period before solidifying, difficult castings can be made with ease. No heat treatment is said to be required, the hardness being varied by changing the proportion of the constituents. Cutting tools have been produced with a hardness of 250 up to 500 Brinell, the latter still retaining sufficient toughness to withstand heavy roughing cuts.

Digitized by Google

FITTING AND ADJUSTING CONNECTING ROD BEARINGS



By Victor W. Page M.S.A.E

PART II

Remetalling Connecting Rods

In a number of the cheaper cars, the bearing metal is cast in place in the connecting rod lower end and in the main bearings, and is not in the form of removable die cast bushings as are used on the more expensive cars. The repairman who is called upon to replace the bearing metal will perhaps find the following instructions regarding remetalling bearings of valve. The method described was used by the writer while in charge of a large shop where much work of this kind was done, and while the instructions given below and shown at Fig. 1 apply specifically to lining the big ends of connecting rods, the same process may be used successfully on any other bearings where the mandrel and collars can be used, the dimensions being changed to suit the requirements of the worker.

In the case mentioned the journals of the crankshaft were two inches in diameter and the big ends of the connecting rods were worn too much to allow of adjusting. A piece of pipe about 9 inches long was procured and turned down in a lathe until it was .020 inch under two inches in diameter, which made a hollow mandrel of it. A piece of steel tubing could have been used to as good advantage had any been available. As the outside of the bearing caps were machined true a couple of set collars were bored out to be a good fit on the mandrel, and while still in the lathe they were recessed out to just fit over the outside of the big ends, as shown in sketch and each of the collars was provided with a drilled vent. One of these collars (C) was placed on the hollow mandrel (A), after which the mandrel was pushed through the big end, and the other collar was put on the other side, insuring that the mandrel was as near center as possible for it to be.

The assemblage is then supported on a couple of V-blocks, which are supported on a lathe bed as a convenient support, the ends of the mandrel lying within the V-blocks while the connecting rod hangs between the ways. A piece of solid round iron or steel which will go inside of the hollow mandrel should be made red hot while the antifriction metal is being melted and is pushed inside the mandrel to heat it. In a minute or two the metal may be poured in through B to fill the space and as the metal and the big end caps are well heated the molten metal will flow to every point. The heating of the mandrel can be just as well accomplished by directing the flame from a blow torch or Bunsen burner into the opening. After the metal is poured and has set for a time the whole may be easily cooled by running water through the mandrel or by directing a blast of air against the big end, as desired.

Before the cap is assembled with the connecting rod several shims or liners of sheet brass or copper should be placed between them so that adjustment for wear of the new bearing can be compensated for by the removal of a liner. As is evident, the thinner the liner and the greater the number used, the finer the adjustment possible.

The use of a hollow mandrel is to be preferred to a solid one because of the simple way it can be heated and cooled. Vents may be made for the heated gases by grooving the face of each of the collars nearest the big end and on the same side as the hole through which the metal is poured. If provision is not made for "venting," the molten metal will not run uniformly and will become honeycombed. After cooling, the bearing is either bored out in a lathe to nearly the size of the journal and then reamed to the finished size or scraped to a fit by hand. The method of pouring the molten metal is clearly shown while the sectional view makes the construction and application of the mandrel clear. The same method may be used to rebabbitt main boxes except that a pair of collars will be needed for each bearing and a long mandrel used.

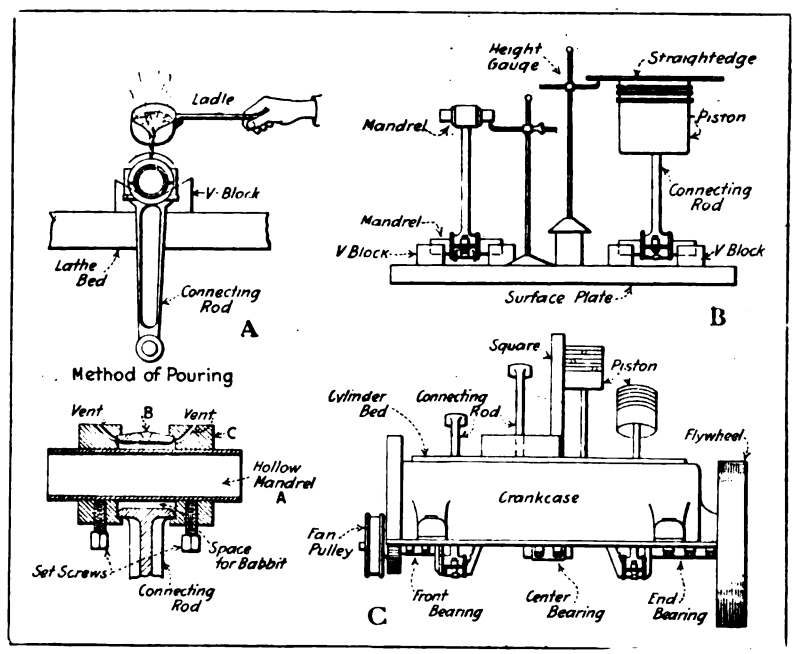


Fig. 1. Suggestions for remetalling connecting rod bearings when bearing metal must be poured in

Testing Bearing Parallelism

It is not possible to give other than general directions regarding the proper degree of tightening for a connecting rod bearing, but as a guide to correct adjustment it may be said that if the connecting rod cap is tightened suffi-

Digitized by Google

ciently so the connecting rod will just about fall over from a vertical position due to the piston weight, when the bolts are fully tightened up, the adjustment will be nearly correct. As previously stated, babbitt or white brass bearings can be set up more tightly than yellow bronze (now seldom used), as the metal is softer and any high spots will soon be leveled down with the running of the engine. It is important that care be taken to preserve parallelism of the wrist pins and crankshafts while scraping in bearings. This can be determined in two ways. That shown at Fig. 1, B, is used when the parts are not in the engine assembly and when the connecting rod bearing is being fitted to a mandrel or arbor the same crank case, and that member secured in the chassis frame, a steel square may be used as outlined at Fig. 1, C, as it is reasonable to assume that the wrist pin, and consequently the piston it carries, should observe a true relation with the top of the engine base. If the piston side is at right angles with the top of the engine base it is reasonable to assume that the wrist pin and crank pin are parallel. If the piston is canted to one side or the other, it will indicate that the brasses have been scraped tapering, which would mean considerable heating and undue friction if the piston is installed in the cylinder on account of the pressure against one portion of the cylinder wall. The height gauge method shown above consists of a casting having guide bearings to support an arbor on which collars are placed. These serve to hold the molten metal in the bearing boxes in the crankcase while it cools. The metal is heated in a ladle over a plumber's kerosene or gasoline fired melting pot, by a brazing torch or charcoal fire in a form.

As a general rule the best temperature at which to pour the babbit metals is that when the commotion ceases around a piece of soft white pine immersed in the bath. At this temperature the metal has a clear, silvery, mirror-like surface, from which oxide dross is easily skimmed and on which it is slow to re-form. At the same temperature the metal takes a neat mold

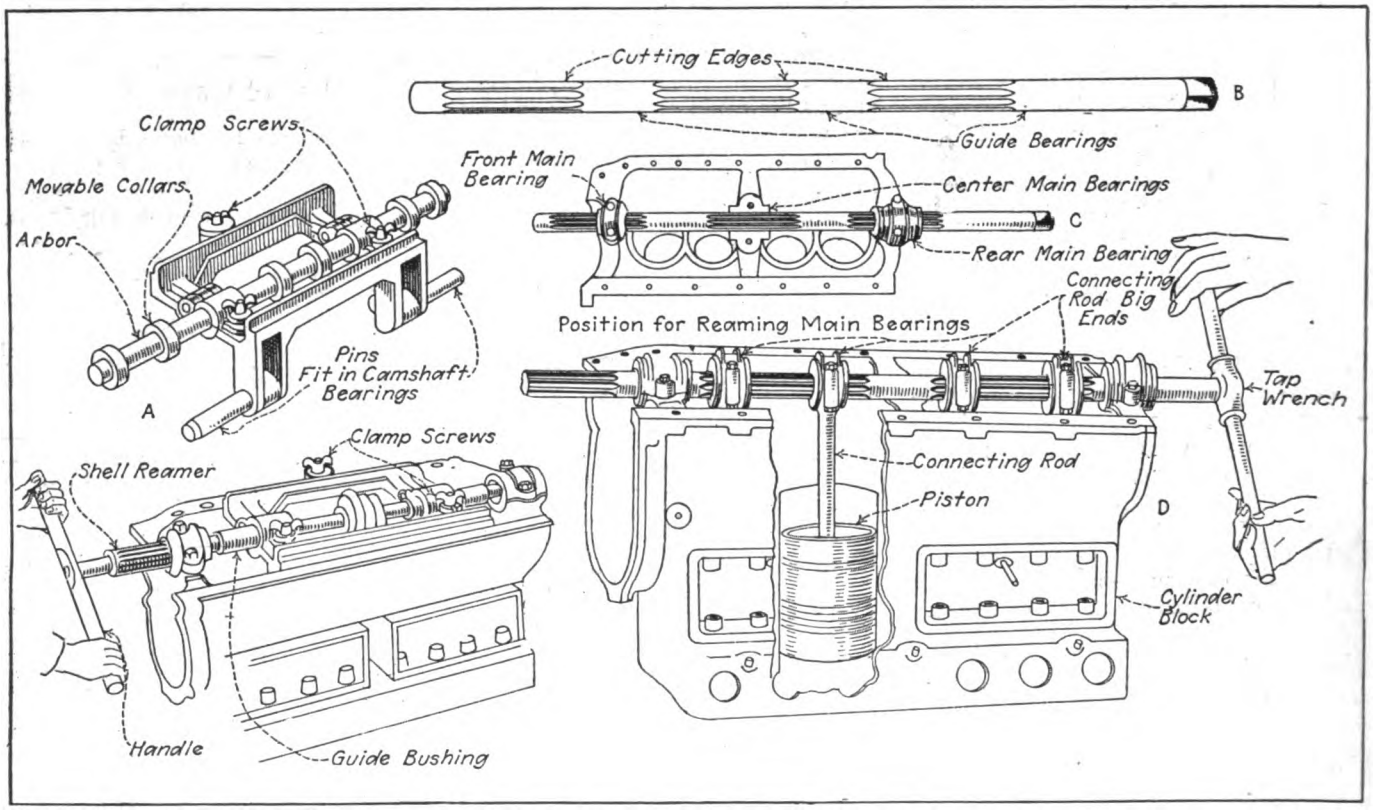


Fig. 2. Diagrams showing special fixtures to assist in remetalling main bearings and how poured bearings may be fitted by a reaming process

size as the crank pin. The arbor, which is finished very smooth and of uniform diameter, is placed in two V-blocks, which in turn are supported by a level surface plate. An adjustable height gauge may be tried, first at one side of the wrist pin which is placed at the upper end of the connecting rod, then at the other, and any variation will be easily determined by the degree of tilting of the rod. This test may be made with the wrist pin alone, or if the piston is in place, a straight edge or spirit level may be employed. The spirit level will readily show any inclination while the straight edge is used in connection with the height gauge as indicated.

When the connecting rods are being fitted with the crankshaft in place in may be used instead of the steel square, if desired, because the top of the crank case is planed or milled true and should be parallel with the center line of the crankshaft.

Remetalling Main Bearings

What has been said in regard to remetalling and refitting connecting rod bearings applies just as well to the pouring of bearing metal in the cylinder block of such cars as the Ford, which still use poured integral bearings of babbit rather than removable brasses of white metal. Special aligning and pouring jigs and reamers make the operation of bearing replacement a comparatively simple one. A typical pouring fixture is shown at Fig. 2. This impression and will usually be found free from those surface discolorations arising from over-heating.

The use of aligning reamers and fixtures insure that the bearings will be reamed out to the proper size, making refitting a very simple task. A typical combination fixture that serves either for holding a babbiting arbor or guiding the bearing finishing reamer is shown at Fig. 2 A. This has locating pins which fit the camshaft bearings and insures that the crankshaft will be parallel to the camshaft when the bearings are finished. A very simple aligning reamer is shown at Fig. 2 B, and its use for reaming main bearings is outlined at C. After the main bearings are properly fitted, they can be used as supports and all the connecting rod big

Digitized by Google

ends may be reamed as shown at D. The practice of reaming bearings is growing and is not confined to cheap cars, by any means. Expensive hand scraping is largely eliminated and the repairman is sure the bearings will be in line if reamed altogether as the aligning reamer permits.

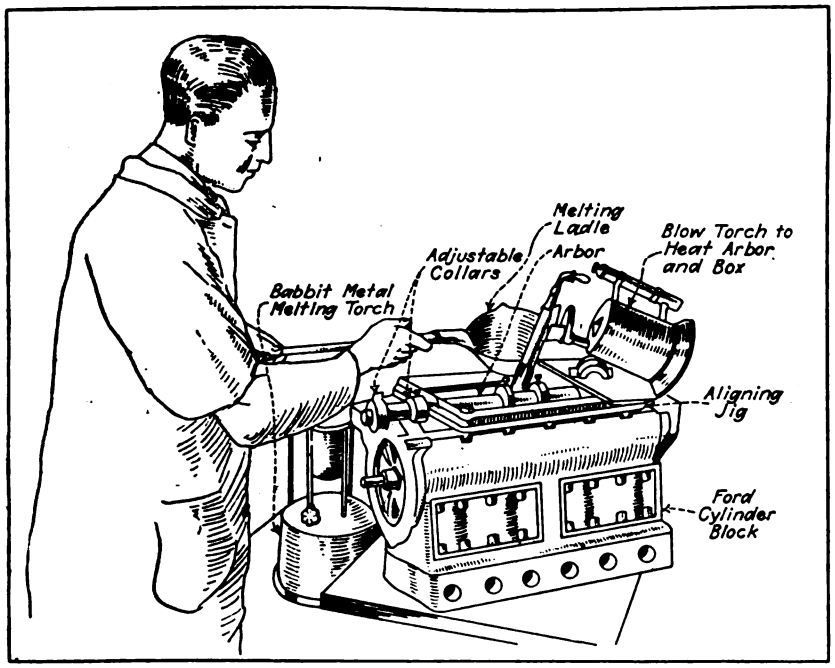


Fig. 3. Showing method of pouring bearing metal in the main bearings in cylinder block of Ford engine showing use of mandrel and aligning fixture

Coatings that Prevent End Checking

WOOD, whether in the form of logs, lumber, timber, shaped blanks or veneer, will split and check at the ends during seasoning if drying is allowed to go on at a natural rate through the end grain. To retard the rate of drying from the ends, it is necessary to cover them with some protective coating.

The law of end coatings, in simple terms, is that the harder and greener the wood, the more effective must be the coating. In its experiments to determine the practicability of various coatings and end dips, the Forest Products Laboratory found the following to be true: *Paint* is convenient to handle, but is of low effectiveness. *White lead* is convenient to handle, and is of medium effectiveness. *Lorac*, a commercial compound, is convenient to handle, and is of considerable effectiveness. *Rosin-lampblack* is inconvenient to handle, but is of high effectiveness.

Rosin-lampblack is made according to the following formula:

Clear grain rosin....60 parts by weight
Lampblack ..... 1 part by weight

The rosin should be melted but not allowed to boil or froth. The lampblack should then be thoroughly stirred in. The ends of the sticks should be dipped in this molten mixture to a distance of about ½ inch. When hard the coating should be smooth, free from bubbles, shiny, and an eighth of an inch thick over the end.

If the stock is to be subjected to rough handling which might cause the coating to chip when cool, linseed oil may be added, in the proportion of 1 to 15 by weight, but this will have a tendency to make the coating excessively soft in the kiln at temperatures above 130° F.

Life of a Locomotive

THE iron horse does not last much longer than the horse of flesh and bones. The ordinary life of a locomotive is said to be thirty years. Some of the smaller parts require renewal every six months; the boiler tubes last five years, and the crank axles, six years; tires, boilers and fire boxes from six to seven years; the side frames, axles and other parts, thirty years. An important advantage is that a broken part can be repaired, and does not condemn the whole locomotive to the junk shop; while, when an animal breaks a leg, the whole is only worth the flesh, fat, and bones, which amount to a very small sum in this country, where horse flesh does not find its way to the butcher shop as it does in France and Germany.

Removing Iron Plate Rust

A CHEAP and effective method of removing rust from corroded and pitted iron plates has recently been evolved as a result of experiments described in *Machinery*. It consists in applying to the surface of the iron a mixture of two parts of finely crushed sodium bisulphate (sodium acid sulphate, Na_2So_4, H_2SO_4, $3H_2O$) and one part of common salt, which is moistened just enough to make it cohesive. The moist mixture can be left on until the plate is clean, but the action is more rapid if the mixture is scraped off every two or three hours and the iron scrubbed thoroughly with a wire brush and water; the treatment is repeated until the plate is clean. Usually 24 hours is sufficient for a badly corroded plate. When the plate is thoroughly clean it is well washed with an alkaline solution and dried quickly. A coating of paraffin oil (kerosene) is at once applied to protect the surface against oxidation. The metal is then ready for the paint or other protective covering. This method has been found to be more effective than hammering, chiseling, the use of wire brushes, or even a sandblast.

Uses of Castor Oil

APART from the needs of the aircraft, for which very large quantities of castor oil are required as lubricant, only 25 per cent. of the oil extracted, if quite that much, is consumed in the various departments of pharmacy. The other fields of employment are much more extensive than is generally realized. For instance, castor oil figures to a large extent in the manufacture of artificial leather, which is used in upholstering. Castor oil is an essential component in some artificial rubbers, and there are various kinds of celluloid which depend upon this product of the castor bean. Castor oil furnishes a very satisfactory coloring for butter; and from castor oil is produced so-called "Turkey-red oil," which is an important factor in the dyeing of textiles and in the treatment of the fabrics.

One of its largest uses is in the making of transparent soaps. Castor oil yields sebacic acid, which is superior to stearic acid in the manufacture of candles, and from it is also obtained caprylic acid, which lends itself to the composition of varnishes peculiarly suited to the polishing of all kinds of high-class furniture, carriage bodies and paintings, and is extensively employed in the preparation of vellum, tracing cloth, etc. Caprylic acid plays a part in the production of ethers which are used by perfumers and confectioners. Castor oil is used in the making of certain waterproof preparations, and a liquid disinfectant is obtained from the "seconds" or lower grade oil. The oil is an admirable preservative for various kinds of leathers, is extensively used in the leather industry, and is particularly serviceable in adding to the service life of leather belting employed in heavy work. Our fly papers would not be so effective if it were not for castor oil, and the oil enters into the composition of a great many adhesive agents.

Digitized by Google

The Chemistry and Physics of Flame

By W. C. Dumas

SUCH an apparently simple phenomenon as the combustion of a gas with its visible manifestation called flame is very interesting when considered in detail.

Flame is nothing more than a combustible gas heated to incandescence. It is a chemical combination made visible. During this combination light and heat are produced. The words "to burn" usually convey the idea that carbon itself, or one of the many compounds of carbon, unites with oxygen producing the flame, and having as end products carbon dioxide and water.

Simply stated, this is the usual mechanism of flame, but flame and burning may take place when oxygen is not concerned at all. For instance, hydrogen will burn in chlorine producing hydrochloric acid.

In ordinary burning, the actual flame is produced by the combination of gaseous decomposition products with oxygen. When flame is observed in the burning of wood, coal, or a candle, it is due to the fact that at high temperatures gaseous decomposition products are formed.

When a gas can be made to burn in air or oxygen, it is spoken of as a combustible gas. However, this term is only relative, as oxygen can be easily made to burn in ordinary illuminating gas. When air burns in gas, the flame is known as the *reverse flame* to distinguish it from the *direct flame* produced by gas burning in air. Both the reverse and direct flames can be produced by the following experiment:

B is a medium sized lamp chimney fitted at the bottom with a large two-holed rubber stopper. The tube, *b*, which is connected with the gas supply, is of rather small bore, while the tube, *c*, opening into the outer air, is of a relatively large bore.

The chimney, *B*, is first removed and the gas lighted at the end of the tube, *b*, at *g*, and regulated so that the flame is only about half an inch long. The stopper is now replaced in the bottom of the chimney and the gas continues to burn at *g*. Now slowly turn the gas up to full height. The flame leaps from *g* to the end of the tube, *c*, connecting with the air. A large pale flame, *d*, is formed on the end of *c*. At the same time, a second large flickering flame develops at the upper opening of the chimney. This is the flame, *e*, in the diagram.

The flame, *d*, is *air burning in gas*, and at the same time the excess gas escaping at *e* ignites and burns in the outer air. When this takes place there is no longer any flame at all at *g*.

This experiment shows both the direct and reverse flames. The flame at *e*, gas burning in air, is a direct flame, while the flame at *d* is a reverse flame or air burning in gas.

This experiment can even be carried further, as shown in Figure 2. If a very small glass tube, *k*, is bent and carefully inserted in *c* and then the gas slowly passed through it, a tiny blue flame, *f*, will appear in the larger flame. This is a flame within a flame. To summarize, we can say that the flame, *e*, is gas burning in air; the flame, *d*, is air burning in gas; and the flame, *f*, is again gas burning in air. All of these phenomena are taking place at the same time.

An examination of the actual structure of the flame is interesting and instructive. It can be very clearly illustrated by a diagram of the ordinary candle flame shown in Figure 3.

The candle flame has three primary zones. The central zone, *a*, consists of volatile compounds which do not burn. The zone, *b*, is the luminous zone, while the outer zone, *c*, is non-luminous.

When a candle is lighted, the following changes take place: The stearin is first melted and by capillary action the liquefied stearin is drawn up into the wick. The heat volatilizes the hydrocarbons forming the central zone, *a*, in which there is no combustion. The existence of combustible gases in this zone can be demonstrated by inserting the end of the bent tube, *e*, into the inner cone. When a light is applied at the other end of the glass tube, the flame, *d*, will form and burn. This is an actual burning of the combustible gases passing out from the inner cone.

The dark central zone is surrounded by a luminous zone, *b*. In this mid-luminous zone of the candle, the hydrocarbons, mainly ethylene, C_2H_4, passing from the inner cone, are broken down into methane, CH_4, and carbon. The methane uniting with oxygen burns completely to carbon dioxide and water while the separated carbon is heated to incandescence. This is the cause of the luminosity of the central zone. There is not enough oxygen present in this zone to unite with all of the carbon.

The presence of free, unburned carbon in the mid-central zone of the candle flame can be shown by inserting a cold glass rod into it. The carbon particles will adhere to the cold surface and be deposited in the form of soot.

The third part of the flame is the non-luminous outer zone, *c*. In this zone combustion is complete. The carbon which is present in the central cone passes outwardly and is burned completely in the zone, *c*, with the formation of carbon dioxide.

Flames may be so nearly non-luminous as to give little or no light. The hydrogen flame produced by the combustion of hydrogen gas in air is almost invisible because water is the end product and there are no solid particles of carbon to be heated to incandescence.

The familiar gas flame, very luminous from its incandescent carbon particles, can be made almost non-luminous by introducing a large amount of air and letting it mix with the gas before it burns.

Every substance which will burn has to be raised to a certain definite temperature before combustion takes place.

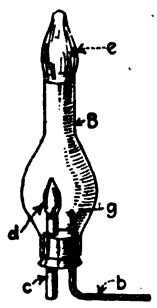


Fig. 1

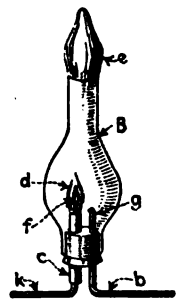
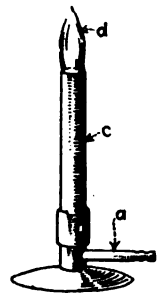


Fig. 2



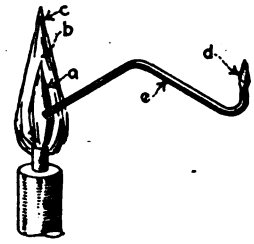


Fig. 3

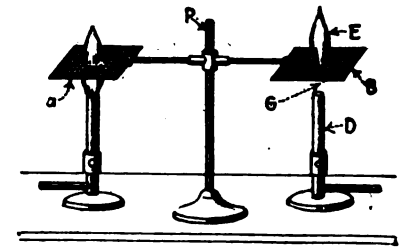


Fig. 4

Digitized by Google

This temperature is called the temperature of ignition and is fairly constant for a given substance. Every gas has its kindling temperature. This ignition temperature must be reached before the flame will appear, or, in other words, before the gas will burn. The following experiment illustrated in the diagram in Figue 4 shows this:

A and *B* are two squares of close mesh wire gauze clamped in the holders of the stand, *P*, as shown in the diagram. If the gas is turned on the burner, *D*, and a match applied above the gauze, *B*, the flame, *E*, will appear and burn while the space, *G*, between the bottom of the gauze and the top of the burner will be cool and free from flame.

This is because the wires of the gauze conduct the heat produced away so fast that the gas rising from the burner under the gauze is not heated to its ignition temperature. But if a light is applied below the gauze, the flame will burn both above and below the gauze as shown on the left. In this case, the match raises the temperature of the ascending gas high enough for it to ignite.

This principle was long ago utilized in the miner's safety lamp. The light is enclosed in a screening of fine wire gauze. If such a lamp is carried into the atmosphere of a mine containing an explosive mixture, the dangerous gases are not ignited. Instead, they simply pass through the meshes of the gauze into the lamp and burn quietly there.

The actual temperature of the average flame is much lower than might be supposed from theoretical considerations. For instance, when hydrogen gas burns in oxygen, the calculated temperature is 6600 degrees Centigrade, but if the temperature is actually measured it will not be found in excess of 2500 degrees Centigrade. There must be some basic reason for such a great discrepancy.

The temperature of 6600 degrees Centigrade could be obtained at a given point if oxygen and hydrogen united instantaneously and completely, and if the steam formed were not again dissociated partially into the component gases. At 1300 degrees Centigrade the formation of water is checked by the opposite process of dissociation of steam by heat. This process of dissociation absorbs heat, so the theoretical temperature of burning hydrogen cannot be obtained. The combustion cannot take place at any particular point but must be gradual throughout the whole extent of the flame.

Construction of Thermo-Electric Cells

By Roy Franklin Heath

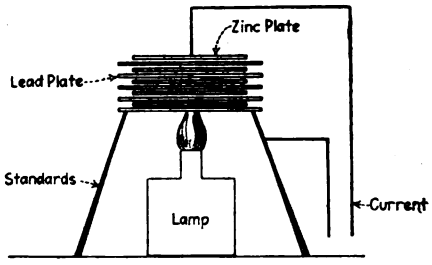
THE thermo-cell or battery is a device which is capable of converting radiant heat waves into electrical energy. The action of these cells is not clearly understood by scientists.

All of the metals have been classified and their thermo-electrical properties are fairly well understood. If two dissimilar pieces of metal are brought in contact and the junction heated, an electric current will be produced. If just two pieces of metal are employed to form the battery, the current produced will be almost beyond measurement with the crude means generally at the disposal of the experimenter. For this reason, a number of pieces of metal are used, which cause a measureable current to flow in the circuit when the heat is applied.

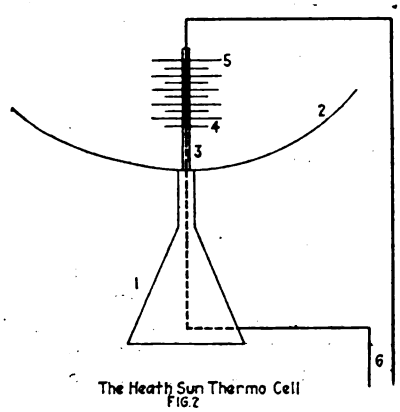
Figure 1 gives a design for a small thermo-cell made by zinc and metal plates arranged alternately in the same manner as the plates of a Volta pile are grouped. There should be a lead plate at one end of the cell and a zinc plate at the opposite end of the cell. The cell shown was designed to be used with a Bunsen burner or alcohol lamp as the source of heat. The lead plates are three inches in diameter and the zinc plates two and one-half inches in diameter.

Figure 2 illustrates a different type of thermo-battery which receives its heat from the sun. The heat waves are brought to a focus by means of a parabolic reflector (2). Bismuth plates (5) and antimony plates (4) form the active elements of the battery. These are arranged upon a standard which is mounted in the center of the reflector so that the battery will be in the focus of the heat waves.

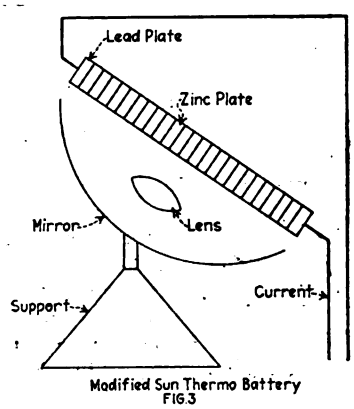
A third form of thermo-cell is illustrated in Figure 3. This, too, employs a parabolic reflector and a concentrating lens. The cell makes use of the electro-thermic properties of the metals zinc and lead. An especially long type of cell is employed in this case.



Simple Thermo-Cell or Battery
FIG.1



The Heath Sun Thermo Cell
FIG.2



Modified Sun Thermo Battery
FIG.3

The best time to experiment with thermo-cells is during the summer months. This is especially true in the northern regions of the country.

To carry on experiments with thermo-cells and electro-thermic phenomena, a good sensitive galvanometer or electrometer is needed for current detection and measurement.

In work of this nature, the experimenter has before him a very little explored field. Great possibilities lie with thermo-cells. The problem of converting heat waves directly into electric current will probably be solved through the medium of the electro thermic cell. The construction of the simple cells outlined in this article will do much to give the experimenter a start in this interesting study. At the present time, the world is just waiting to crown the man with glory who is able to produce a practical cell capable of rendering commercial service.

An experimenter named Seebeck discovered the method of producing electro-thermic currents in the year 1822. In 1834, Peltier discovered a phenomenon which is the converse of that discovered by Seebeck. Peltier found that if a current of electricity was sent through a junction of dissimilar metals that the junction is either heated or cooled depending upon the direction of the current.

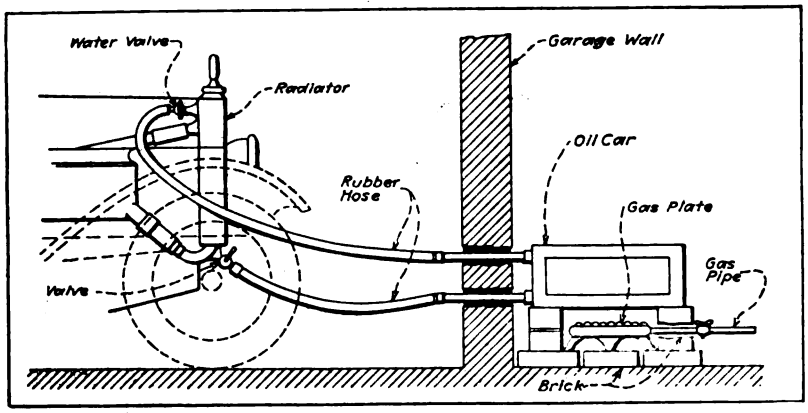
It may be possible to produce an intense cold by the use of this peculiar effect.

Digitized by Google

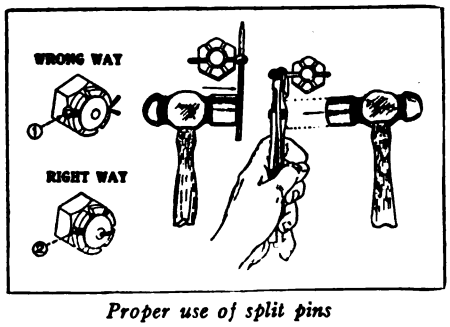
EVERYDAY MOTORIST

Garage Heater

THE outfit illustrated consists of a small box or house close to the rear of a garage in which an oven of firebrick is placed on the ground to surround a burner supported to clear the ground. The four-inch gas burner is placed in the center of the oven and connected through a shut-off valve to the gas supply of the house-lighting system. A two-gallon gasoline or oil-can is placed over the burner setting on the brick sides of the oven and clearing the burner three or four inches. Two ⅜-inch pipes were run from the side of the can through the wall of the garage, one pipe above the other. The pipes are attached to the can by soldering brass nipples to it. Rubber tubing, ½-inch bore, leads from the pipe to the radiator of the car, the lower tube being connected to the drain petcock and the upper tube is carried in an easy curve to a petcock soldered at the top of the radiator inside. When the automobile is run into the garage for the night the hose are connected at the top and bottom of the radiator, the petcocks opened and the gas lighted at the burner. The water will heat in the tank and a circulation will be started through the radiator that will keep the cooling liquid warm and the car ready for use at a moment's notice. The degree of heating is easily controlled and the only precaution is to see that the heating can and pipes and the tank of the radiator are kept full and that the upper pipe slopes gradually upward and does not sag or kink anywhere, otherwise air or steam locks may stop circulation.



Simple heater for garage



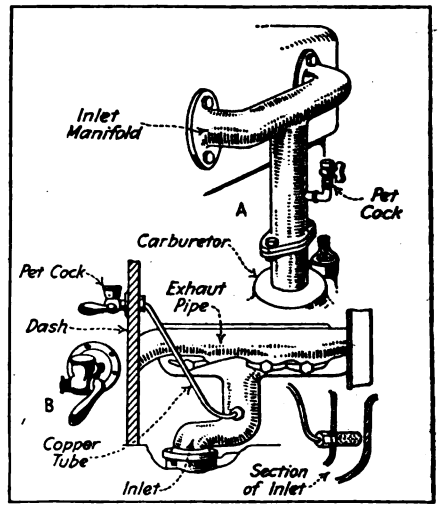
Proper use of split pins

Proper Use of Split Pins

THE most common form of nut retention is by employing a split pin in connection with a castellated nut. A number of tools have been described for cotter-pin removal, but many owners of cars do not possess anything but the tools furnished with the repair kit. Two methods of doing this work easily which do not require the use of a special tool are shown. One of the best ways for getting an ordinary split pin out of the hole is shown at the top of the illustration. The pin is grasped between the ordinary combination plier jaws and a hammer is used against the plier to draw out the pin. The other method, which is shown below, consists of inserting a steel drift pin or nail-set through the hole in the cotter-pin head and then striking the drift with a hammer. It will be found that the removal of the pin will be expedited considerably by squeezing the ends together, if they are spread, with the pliers before attempting to withdraw the pin from the hole. It is not generally known that there is a wrong and right way to do such a simple thing as securing a split pin. These are shown at 1 and 2 in accompanying cut. In the former, the head of the cotter is not in the slot of the nut because it is turned wrong and the ends are not split right. This combination may work loose. At 2, the right way is shown, as the head is pounded down firmly in the slot of the nut and the ends of the pin are securely held as one end is pounded back over the end of the bolt, the other leg being bent down. The cotter pin is a positive lock when installed in this manner.

Simple Priming Devices

SEVERAL simple priming devices may be constructed by anyone of average mechanical ability to facilitate motor starting in cold weather. One such equipment is shown herewith and comprises a dash priming cup, tubing connecting it with the intake manifold and a spraying device, which is shown separately in the drawing. It will be noted that the last named member is perforated. To utilize the primer a little gasoline or ether is poured into the cup on the dash and the lever turned slightly to admit the fluid, also a little air. The fuel flows through the tube to the perforated member and upon cranking the engine the air drawn in through the choked-down air-intake of the carburetor and petcock breaks up the fuel, converting it into a rich mixture.



Simple priming devices

It is stated that the motor will start readily even in the coldest weather. The material required to install the primers consists of a petcock, which is secured to a plate on the dash, a connector having a tubing and pipe-thread end, one-quarter-inch annealed copper tubing, and a union. To the last named is soldered a piece of brass tubing which is drilled full of No. 62 drill holes. Its length should be approximately that of the diameter of the intake pipe, into

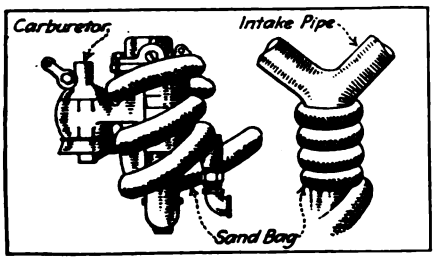
Digitized by Google

which it is inserted by drilling and tapping a hole. The manner of installing the parts is clearly depicted in the drawing. It is stated that the equipment described can be made at a slight cost. A simpler installation is also shown, this consisting merely of a petcock threaded into the intake manifold. It has the disadvantage that it is inaccessible as it can be reached to be filled only by raising the hood. The owner of a Ford states that he has obtained increased mileage by the use of the primer, as the petcock on the dash may be opened to admit auxiliary air. In average running in warm weather he has secured 26.5 miles to the gallon and 32 miles on long trips.

Warming Manifold for Easy Starting

ONE finds numerous instructions for easy starting of a gasoline engine under conditions of low temperature when the gasoline does not evaporate readily. Some writers have recommended the use of hot cloths heated by being saturated with boiling water, others have advised to heat the manifold with an ordinary blow torch.

The necessity of keeping the naked flame away from gasoline is apparent to any one familiar with this liquid and it is also evident that water dripping from a saturated cloth in through an auxiliary air valve and freezing would cause considerable trouble on account of being matter out of place. An excellent method of heating a carburetor or manifold without any danger is to use a tube of cloth or long bag which is filled with sand and heated in an oven, after which it may be wrapped around either the carburetor or manifold as



Safe method of warming manifold

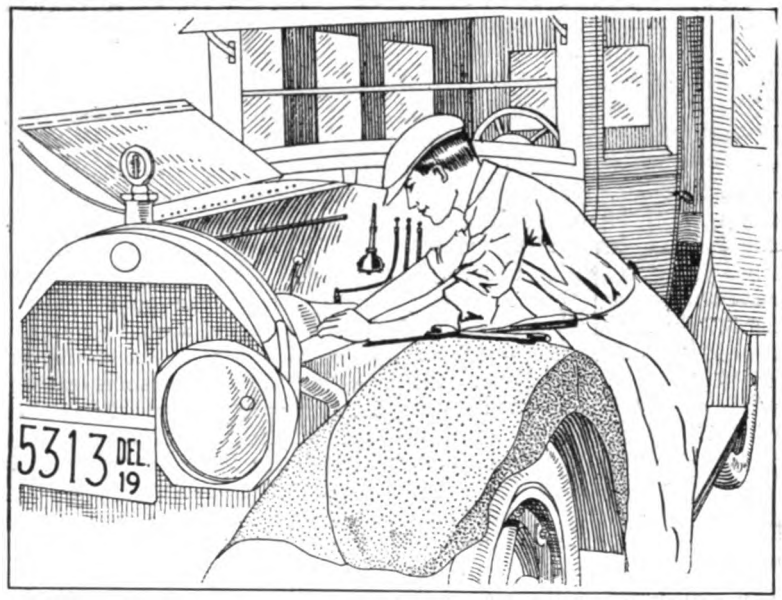
shown without any danger of fire as is present when a torch is used or getting ice into the carburetor as is possible when wet cloths are employed as a heating medium. Electrically heated primers are now available that will assist in easy starting; these are not expensive and can be installed without much trouble.

Tighten the front spring clips occasionally. This may prevent a broken spring or the axle shifting out of line and greater safety will be insured together with less tire wear.

Cover for Mudguard

AUTOMOBILE repair men, the opinions of many car owners notwithstanding, do not like to be called upon to make embarrassing apologies for scratching, marring and otherwise damaging the varnish on mudguards, hoods and car bodies while they are undergoing repairs in their shops.

The accompanying illustration shows a new fender protector that can be easily made by the mechanic or that may be purchased on the open market.



Cover to protect finish of mudguards

It is made of a leather substitute consisting of a strong cotton fabric base coated with pyroxylin "dope." It has a pocket along the outside edge into which the edge of the mudguard is inserted. A flap on the cover runs down on the inside in such a way that the finish is entirely covered while the mechanic is leaning over it to work inside the hood. Thus the buttons on the clothing cannot scratch the varnish, nor is any harm done if he drops a tool or lays it down on the mudguard, which is a very handy receptacle or shelf for tools and parts not in use.

Motor Fuel Intensifiers

MANY ideas have been advanced for adding substances to motor gasoline to increase its volatility, fuel value or give it carbon removing properties. There is considerable difference of opinion regarding the value of such agents.

The best one unquestionably is ether. Of course ether cannot be put into a tablet or powder form. As a matter of fact, ether is so powerful that one can use kerosene to run a gasoline engine if he fortifies it with ether sufficiently. Most of the carbon Removers are nothing more than "Flake Tar Camphor" compressed into cake form or dissolved in gasoline. Manufacturers of these claim that besides removing carbon, it also gives more power and more mileage. It may do all three, but authorities are now almost convinced from actual experience that it does not do any of the three. A mixture that would do for both more power and mileage, and also for removing carbon, would be as follows:

Ether	1 part
Acetone	1 part
Turpentine	1 part

One ounce of this to 5 gallons is said to be enough to show results, and its advocates do not recommend more than 1 oz. to 2 gallons of gasoline.

When lubricating the car, look for oil holes that are stopped up with mud and clean them out with a piece of wire. All holes should be covered with an oil cup, but sometimes manufacturers do not take this precaution, leaving the holes open, especially on brake cross shaft and clutch pedal shaft support bearings. If the impediment is not removed the oil cannot reach the bearing surfaces. Do you fill the universal joints about every 500 or 1,000 miles? Perhaps you are wondering why the car is noisy in action. Don't wait until they squeak or develop back lash but be sure to keep these hard working parts properly oiled.

Watch your steering mechanism closely. Do not allow too much lost motion in the wheel. A careful inspection should be made from the wheels back to determine that all parts of the steering linkage are tight and properly adjusted. Periodical adjustment and lubrication will insure not only easier control of the car, but greater safety as well.

Digitized by Google



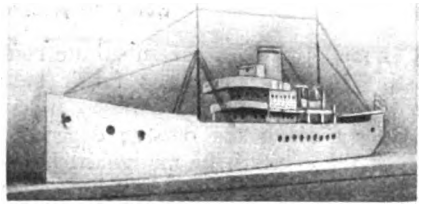
THE JUNIOR EXPERIMENTER

A Cardboard Model Passenger Steamer

By Edward Beal

FOR a model dock, on a railroad system of 7/8 in. gauge, this waterline steamer was made by the writer some time ago. The model cost absolutely nothing to make, all material being waste or surplus. The vessel is exactly 3 feet in length by about 4½ ins. maximum beam. Since it was modelled merely to occupy a spare corner on the dock itself, there was little need for strength to be considered. Yet the model is strictly designed to a scale of 3/16 of an inch to the foot. It has been called a passenger steamer, though it can also claim to be equally a freighter, the passenger "accommodation" only occupying a few inches. It was originally built as shown in the first photograph, but was afterwards dismantled as it was not exactly to scale, the finished product being that seen in the other photos.

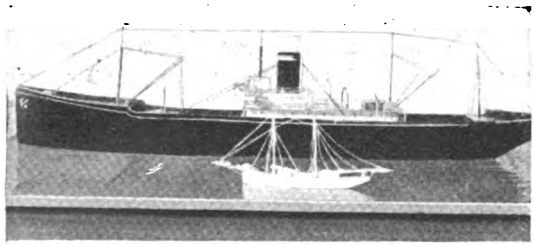
The hull was made from stout strawboard, cut from empty boxes obtained free from a dry-goods store. The pieces were fitted together with glued inside tabs, being cut to shape before being assembled. A similar base was fixed with strong pins, and the various decks were thus placed in position as the design stipulated. The decks were given the necessary curve to centre, being afterwards covered with gray, or pale brown paper, exactly to the color required. These decks, after thorough drying were marked out with a soft black pencil and straight edge, afterwards being placed in position. The deckhouses are of cardboard, glued into position, and marked out with deep black ink. In the center of each panel on the walls a porthole is fitted. The ports on the deck houses consist of very small eyelets used by shoemakers to make laceholes. These are merely forced into holes which are first pierced in the panel centers. The hatchways, which look very realistic, though they cannot be seen on the photographs, are made from the lids of Remington ribbon tin boxes, a piece of thick paper being stuck on the top, lined out as planking with a compass point, and painted. The ventilators, always very expensive items to buy from the various manufacturers, are simply short lengths of 1/8 in. iron wire, hammered over to shape and painted, afterwards being driven through the decks to the base. Handrails and staunchions are of white thread and headless pins, the latter painted after the model was completed, the enamel holding the thread in strict position. Davits and deck staunchions are of 1/16 in. iron wire, straightened carefully and enamelled white. The ports in the hull consist of the large type of shoemakers' eyelets, being brown. For hawse pipes on the deck and hull four of these eyelets were nipped in the pliers and took the exact shape required. Those on the bows of the hull are black, to contrast with the brown ports. The anchors are of cardboard, cut strictly to scale. A length of cable passes from the concealed ends of the anchor stocks and is wrapped twice over the winch. The winch is made in a very simple manner, but it looks quite real. Two small bell terminal bases were put together, the flanged ends outward, and a small watch wheel was then fixed with the terminal screw to the wrong end of each terminal. The result was a long brass bobbin with a wheel at either end. One of the wheels is a block and the other spoked. This portion was then placed on a pair of bearings which were glued down to the deck between the bows. The masts are made from disused paint brush shafts, the hairs being cut off and a piece of wire lashed on for a top-mast. The funnel is a Kodak film can, covered with white paper, a red band being attached to it. Rigging cord is black thread.



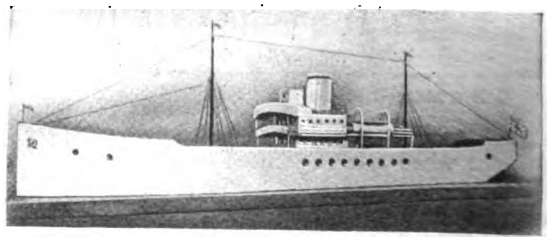
A side view of the finished model steamer

The hull was not painted, as paint on such a small model would tend to produce a thick and heavy look, but the whole was covered with white paper, trimmed after attaching. The life boats presented the most difficult task, but when once set about they were made in ten minutes. A small piece of wood was whittled with a pocket knife roughly to shape, after which the model was trimmed thoroughly with coarse and fine sandpaper. The steering wheel is a small watch-gear, painted brown. Abaft the boat deckhouse is a ladder and handrails leading to the main deck. This was the only accessory on the whole model to be purchased.

When completed, the vessel's appearance is very imposing, and it occupies an important place on the model dock already mentioned. Its "waterline" nature is no deprivation, since the dock is lined out with polished glass, laid on dark brown paper. The reflection of the ship in the water is no small factor in its realistic appearance.



At the left is shown the boat and a small sailing vessel at its side. The right shows another view of the completed boat



Digitized by Google

Well-Designed Crystal Detectors

Ideas for Making Crystal Detectors Are Suggested by These Types Built by the Wireless Specialty Company

AS is true of any radio instruments, the design of detectors must not be of the stuck together sort if the results are to be satisfactory. The extra work and expense of making good apparatus is always repayed in results and pride which can be taken in creditable work.

One of the first points is the crystal mounting. A detector crystal is not intended to be set in suspender clips, bent safety pins, spring binding posts, but put in a secure mounting which furnishes a proper contact with the crystal. It is necessary, of course, to try out the crystal before mounting. This can be done in a simple stand. Then when the sensitive spots have been located it should be set in an alloy.

A mould can be made by turning a small hole in a wooden or metal block, or by putting a brass rod in a length of brass tubing. The alloy may be soft solder and mercury. Setting the crystal is just a matter of putting a little alloy in the mould, and, when it is nearly cool but still liquid, pressing the mineral in it.

Four detectors, manufactured by the Wireless Specialty Apparatus Co., are shown as examples of good construction.

The type in Fig. 1 has three adjustments, two lateral and one vertical. The metal block which holds the crystal carries a rod which is fitted in a tube secured to a pivot screw. Inside the tube is a spring pushing against the rod, so that the crystal block is pressed against the two adjusting screws. By turning these screws the crystal can be moved in and out or to either side. A third handle varies the pressure of the contact.

Three stands of the same type are shown in Fig. 2. A universal adjustment is provided by the ball and socket which can be set by pressing the supporting strips together with a thumbscrew at the side. The contact is carried by a rod in a threaded barrel. This barrel can be screwed in or out of the ball, thus varying the tension of a spring located inside of the barrel which presses the contact rod forward.

Fig. 3, a galena detector, needs no explanation, as the design is an excellent example of the simplicity which should be characteristic of radio instruments. In Fig. 4 a combination of Figs. 1 and 3 is shown.

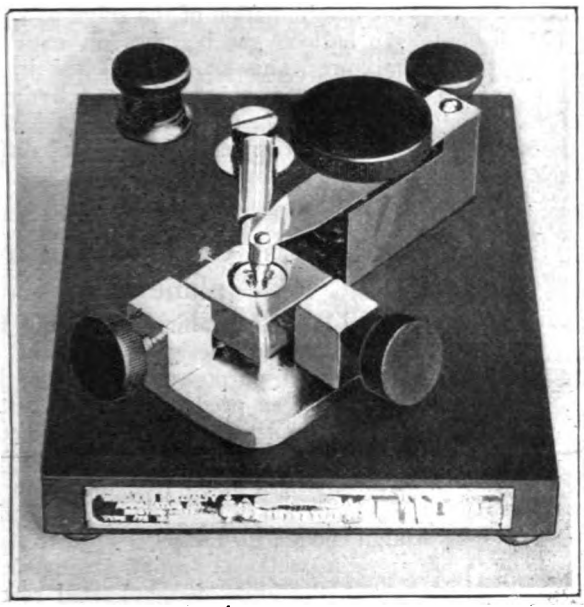


Fig. 1. While a universal adjustment is provided, the construction is so rugged that the detector will not jar out

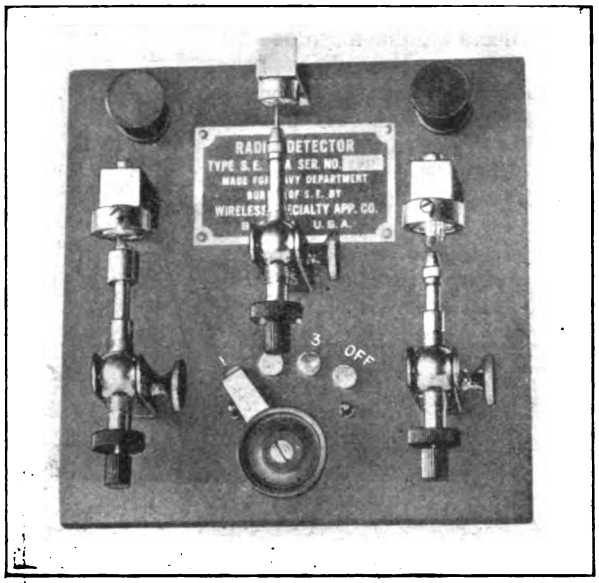


Fig. 2. The excellence of this design lies in the ball mounting and the adjustable spring tension

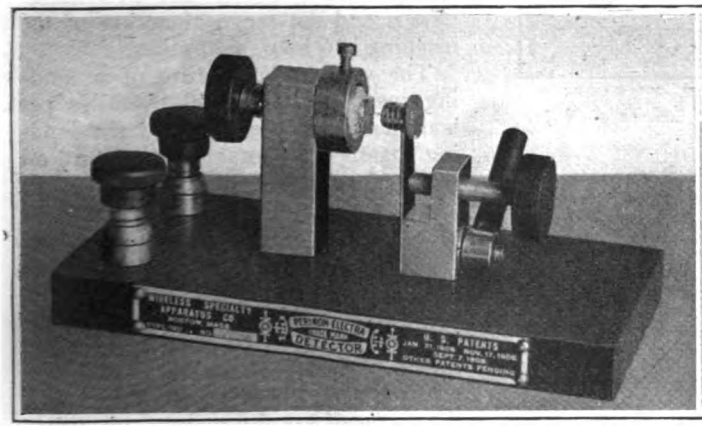


Fig. 3. Once adjusted, this galena detector will hold its setting, for it is both rugged and delicate

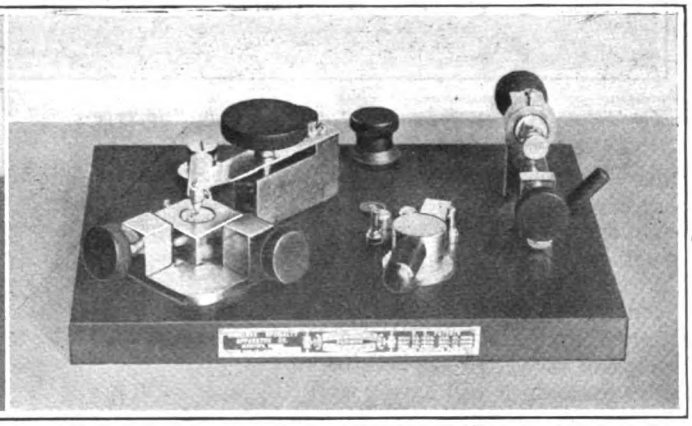


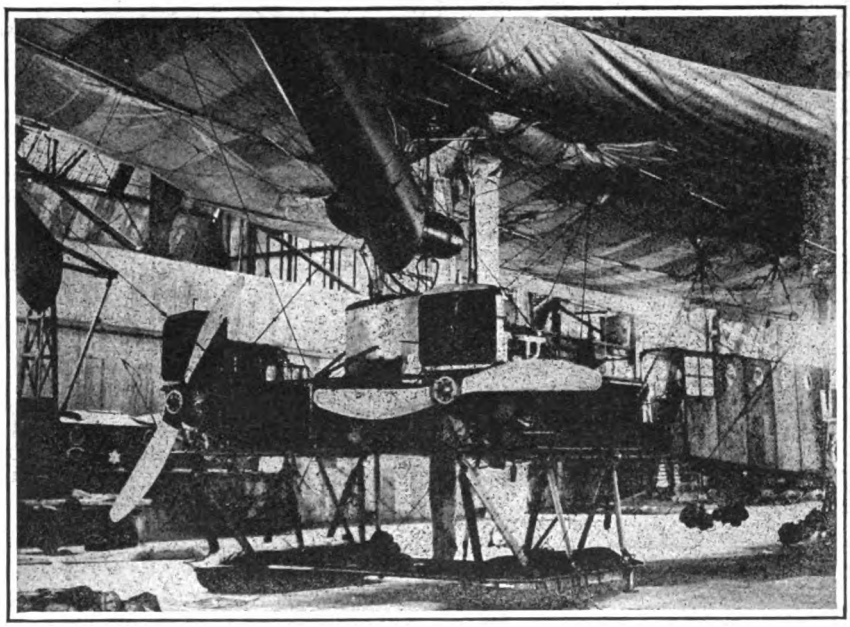
Fig. 4. Galena and silicon make an excellent combination of ruggedness and sensitivity. The switch is unusual in design

Digitized by Google

AVIATION BRIEFS

Metal in Airplane Construction

IN endeavoring to find a satisfactory substitute for spruce, which was hard to obtain in the required quantities in England during the war, Messrs. Vickers, builders of the machine that made the first non-stop flight from America to Europe, tried a number of experiments with metals of different kinds for the framework of aerofoils. Both high tensile strength alloy steel and duralumin were tried. Steel was not suitable for building pieces of thin section that had to be heat-treated on account of distortion during the heating process. Test spars for various machines were made of duralumin and these showed a saving of 25 per cent in weight over spruce members of the same strength. Wing frames made entirely of duralumin spars and ribs were made of equal strength to wood construction at only 75 per cent of the weight. A seaplane of very large size is being built by this firm which will have a total lift of fifty tons in which all important structural parts will be built entirely of metal, steel in some parts and duralumin in others.



The power plant arrangement of a British non-rigid type dirigible balloon used for coast patrol duty

Gas Leakage in Dirigibles

PERMEABILITY to gases is an inherent property of rubber and it can only be modified, not eliminated, by the method of manufacture of rubber coatings, says a writer in "Aviation." The best of the modern airship fabrics seldom have a permeability of less than 8 liters per square meter (.236 cubic feet per square yard) in 24 hours, measured at 25 degrees Centigrade (77 degrees Fahrenheit). Thus it comes about that there is always some diffusion of air into, and of hydrogen out of, a balloon, quite apart from the leakage of hydrogen which takes place through holes in the balloon when the pressure inside is greater than the pressure outside. The relative rates of penetration of rubber by hydrogen and air are not the same but are in the ratio of four to one; that is, when the enevelope contains approximately pure hydrogen, one volume of air passes through the fabric into the balloon for each four volumes of hydrogen leaking out. But the "air" passing into the balloon is richer in oxygen than normal air, owing to the fact that rubber is about twice as permeable to oxygen as to nitrogen. The method of determining the purity of balloon gas by measuring its oxygen content and assuming that nitrogen is present in the proportion in which it occurs in air is therefore obviously in error. A better method is to determine the specific gravity of the gas in the envelope, when the error in estimating the purity from the result, without actually finding the relative amounts of oxygen and nitrogen in the gas, is very small on account of the small difference in the densities of these gases. The determination of the oxygen content may be useful, however, from another standpoint, that of the determination of the stage at which the balloon gas becomes an explosive mixture. This stage is reached with a greater percentage of pure hydrogen than would be ordinarily the case, since the oxygen content of the "air" diffusing into the balloon is so high.

A British Commercial Airplane

WHAT is claimed to be the first airplane designed entirely for commercial purposes in England has recently been produced by the British Aerial Transport Co., Ltd. Although the span of the machine is only 46 feet, with a length of 33 feet, the cabin accommodation is 8 feet by 3 feet, and is high enough for the passengers to stand upright, while its seating arrangements are in the form of upholstered revolving bucket seats. Heating from the exhaust is provided when necessary and the admission of the heat is controlled by the turning of a button and it is claimed that inside the cabin there is no noise from the engines. Wireless telephones are installed for the purpose of communication with ground stations while in flight.

The engine is Rolls Eagle Series VIII, of 12 cylinders and 375 horsepower, and the range of action of the machine is 6 hours-600 miles.

The very useful feature of a landing speed as low as 40-45 miles per hour has been attained, and the landing chassis incorporates rubber and oil shock absorbers—working on much the same principle as the recoil mechanism of a gun. Another novelty in the construction of the machine is the provision of trimming gear, which enables the incidence of the horizontal stabilizer tail-plane to be varied according to the load carried and thus maintain a constant center of pressure, although the center of gravity may be other than the normal due to disposition of passenger load and its varying weight.

Caleb Bragg, flying a Loening hydromonoplane fitted with a 300 h.p. Hispano-Suiza engine, established at Port Washington, L. I., a world altitude record for seaplanes by ascending to 18,500 feet with a passenger.

Digitized by Google

The Hydrodrome, a New Gliding Craft Capable of a Speed of 70 Miles Per Hour

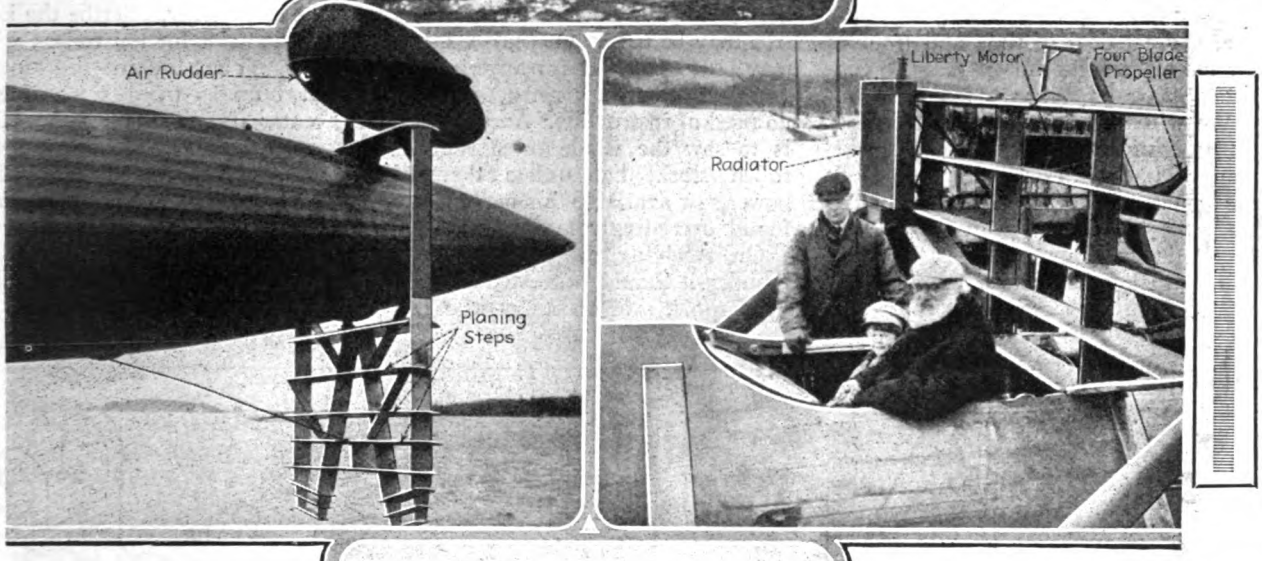
THE inventor of the telephone, Dr. Alexander Graham Bell has just completed a gliding craft that will skim over the surface of the water at record speed when the two Liberty Navy type or low compression aircraft engines are opened up. The energy available is 350 horsepower for each engine or an aggregate of 700 horsepower, and the thrust that produces the record-breaking speed is obtained from two four-bladed propellers. As will be noted from the accompanying illustration, the craft is of very novel construction and applies aeronautical engineering principles to a creation designed to operate in a medium having a specific gravity 800 times greater than that of air. Owing to this, the steps or hydrofoils needed to support the craft at full speed need be but 1/800th the area of the aerofoils that would be needed to carry an airplane of the same weight.

The craft is neither seaplane or hydroplane, though it operates on principles common to both of these craft. The main idea, that of reducing the resistance of the supporting medium by lifting the hull clear of it, is by no means new. Cooper-Hewitt in this country and the engineer Folanini in Italy both have experimented with superposed hydrofoils and even the early types attained considerable speed.

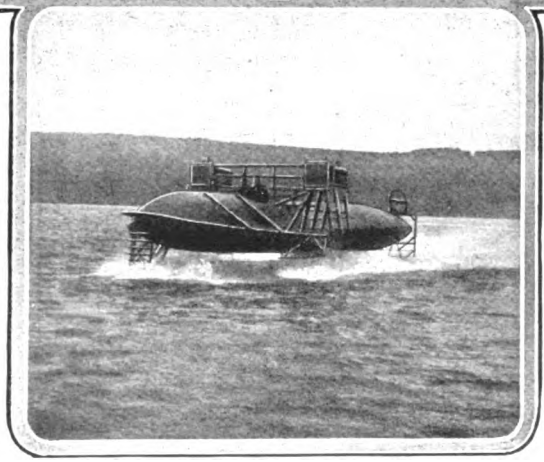


The hydrodrome at rest on the water is shown at right

Dr. Alexander G. Bell seated in the cockpit of the hydrodrome



The rear planing steps which also act as a rudder



When the hydrodrome is at speed it rides on planing steps

The photograph shows details of the steps, and while only those at the rear end of the hull are shown, it is easy to understand how similar planes are also installed at each side of the hull and at the front end. The planes are of steel and are large at the top and gradually become smaller as they near the bottom of the shutter-like frame. The rear set is used for steering. As the speed increases, the hull rises up more out of the water because less surface is needed to carry the weight as the velocity augments, just as in an airplane working in the lighter medium.

It is stated that the hydrofoils are supporting a ton load per square foot when the machine is making about 60 miles per hour. At one-third that speed, enough surface is immersed so the load is about 300 pounds per square foot. Doubling this speed results in ten square feet carrying the load, which is then sustained at a ratio of 1,000 pounds per square foot. The main portion of the craft is a torpedo-shaped hull of good streamline form, sixty feet long, having two outrigger hulls or pontoons sixteen feet long and connected to the main hull by a deck which assists in supporting the motors. This deck is in the form of a cambered top, flat under surface aerofoil, and when the machine is at rest, it is partly submerged

Digitized by Google



MECHANICAL NOTES

SHOP PRACTICE FOR AMATEUR MECHANICS

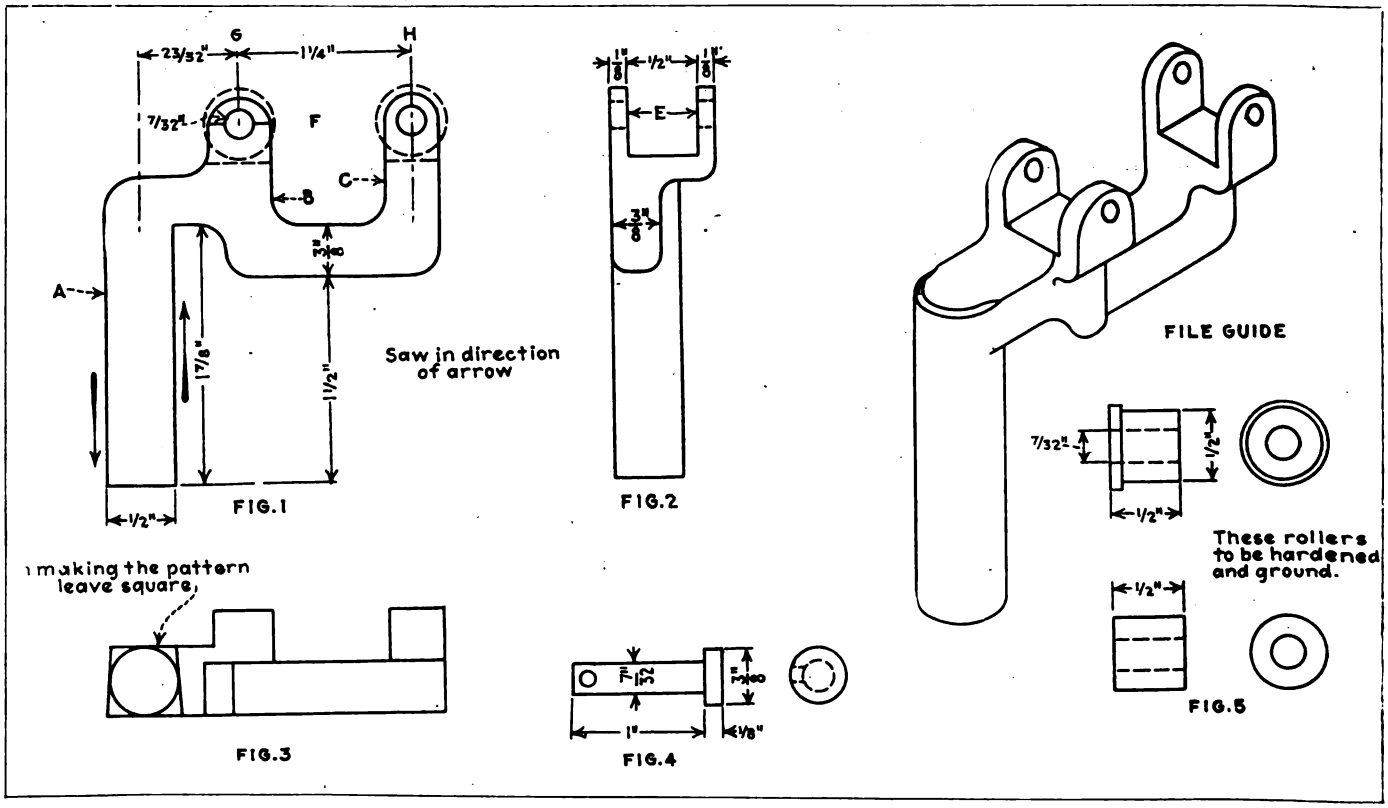
A File Rest and Index Head for Small Lathes

A VERY handy attachment for the amateur's lathe is a File Rest in combination with an indexed head. In making any small mechanical devices there is generally some part which has to be square or hexagonal. The usual amateur's equipment seldom includes a shaper or milling machine. Thus, it becomes necessary to worry the piece to shape with file and square, and the result—for most of us—is never quite satisfactory.

The little device described here will, to a very large extent, aid in the accurate squaring of small pieces and save a great deal of time and trouble; far more than the time it takes to construct it.

We will first describe the method of constructing the file rest. This particular attachment was designed to fit the amateur's bench lathe No. 125 made by the Goodell-Pratt Co. Leg A, Fig. 1, is cast square, as it is less difficult to make the pattern for a square casting than for a round casting. The pattern is cut from a solid piece of wood. Soft pine is probably the easiest to work, although mahogany or cherry are undoubtedly the best on account of their freedom from warping. A jig saw is the easiest way to cut the pattern, especially with one on which the table can be tipped. In this case, the table is set at an angle of about 85° which will give the requisite draft. The cuts are taken in opposite directions (see Fig. 1), and followed around the outline of the piece. The metal used is crucible steel, although if the amateur desires to save time in machining, cast iron may be used. Of course, the piece may be forged, but for anyone capable of this method of construction there is no need of instruction. Another method is to saw the whole piece from cold-rolled stock, but unless there is a power saw available this method will be found exceedingly tedious.

On receiving the casting from the foundry it should be treated as follows: First run it over an emery wheel to remove the scale. Next centers 1 and 2 (Fig. 1) should be prick-punched. In doing this, be sure that the line between the centers passes down the center of the leg and is as nearly parallel to faces B and C as possible. The casting is next center drilled on these marks, set between centers and machined to the finished size. In machining, it will be found necessary to compensate for the off-center weight of the casting by mounting a weight on the opposite side of the face plate. Unless this is done it will not be possible to machine the stock truly. Scribe the lines E and cut the slot for the rollers with a hack saw. The sides of the slots are next filed up as true as possible with the center line of the leg A. It is better to make the two slots of the same width as in that case the rollers will be interchangeable. Next comes the task of drilling the holes for the roller pins. The centers of these holes are found by scribing lines F which should be as nearly parallel as possible to the bed of



Digitized by Google

the lathe when the casting is set in the tool rest. One of the easiest ways of doing this is to place the casting in the tool rest and a scribe in the tail stock. Place the tool rest on the ways and set the casting to the desired height. Press it against the scribe and move the tool rest across the ways so that the scriber will mark a line. The intersections of line F with the center lines G and H of the arms are thus marked and may be prick-punched. The holes may now be drilled, but great care must be taken that the center lines of the holes are parallel to the lathe bed as otherwise the work done with the tool will not be accurate. One method by which the holes may be accurately lined up is described as follows: Place the casting in the tool rest and parallel with its foot or base. Clamp the tool rest at right angles to the ways (a fairly accurate right angle setting may be obtained by use of the try square). Chuck a 7/32-in. drill and true it up. Loosen the clamp of the tool rest and move the casting till the drill point touches either arm B or C at one of the points which has already been located. Then reclamp the rest making sure that it is still at right angles to the ways. Bring up the tail stock and mark carefully where it center touches the work. After prick-punching on this mark recenter on the point of the drill and the tail stock center. Unclamp the tool rest and holding it firmly down with the left hand force the work against the drill point by means of the tail stock screw. When one side of the arm has been drilled, reverse the work and drill the other side. In a similar manner drill the other arm. If a reamer is handy, drill the holes slightly undersize and ream to the finished size.

The next pieces to be machined are the pins. These are cut from cold-rolled stock and turned up on the lathe.

The rollers are turned nearly to size from good machine steel, then hardened and ground. As will be noted from the drawings there are two kinds of rollers. Those with a shoulder are of great use when squaring up to a definite point, while the straight rollers would be used for longer pieces.

The purpose of the index head is to hold the stock fixed in one position while one side of it is being filed and secondly to rotate the stock through any desired angle. A simple and practical method of construction is shown in Figs. 5 and 6. No exact dimensions are given for the reason that in the majority of cases the design will have to be modified to fit the size of the machine and the needs of the operator.

The device is made up as follows: A ⅛-in. by ½-in. cold-rolled steel bar is clamped around the head stock, as shown in Fig. 5. The bar is bent at right angles as shown by the dotted lines in Fig. 6 and a hole N drilled through it parallel to the center line of the live spindle. This hole must be large enough to take the cold-rolled tube shown in Fig. 5. The inside diameter of the tube is 3/16 in. The tube is brazed or threaded into place. A plunger, likewise shown in Fig. 5, is turned up on the lathe and a hole for a 1/16-in. pin drilled through it close to one end. In assembling, the plunger is sliped into place and a light compression spring is placed around the plunger and between the tube and the pin. In the periphery of the driving pulley nearest the head stock, slots are milled into which one end of the plunger fits. These slots should be 3/16 in. by 5/32 in. and their center lines placed 15° apart. The amateur is probably not equipped to mill these slots and it is much better to have this done at some properly equipped shop than to attempt cutting them out with hack-saw and file. In sending out the pulley a properly centered arbor should go with it as this will cut down the cost of the machine work to a considerable extent.

A practical illustration of the way the device works is given below. Suppose it is required to square a piece of round stock of ⅜-in. diameter; the diameter across the flats to be ¾ in. To begin with, center a piece of stock and turn it down to 3/16-in. diameter. Place the file in the guide in the tool rest so that the arms surround the 3/16-in. stock. Place a flat bar of known thickness on the rollers and above the stock. Adjust the height of the rollers until the distance from the top of the flat stock to the bottom of the 3/16-in. piece is equal to the thickness of the flat stock plus one-half of the diameter across the flats plus one-half the diameter of the stock on centers. In the illustration given, if the flat stock is ¼ in. then the roller should be adjusted so that the distance from the top of the flat bar to the bottom of the turned piece is equal to ¼ in. plus 3/32 in. plus ⅛ in., or 15/32 in. The height of the rollers having been properly adjusted the stock which it is required to square is placed in the lathe and filed. One side of the squared surface is thus obtained, and by means of the index head the other three surfaces may be accurately obtained. In squaring holes or cutting key-ways a file of the proper width is obtained, the rollers raised to such a height that the center of the file is on a plane with the center of the stock, and the file forced against the work.

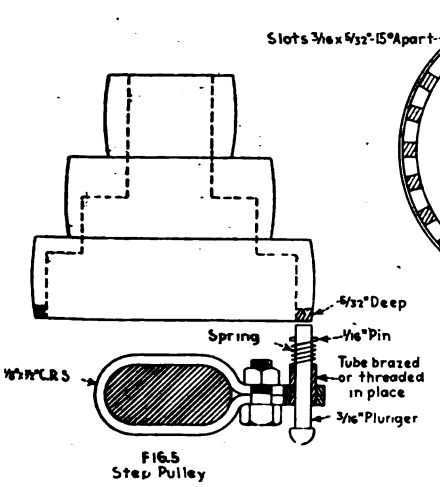


FIG.5
Step Pulley

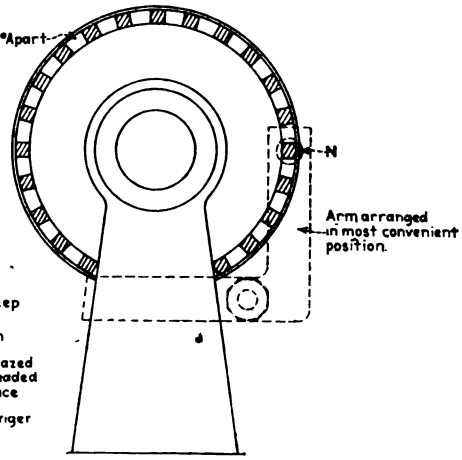
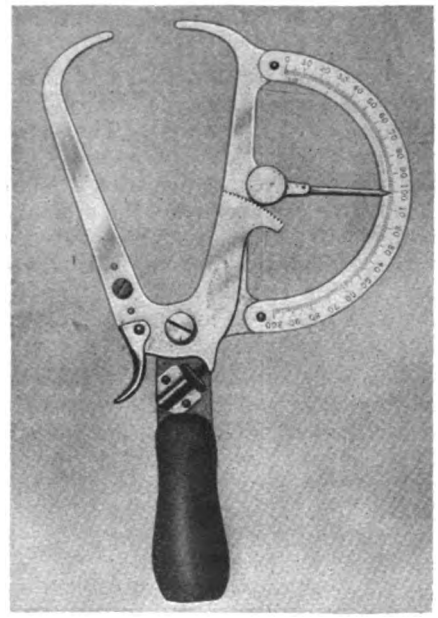


FIG.6
Index Pulley for Lathe

A New Caliper

Probably one of the most ingenious and practical tools that has appeared on the commercial market in some time is shown in the illustration. This is a self-reading caliper. Its construction and operation is very simple. It is a product of accurate workmanship and it will give entirely reliable readings.



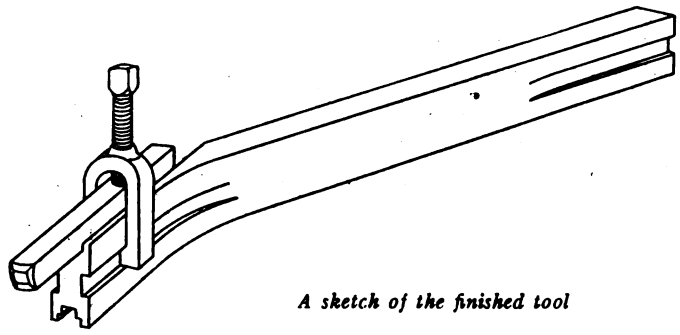
It is made of the best steel beautifully polished. The new caliper is manufactured in different sizes. The one shown in the illustration measures articles up to two inches. The caliper can be set in any position by means of the screw at the side.

Digitized by Google

A Well-Designed Lathe Tool Holder

THE lathe tool holder shown in the illustration is made from a single piece of steel provided with slots and a small screw clamp. The general idea embodied in this simple, but well-designed tool, will be apparent upon examining the drawing. The tool is provided with slots at each end. One side is provided with a slot ¼ in. in diameter for small tools and the opposite side is provided with two slots, one for ⅜ in. tools and the other for 5/16 in. tools. The slots to be made properly should be milled out, but this little job need not worry the ingenious mechanic who does not possess a miller. It is not essential that the slots be absolutely true. With a good sharp file, a hacksaw and chisel the slots can be very easily cut in the shop.

It will be seen that one end of the holder is bent a few degrees. This can be done by heating the steel to redness and bending it to the required angle with a vise. Two slots, one on each side, must also be provided for the small screw clamp which holds the cutting tool firmly in position.



A sketch of the finished tool

Tool holders of this type can be made for all ordinary size tools from ¼ in. up. The one shown in the drawing is intended for the smaller tools which are used by amateur mechanics on small screw cutting and bench lathes.

A screw clamp can be cut in a solid piece of steel and drilled out in the top to receive at least a ¼ in. machine screw with square head, so that a wrench can be used to tighten it.

There are many different types of patented lathe tool holders on the market but none of them seem to be so well adapted to amateur needs as this one which is able to accommodate several different sizes of tool stock. All other patented tools are only able to use one size of tool stock. This holder can be manufactured very cheaply and sold at a price within the range of all experimental engineers. It contains only four parts.

A Boring Bar Holder

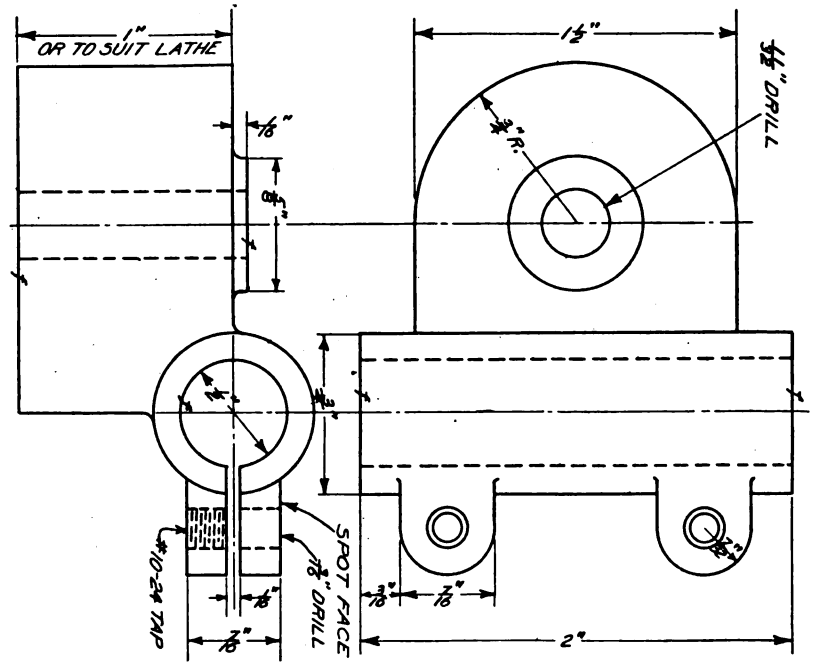
By S. C. Swanson

MOST of the boring tools on the market have drawbacks of one kind or another. The ordinary one-piece forged tool is satisfactory in the medium and larger sizes, but has the disadvantage of not being adjustable for rake without grinding. The several patented boring tools are not made for very small work, and the cost of one might, in many cases, be prohibitive.

The toolholder described and illustrated herewith combines cheapness, simplicity and ruggedness. The shape was evolved by force of necessity, as the slide rest screw on the writer's South Bend lathe did not permit the ordinary boring tool to traverse far enough for very small work by reason of its shortness. This accounts for the bore in the holder being so much off the center line of the casting.

The body of the holder should be either cast or malleable cast iron. It should first be faced off on the bottom either by filing or by chucking in the independent chuck and faced off in the lathe. If faced in the lathe, the 11/32-in. hole for the holding down bolt may be drilled at the same setting, but for the sake of appearances it is best to drill this from the top so that it may be centered in the boss there provided. This boss should be faced off to provide a suitable bearing for the nut.

The casting is then bolted on the slide rest, so that the center line of the cylindrical part coincides with the lathe centers, and then drilled ½ in. by feeding up to the drill in the live spindle. The end faces can be filed up sufficiently true for the purpose.



Drill the lugs 3/16 in. half way through the finish with No. 26 drill, tapping out No. 10-24. A saw cut longitudinally through the center of the lugs into the bore completes the casting. Two ½-in. No. 10-24 round or fillister head machine screws are used for clamping the tool in place.

Tools for use in this holder can be made of ½-in. drill rod, drawn out, or filed to shape, hardened, tempered and ground. Smaller sizes of drill rod may be used by providing split bushings to fit the holder, and bored out to take the various sizes of rod used.

If the tool is properly made slight adjustments can be made in the rake by altering its position in the holder. This holder may also be used for holding drills, etc., by properly locating its center line to coincide with lathe centers.

One dimension which is so marked on the drawing is variable according to the lathe on which the tool is to be used. This should be made equal to the distance vertically from the top of the slide rest to the lathe center.

Digitized by Google

To Sharpen Files

DULL files may be sharpened without recutting by treating them with acid or with the sand blast.

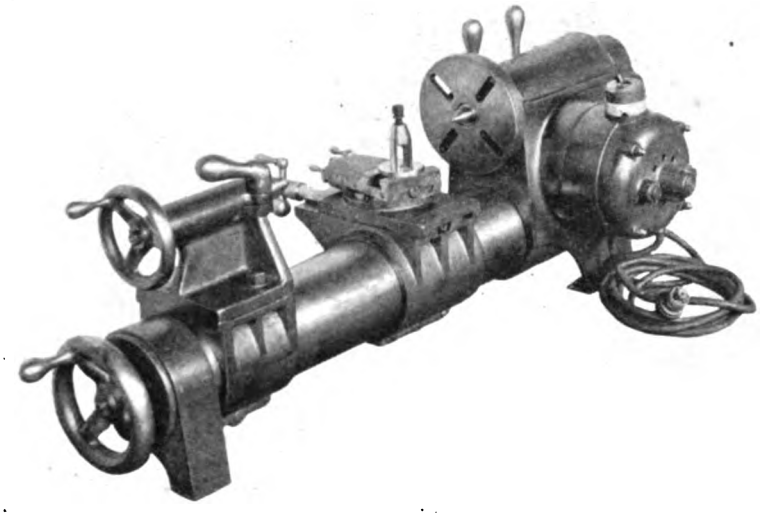
In treating files with acid they are first freed from adhering grease by scratch-brushing with the use of potash or soda lye. They are then brought into an oblong box of a material not attacked by acids, a few thin glass rods or varnished sticks of wood being first placed upon the bottom. The files being laid alongside each other, sufficient cold water to cover them is poured into the box, the eighth part of concentrated nitric acid is then added, and after mixing water and acid by moving the box, the whole is allowed to stand quietly for 25 minutes. The files are then taken from the bath, thoroughly scratch-brushed with the use of water and replaced in the box for 25 minutes, the bath having previously been strengthened by an additional eighth part of nitric acid. During this operation care must be had to several times turn the files and to see that they are entirely covered with the fluid. The files are then again taken from the bath, thoroughly cleansed with a scratch-brush and replaced in the bath, to which previously the sixteenth part of concentrated sulphuric acid has been added. The bath now becomes heated, and red-brown vapors of hyponitric acid escape. Care must be had to keep the box in a rocking motion so that the acids act as uniformly as possible. After 5 minutes the files are again taken out, cleansed, and then replaced for 5 minutes more in the same bath, previously strengthened by the addition of one-sixteenth part more of concentrated sulphuric acid; care must be had to constantly keep the bath in an undulatory motion. The operation is now finished, the files being finally scratch-brushed, and, for the removal of every trace of acid, placed in a vessel with water compounded with a few handfuls of caustic lime, which gives them a good color. They are then rinsed in clean water, dried over a spirit-flame and rubbed with a little oil.

The treatment with acid may also be effected by means of a galvanic battery, the bath, which is composed of water, 100 parts; nitric acid, 80, and sulphuric, 40, being connected with the positive pole. The negative pole is formed of a copper spiral passing around the files without touching them, and with the end pointing toward the surface of the fluid. By using a galvanic battery of 12 Bunsen elements 10 minutes suffice for the treatment.

If the experimenter follows these directions he will not need to discard his old files when they have become dull.

A New Screw Cutting Bench Lathe

A BENCH lathe has recently been brought out which possesses a number of distinct and original features. The driving motor is built directly in the head stock, which also encloses the driving gears, which are submerged in oil. The bearings are made with radial thrust which totally eliminates end play on the live spindle.



The bed of the lathe greatly resembles the well-known English Drummond lathe. The motion of the lead screw is controlled by the wheel at the end of the lathe. When located concentrically within the lathe bed, the lead screw is well protected from chips and dirt which insures maximum wear. The change gears, which are provided with the machine, will enable the operator to cut threads from 8 to 64.

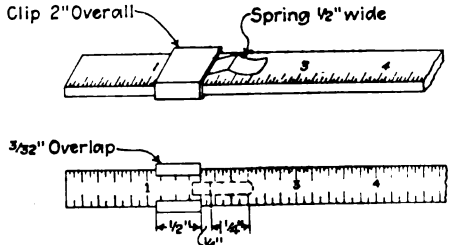
The weight of this new lathe complete with driving motor is in the neighborhood of 200 lbs. and can receive its power from the ordinary electric light socket.

The lathe is provided with selected forward speeds, 125, 250, 400, 650 and 1,000, with a reverse speed of 3 r.p.m. It has a swing over the bed of 8 inches and a swing over the carriage of 5¾ inches, with a maximum distance of 12 inches between centers. Although the general features of the bed, tail stock and carriage greatly resemble the English Drummond lathe, there is one feature which has not been added and which is very characteristic of the English type. This is the boring table with inverted T slots. It is regrettable that American manufacturers have not as yet recognized the value and convenience of the boring table. Of course, the boring table makes it difficult to equip the lathe with a compound slide rest such as this machine is provided with.

The most gratifying feature of this machine is the driving motor which forms an integral part of the head stock, thereby eliminating belts, pulleys and countershaft, which greatly adds to the expense of the lathe and to the trouble of setting it up for operation. A machine of the nature described is ready for use the moment it is received. It also requires but little pains and the possibilities of the operator injuring his fingers with uncovered gears or belts is entirely eliminated.

A Handy Scale Clip

A VERY useful article which every machinist should have is shown in the sketch. In fact, every one who uses a pocket scale will find this little device very useful.



This clip is made of sheet brass .015 of an inch thick by 2 ins. long, allowing enough so that the clip will lap over 3/32 in. on the back of the scale, as shown on the sketch. The clip is laid out with a combination square, the surplus stock cut away with a tinner's shears. The clip then resembles the letter T. It is then placed on the scale so that the spring is in the center, put in a vise, hammered one side, taken out, turned around and the same done with the other side. It is then slipped off the scale, bent and shaped as shown in the sketch.

HERMAN KEPPLER.

Digitized by Google

FUSELAGE DETAILS
TWO SEATER SEA-PLANE

Designed By C.E MULLER M.A.E

Scale Of Feet

1 2 3 4 5 6

~ PLATE SIX ~

MOTOR MOUNTING (3-CYL LAWRANCE) FIG.-13.

16 B.W.G. (.068)
8120 ±.001 REAM
3/8" Radius
℄ OF ATTACHMENT
℄ OF CYLINDERS
℄ OF GRAVITY MOTOR

CONVENTIONAL CONTOURS
NOT TO SCALE

AMER. MONOCOQUE
PLAN
FIG.1
SIDE ELEVATION

ROTARY MOTOR "SCOUTS"
FIG.2

POOR DESIGN
FIG.3.

ENGLISH PRACTICE
FIG.4.

"SPAD TYPE
FIG.5.

SIDE ELEVATION OF THE ABOVE
FIG.6.

CURTISS TRAINING TYPE
FIG.7.

LOW CENTER OF GRAVITY
FIG.8.

FIG. 14.
SPINDLED LONGERON SECTIONS
Only Between Stations
SPECIAL VERTICAL GRAIN

FIG. 9.

LOWER PAN FORMERS
FIG.10.

"X" AXIS
30"
3 PLY VEN'R
FIT TO LONGERONS
MOTOR BULKHEAD

SIDE PLATES SUPPLIED WITH MOTOR
FIG. 11.

#20-GAUGE ALUMINUM FITTED TO LOWER LONGERONS
END OF PAN TO FASTEN TO OIL TANK
STATIONARY BULKHEAD
3-PLY VENEER

FUSELAGE SKELETON
FIG. 12.

TURTLE BACK OF SPRUCE AND FABRIC
FASTENED TO LONGERONS BY CLIPS (ALUMINUM)

DETACHABLE COWLING
TO BE SCREWED ON LONGERONS USING 3/8" #6 R.H. BRASS W. SCREWS

Section A-B

Section C-D

RUDDER

Building A Two-Passenger Seaplane

By Charles E. Muller

Consulting Aeronautical Engineer

Fuselage Construction
Part Five

THE fuselage or body constitutes the nucleus of the complete airplane. It may be considered a unit, as it is usually assembled and disassembled as such. It originated with the monoplane in France and by combining it with the biplane cellule or wings produced the present type of "tractor biplane." Sometimes, for transportation purposes under its own power, the wings are folded back or detached, then fastened edgewise to the fuselage. It is often packed in automobiles, freight cars, trucks or baggage cars in this condition or towed behind an auto by hitching the tail end to the tonneau of an automobile or to the rear of a truck.

Methods of Fuselage Construction

There are practically four types or methods of wood fuselage construction which may be classified in the following order:

(1) The box girder method using four longerons or rails with horizontal and vertical struts (sometimes called spreaders) in compression with a wire bracing as tension members and will be adopted with veneer panelling as suitable for the two-seater seaplane.

(2) The second method has the tail section of the first method, but the wires of the front portion (usually designated as the motor section) are replaced by a diagonal wood bracing which is fastened by wood screws or with either three-ply veneer or sheet aluminum.

(3) The third eliminates the wiring. Four and sometimes six longitudinal rails connected by cross struts, formers or bulkheads cut to the required shape from three-ply laminations are entirely covered with three-ply veneer, making an excellent structure.

(4) The laminated and monocoque types are built over a collapsible form, the skin being of two or three layers of wood with fabric between the layers, the whole glued as one solid shell of approximately four millimetres in thickness. The veneer layers composing the skin are sometimes stitched together with copper wire as in racing boat hull construction.

Steel is also being used, the longerons and diagonals made from special angle or steel channels. This method was developed by the T. A. Co., of Boston, but failed to become very popular. The French "Breguet Bomber" and the German Fokker use a similar method, but of round steel tubing longerons and struts with wire bracings. The last two mentioned machines were masterpieces of welding and steel engineering, but are decidedly handicapped when replacements and repairs are necessary.

The longerons used in the first three methods of the foregoing classification were either all ash, hickory, spruce, or some combination of these woods, with the hard resilient wood constituting the forward section, extending from the nose of the fuselage to beyond the rear cockpit. The ash and hickory longerons permit of sharper bends and are stiffer for their size. They also resist the shocks of landing and the vibration of the engine better. When the longerons are of more than one length a vertical splice of approximately twelve inches is used, glued, bolted and wrapped with twine or tape, well doped. Formerly a butt joint was used with a long steel ferrule six to eight inches long of twenty gauge steel as a reinforcement. Sometimes laminated wood longerons are used, especially where there is excessive bending. The use of spindled longerons is gaining prominence, as this method provides for extra material at points where it may be necessary to compensate for holes drilled; also it is desirable for production reasons to use the same size longeron fittings as much as possible. A practice much in evidence is to maintain the same cross sectional area to near the pilot seat then taper to the stern post.

Two other methods of tapering have come to the writer's notice. One may taper the longerons gradually from any place back of the engine bearers to the tail post, which is usually condemned owing to complications in the size of fittings, but with the particular fitting recommended for the two-seater Seaplane this objection is obviated by decreasing the struts proportionately. Also there is a rather odd arrangement of keeping the rail parallel section for approximately eight feet from the engine bearers and then diminishing in a series of steps to the tail post. This method only requires three to four sizes of fittings.

The diagonal wood bracing is used considerably when sheet aluminum or duralumin is used, but the difficulty of re-truing this construction when distortion occurs, and also as the erection is somewhat involved, decided the writer not to recommend this construction for the Seaplane. It is also heavier than the first types although it affords a more solid engine mounting with a considerable reduction of vibration. Three-ply fuselage construction, introduced by the series of German Albatross machines, apparently warrants the development that now follows this practice. There is also a saving in weight as a square foot of No. 20 B. W. G. aluminum, the usual thickness used for this purpose weighs eight oz., compared to the five oz. weight of the 3/32 in. birch three-ply. The saving of this weight in the aggregate with the advantage gained through three-ply veneer being a superior stiffening medium, also as it is so readily glued, nailed or screwed to the longerons, surely warrants this construction. The advantages of rapid production, great strength in a vertical and horizontal direction and also the fact that if shot through it would not endanger the structure to the same extent as with a wire braced system, are offset by two important facts. First, it is heavier than the wire bracing. Second, although holes may be cut where permitted, saving weight, it is weak under a torsional stress caused by the difficulty in truing up to allow for distortion.

The monocoque system, Fig. 1, Plate 6, I believe originated in France, originating with the Antoinette monoplane, which was flown at Nassau Boulevard, in 1911. If I remember correctly, the Deperdussin had a similar monocoque body too, consisting of very small stringers and light formers shaped to the fuselage section.

In the designing of the contour of the fuselage the type of motor used is undoubtedly the dominating consideration which surely compromises the ideal stream line. With the vertical four or six-cylinder ("in line") engine it is possible to design a very narrow body, excellent examples being the Italian S. V. A. and S. P. A. biplanes. A rotary or radial engine necessitates an increase in the width, Fig. 2, which also means increased drift. By permitting the tops of the Vee type engine cylinders, Fig. 1, to project through the cowling a gain in the width of the body is accomplished. Fig. 2 illustrates diagrammatically the method used on the Thomas Morse and other rotary engined "Scouts" of carrying the cowling over formers and stringers, gradually merging into the main fuselage. Fig. 3 is similar to Fig. 2, but with the cowling stopping too abruptly, resulting in a dead air region, unquestionably causing excessive drift and inefficiency.

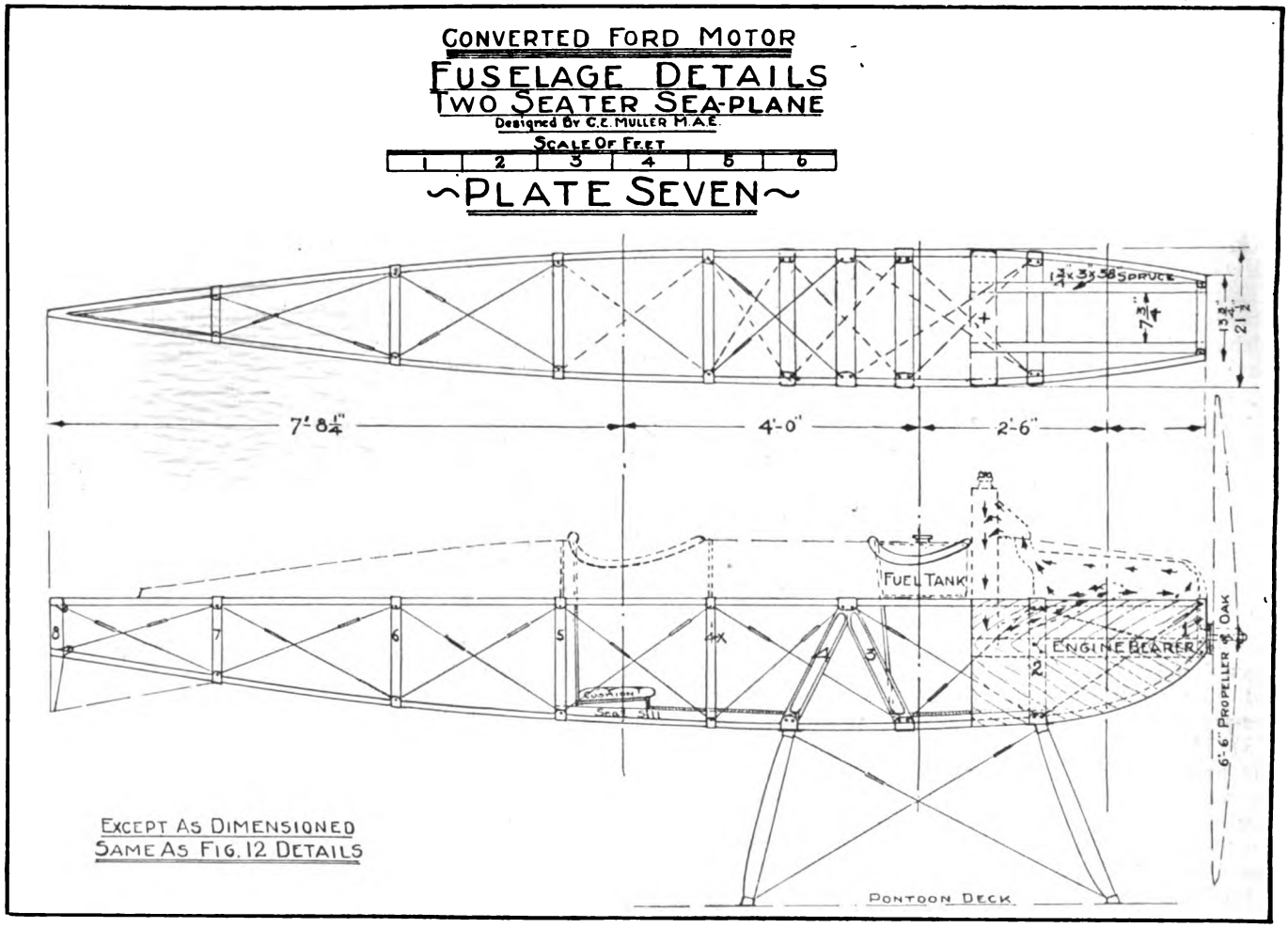
The drawing at Fig. 4 depicts the English standard practice and although theoretically it is not as well stream lined as the German and the French machines typified by Fig. 5, the loss of efficiency is more apparent than real as

Digitized by Google

is proven by actual tests. The many constructional and other advantages gained surely compensate for any possible additional drift. Figures 6, 7, 8 show the side elevations of the current practice, Fig. 6 predominating. This arrangement of having the top longerons, Fig. 6, parallel to the normal line of flight furnishes a convenient datum line for assembling and aligning the airplane. Also for lining up the engine bearers on machines whose line of thrust, i. e., the axis of the motor, is coincidental with the normal flight. In Fig. 7, the Curtiss type, the top longerons are parallel to flight from the stern post to the engine section then dip downward to stiffen the engine bearers and front section.

The illustration at Fig. 8 shows a similar arrangement used for obtaining an accessible motor location, also to produce a low center of gravity. Most all fuselages terminate in a vertical edge the width of the rudder post, but the French Morane monoplane, the German Fokker, the Albatross D-1 and the American Loening monoplane terminate in a horizontal edge which usually permits a certain amount of movement owing to the flat angle of the bracing wires, which is apt to result in the loss of empennage alignment.

The diagram at Fig. 14 illustrates three of the ways that longerons are usually spindled out between stations especially in the tail section. They are always left solid at the stations, where struts and fittings join them and in most cases are left solid section from rear of the pilot's seat to the front of the frame. The fuselage struts are sometimes hollowed or spindled in a similar manner, but left solid at the ends for a better bearing on longerons. The longerons and the wing beams are the most important wooden members in the entire machine and should be very carefully selected of two-year weather dried or steam saturated kiln dried by experts. This fuselage was particularly designed for the benefit of the amateur so that no complicated bending of longerons necessitates steaming or special forms. But if this equipment is convenient, shaping the lower longerons slightly in excess of required bends will facilitate the operation of assembling. One may, if he chooses, bend the lower longerons from station near 8-F to a point flush with the reinforcing flanges of the motor side plates. This will unquestionably stiffen that section, but it is not necessary and would hardly compensate for the additional labor and expense. The three-ply stiffeners with the bulkhead, Fig. 11, has been found sufficient for motors weighing more than five times the weight of the three-cylinder Lawrance, but admittedly of more even torque and having less vibration.



Assembling the Fuselage

I believe the builder will have no difficulty in assembling this fuselage if a temporary bench made of loose boards twenty-four inches by sixteen feet is placed on low horses and a rough layout be made from the dimensions furnished by a reference to the length of struts at stations designated. It is obviously manifest that this fuselage be assembled inverted. Three methods may be used. One, assemble the top side and bottom side, then connect them, or the two sides may be first assembled, then connected. The third method is recommended of assembling the top longerons, turning them over, clamp to table and assemble first section with header in place, secure three-ply panels to all four sides, then continue second section, etc. I believe this will save forms and require less equipment. When springing longerons, a twisted tourniquet will be found all that is necessary. The Static Balance of an Airplane (*i. e.*, equilibrium of the machine at rest) is represented by the line marked C-G or center of gravity. This may be checked up by placing a rounded edge of a 2" by 4" under the pontoons where the center of gravity (when machine is completed) is indicated in the skeleton fuselage diagram,

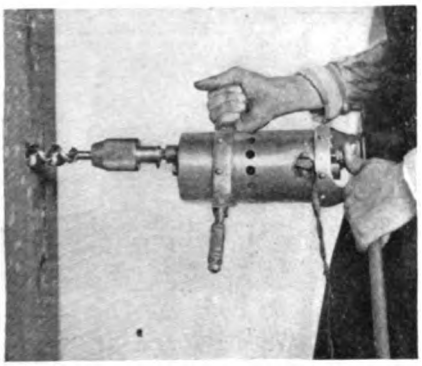
(*Continued on page 221*)

Digitized by Google

A Combination Electric Wrench, Drill and Screw Driver

A NEW machine has recently been brought out which possesses many unique features. It can be used either as a drill, wrench or screw driver. It can also be pressed into service in boring holes in wood with the conventional bit, as illustrated.

All the parts of the machine are set on ball bearings together with an especially constructed clutch. A suitable electric motor of the high speed variety controlled with a properly designed rheostat is incased in a metal cylinder which encloses the operating mechanism. The weight of the machine is but 14 lbs. The body is 10 inches long and 14 inches in diameter. Although the



The machine in use boring holes in wood

device is small, it develops from three to five horsepower in torsion.

When the machine is used as a wrench in placing nuts a simple me-



Using the machine to remove a nut

chanical device prevents the threads from stripping when the nut is fully seated. At this point the power is automatically cut off by means of a special patented device enclosed in the case.

This machine, owing to its utility, will be of great service in the machine shop or garage where it can be used in a number of ways.

The American Society of Experimental Engineers

Who's Who in the A. S. E. E.

MR. R. RUSSELL MILLER is an active member of the A. S. E. E., having joined the Society in 1918. He was born in Dayton, Ohio, the city of a thousand factories, and the site of the greatest and most disastrous floods in the history of the United States. Mr. Miller well remembers this unpleasant event.

Mr. Miller graduated from the grade and high schools of Dayton and later attended the Ohio State University at



Mr. R. R. Miller

Columbus. Here he specialized in physical education, recreational leadership and manual training. He was then employed for two seasons by the Department of Recreations, Dayton, leaving this location finally to assume duties as Recreation Superintendent for the City of Raleigh, North Carolina. Mr. Miller also served as Deputy Scout Commissioner for this district. He later accepted a position with the Wright Airplane Co., of Dayton, Ohio. Leaving the Wright Co. he went to Lakewood, N. J., to serve as head of the Boys' Department in the Y. M. C. A. He now holds the position of Assistant Scout Executive, Queens Council, Boy Scouts of America.

Mr. Miller is very much interested in the promotion of experimental work among boys. He seems to inherit the ability and enthusiasm of his father, who was an expert model engineer in the employ of the National Cash Register Company. Mr. Miller well recalls the days, when as a lad, he tinkered in his father's shop, building models and experimenting. During an exhibition given in honor of Wright Brothers he won first prize in a contest conducted by the Junior Aero Club of that community. He believes, and rightly so, that model engineering is a more worthy and interesting hobby than is commonly understood.

Mr. Miller is very fond of all forms of athletics, and swimming in particular. In this latter sport he is unusually proficient, being a member and examiner of the Life Saving Corps of the American Red Cross. He is a registered A. A. U. basket ball official and handled some of the large college games in the South. Anything that pertains to camping, woodcraft and nature study deeply interests Mr. Miller. He is very fond of music, loves the movies and roots for the Giants.

Philadelphia Chapter of A. S. E. E.

THE Philadelphia Chapter of the A. S. E. E., of which Harry Levene is secretary, held a large meeting in Friendship Hall on Friday evening, December 12th. Large posters were used in recruiting new members and a drive was started for the establishment of a local experimental laboratory where all Philadelphia members could have access to apparatus and equipment that they could not afford as individuals.

The officers of the Society in New York urge every Philadelphia member to put their shoulders to the wheel in order to help this good movement along. Those who contemplate joining this live branch of the A. S. E. E. should immediately communicate with one of the following men: Harry Levene, 2123 W. Dauphin Street; Thomas W. Benson, 3722 M Street, or Dr. M. Eugene Balfrey, Med. Electrician, 5213 Master Street. The next regular meeting will be held January 16, 1920, at Widener Library, 1200 N. Broad St., Philadelphia. All are urged to attend.

The A. S. E. E. Bulletin.

The second copy of the Bulletin issued bi-monthly by the American Society of Experimental Engineers has appeared. This little sheet is given over to news of the Society and what its members and chapters are doing. In each issue there is also included an article that will be sure to interest all real experimenters. As the Society grows, the Bulletin will grow with it until it reaches a good, healthy size.

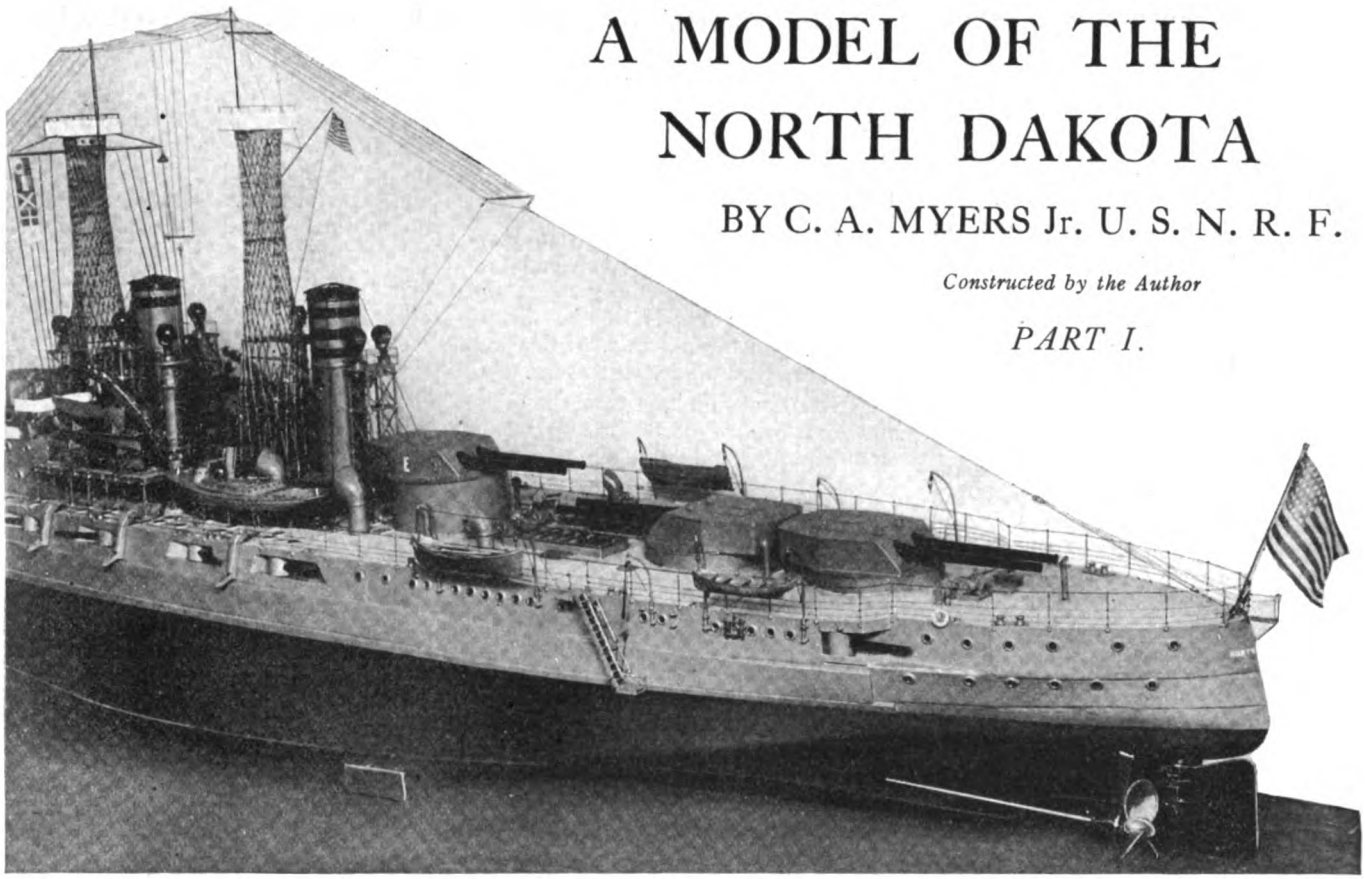
Digitized by Google

A MODEL OF THE NORTH DAKOTA

BY C. A. MYERS Jr. U. S. N. R. F.

Constructed by the Author

PART I.



THE writer has been interested in model-making for a good many years, and, as described in the June issue of EVERYDAY ENGINEERING, has taken up the building of working models of warships, showing by stages the development of naval architecture over the past 2000 years.

As the latest example of the writer's work the model of the U. S. dreadnought *North Dakota* lends itself very well to a description. This model is 5 feet 4 inches long, 10½ inches beam and has a draft of 3⅜ inches. She displaces about 55 lbs. of water and makes a speed of about 150 ft. per minute. At first glance this speed may seem low when compared with an out and out speed boat, but it should be borne in mind that it would look incongruous to see a battleship model rushing around at what would be relatively to its large prototype a mile-a-minute clip; and the speed of each of the writer's models therefore has been brought to what would be the correct rate for vessels of their type.

Only spare time has been devoted to the construction of the *North Dakota* as the work is solely a hobby and no attempt was made to "speed up" or to adopt wholesale methods of turning out the various parts, all of which represent nothing but the most painstaking hand work. The model is constructed entirely of metal from the keel to the topmost part of the fire control towers, the only wooden parts being such items for instance as the oars in the lifeboats. She represents approximately 2,000 hours' work, or, expressed in another way, five years of spare time effort.

The model of the "North Dakota" described in this and a subsequent article is a masterpiece of miniature naval architecture and workmanship. It represents not only a tremendous amount of painstaking labor but a knowledge of naval matters that is in possession of few individuals. Not many models have come to our attention so faithfully reproduced, so carefully executed to the most minute detail and imposing such a tremendous amount of labor upon their builders as this one. We take this occasion to congratulate Mr. Myers and we feel sure that our readers will join us in giving him all the respect and praise due him.—

EDITOR.

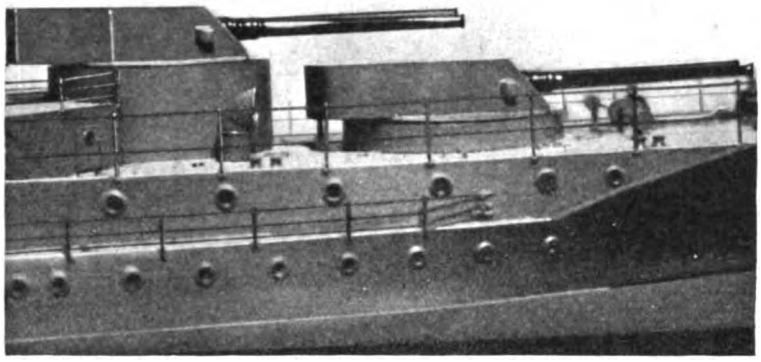
The model is constructed absolutely to scale from Government plans of the real ship, the scale adopted being ⅛ inch to the foot, which produces a very good sized model and yet one that may be carried from place to place with ease by two persons. Every measurement on the large ship is faithfully reproduced on the model down to the minutest particulars and it "works" in every detail down to the firing mechanism of the guns and the steam-launches which are actually propelled by steam.

The ordinary exhibition or glass case model is a land-going ship, and while it may be beautiful to look upon, it is devoid of machinery and if placed in the water would be likely to float on its side if indeed it did not completely capsize and sink. To build a model which will not only faithfully reproduce the real ship in every detail but will also have exactly the correct characteristics of trim, stability, speed, flotation, etc., is no mean problem, to say the least. All of these characteristics the *North Dakota* model has, and in addition her hull, like the real vessel's, is built up of steel plates. Only one who has attempted to build metal-hulled vessels can appreciate the difficulties involved in this point alone.

When the average man wants to build a model ship he takes a log of wood and after rough-hewing and sawing it to shape removes the surplus wood with a draw-knife and hollows out the interior. It is because of the ease with which this work may be done that nearly everyone makes model ship hulls of wood, whether the real ship is built of wood or not. But while the metal hull is as difficult to build as the wooden hull is easy, the metal one nevertheless has certain inherent advantages over the wooden hull that makes it preferable if the difficul-

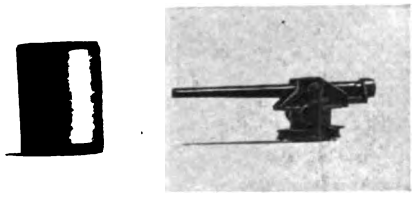
Digitized by Google

ties of construction are overcome. The writer has succeeded in solving the problem in what he believes to be a very satisfactory way and a later issue of EVERYDAY ENGINEERING will describe the process in detail. In describing the hull of the *North Dakota*, then, suffice it to say for the present that the steel plates are fastened to suitable frames reproduced from the plans to the proper dimensions, and, as may be seen from some of the photographs, particularly the one shown, the hull is as smooth and sweet in its lines as any wooden one the writer has ever seen and in addition is considerably lighter. To illustrate the accuracy of the method used in constructing the hull it might be added that the completed model comes within less than a single pound of displacing the weight calculated when working on the plans months before laying the keel.



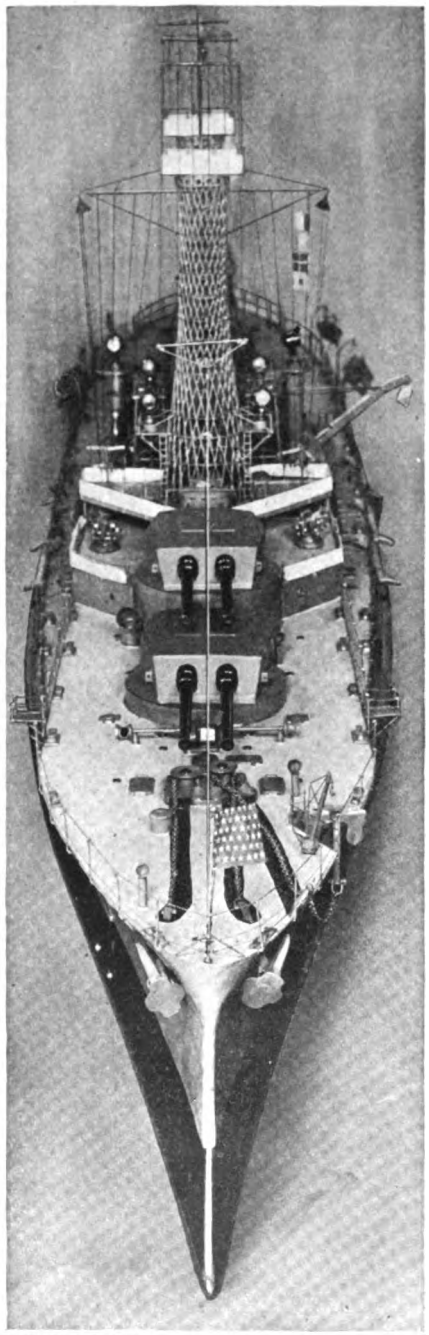
The forward turrets

The armor-belt which on the real ship is 11 inches thick consists of aluminum a scant ⅛ inch thick on the model and resting on the armor shelf is bolted to the side plating just as in Uncle Sam's own vessel. Gun positions for the secondary battery, ash chutes, port holes, electric winches and a thousand other details must be finished and fastened in position before the hull itself is completed, yet the hull is but a small part of the work on the whole model.



Size of one of the deck guns when compared with a spool of thread

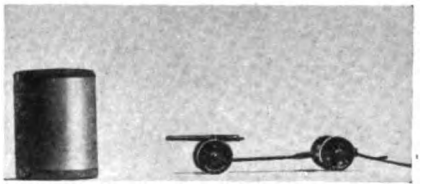
A single item, such for instance as the fire control towers or peach-basket masts as they are sometimes called, represents a simply tremendous amount of work. The masts themselves contain over 60 feet of brass wire and each one has more than one thousand separate soldered joints! But this is not all, for not only are there the usual grating platforms inside with tiny ladders running from one level to another and trapdoors less than ¼ inch square, but inside the forward tower is the navigating bridge with its steering wheel, binnacle, log-desk, engine-telegraphs, etc., to say nothing of a "1,200-gallon" water tank, an "800-lb." bell and even a chart table with a microscopically small chart of New York Harbor laid out under its glass top.



© Edwin Levick, N. Y.

The deck looking aft from above

The construction of these towers was in itself a rather difficult problem, but it was solved by building them over a wooden mould. The masts, as will be noted by a glance at the photographs, are smaller about two-thirds of the way up than they are at either end and it was therefore necessary to have the mould made in two sections with the joint at the point of smallest diameter; otherwise the mould could never have been withdrawn once the wire mast was soldered together around it. The positions for the vertical wires were marked off and numbered at top and bottom and small copper tacks were driven in the mould at these points. Then a single strand of brass wire was soldered to tack number one on the top and the other end to tack number one on the bottom and so on around. Number one on the bottom of the mould, of course, was not directly beneath number one on the top as there was a difference of about 90° in the positions of the various numbers. This gave the wires a slightly twisted appearance; and after all the wires were run one direction another set was started in the opposite one so that they intersected the first set at an acute angle. All points of intersection were then securely soldered and rings fastened around the towers at the positions shown in the plans (see photograph); and after the grating platforms and other details were mounted inside the towers they were then ready to be placed in position on the ship. The writer would like to add right here that while he expected considerable strength in these towers from what has been written about the large ones on our various battleships) he was absolutely astounded at their tremendous rigidity and the resistance they offer to a crushing force, coupled with their remarkable lightness.

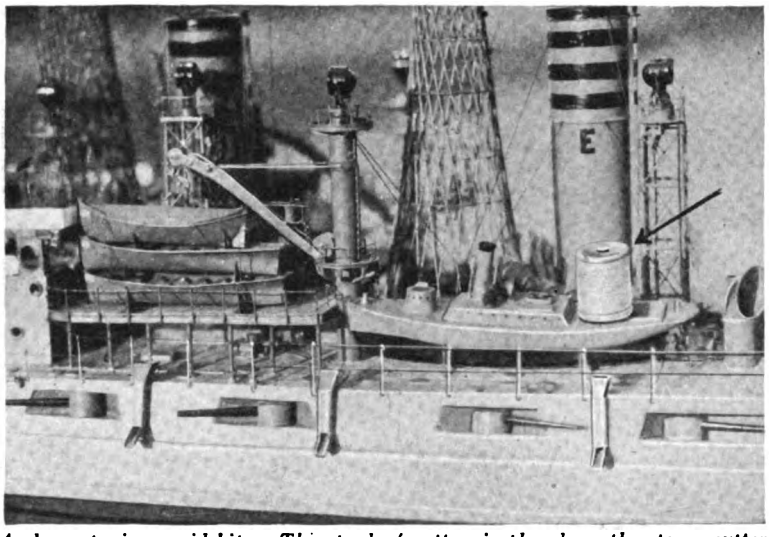


Size of a small land gun when compared with a spool of thread

The five turrets of the *North Dakota* each mounting two "12-inch" guns (⅛ inch on the model) are made of steel like those on the real ship and are revolved by tiny electric motors concealed beneath the deck, one to each turret. The guns are breech loading and are

Digitized by Google

mounted on trunnions and may be elevated or lowered at will. They are designed, moreover, to fire with gunpowder, minute brass cartridge cases not more than ½ inch long being used to hold the explosive charge. The powder is ignited by electricity just as in the case of our real battleships and the wiring is so arranged that the guns may be fired individually or by throwing a switch all ten may be fired in salvo. One of the accompanying photographs shows the instantaneous discharge of both guns in No. 2 turret, and as can be seen, the flash of flame leaps a foot or more from the mouths of the guns, the explosion making one's ears ring. The effect is certainly realistic in the extreme.

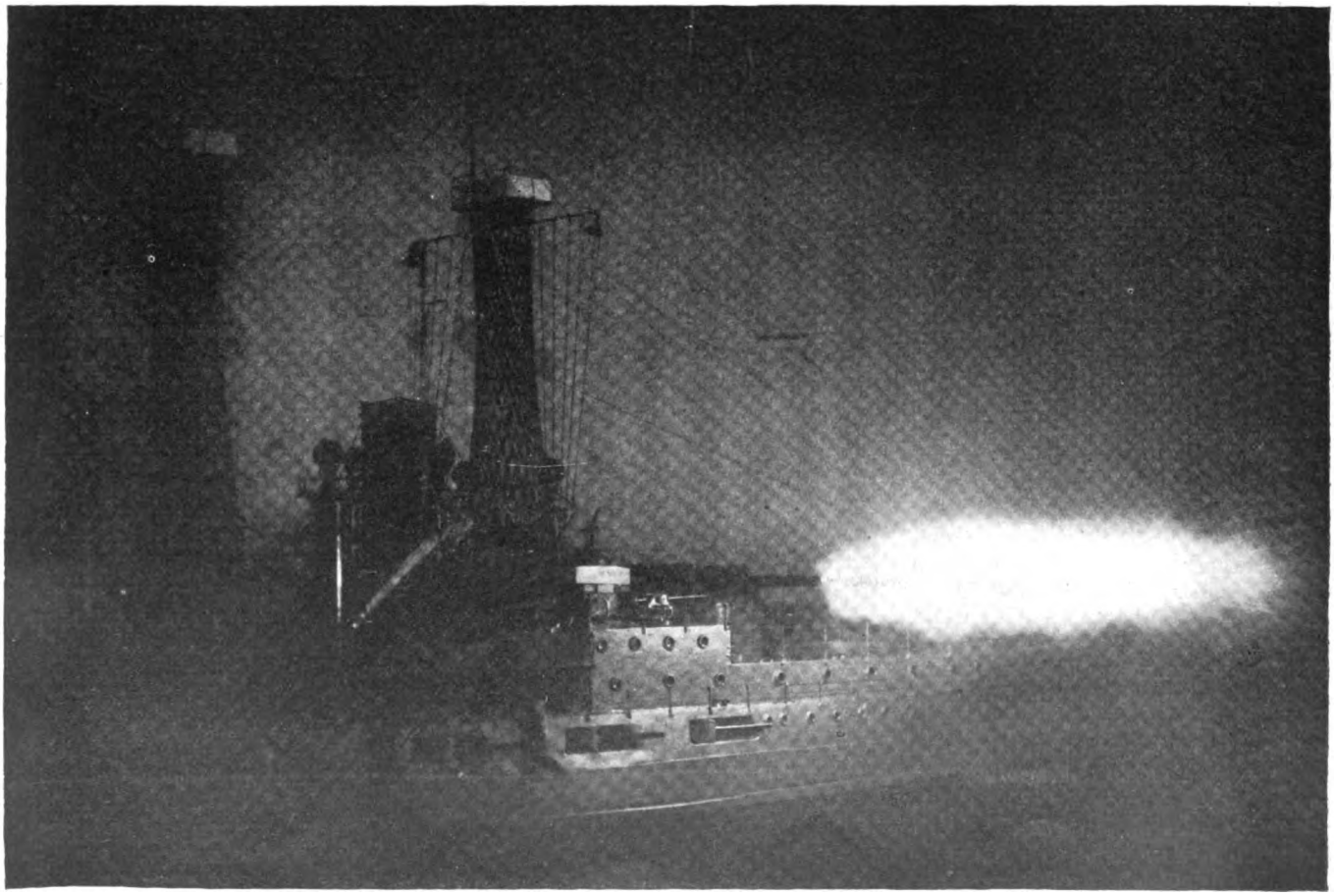


A close-up view amidships. The spool of cotton is placed on the steam cutter to give an idea of its size

Of searchlights the *North Dakota* has eight and on the model these are illuminated with tiny nitrogen-filled electric lights of great power, the bulbs, although less than ¼ inch in diameter, consuming in all more than 30 watts. Highly polished nickelplated parabolic reflectors concentrate all the rays and give the maximum result. In addition to the searchlights there are, of course, the regulation port and starboard (red and green) and masthead running lights which are also lighted by electricity.

Of lifeboats and steam launches the model has the full equipment, carrying among others one "56-foot" and one "40-foot" steam cutter. These boats, as faithfully reproduced to scale as any other item on the model, are 7 and 5 inches long, respectively, and surprising as it may seem are both driven by steam generated by a tiny alcohol lamp under a fire-tube boiler holding less than a teaspoonful of water! When a full head of steam is up, these launches slip through the water at a surprisingly good clip.

The *North Dakota* is propelled by twin screws and on the model these are revolved by six powerful electric motors three to each shaft, the current being supplied by a 6-volt storage battery which also furnishes the power for lighting the searchlights, revolving the turrets, firing the guns, blowing the whistle, etc. The motors are wired so as to provide three permanent speeds forward and one on reverse. Thus, at first speed forward only the last motor on each shaft receives power, the other two idling. At second speed the last two receive current and the other revolves idly. At full speed ahead all six motors drive the propellers. On reverse just as in the case of first speed forward, only the last motor on each shaft does the work. The storage battery has power sufficient to drive the model 1½ hours at full speed, about three hours at second speed and nearly five hours at first speed. With the scale-model idea constantly in mind, two convenient air ventilators have been employed to operate the controller and reverse mech-



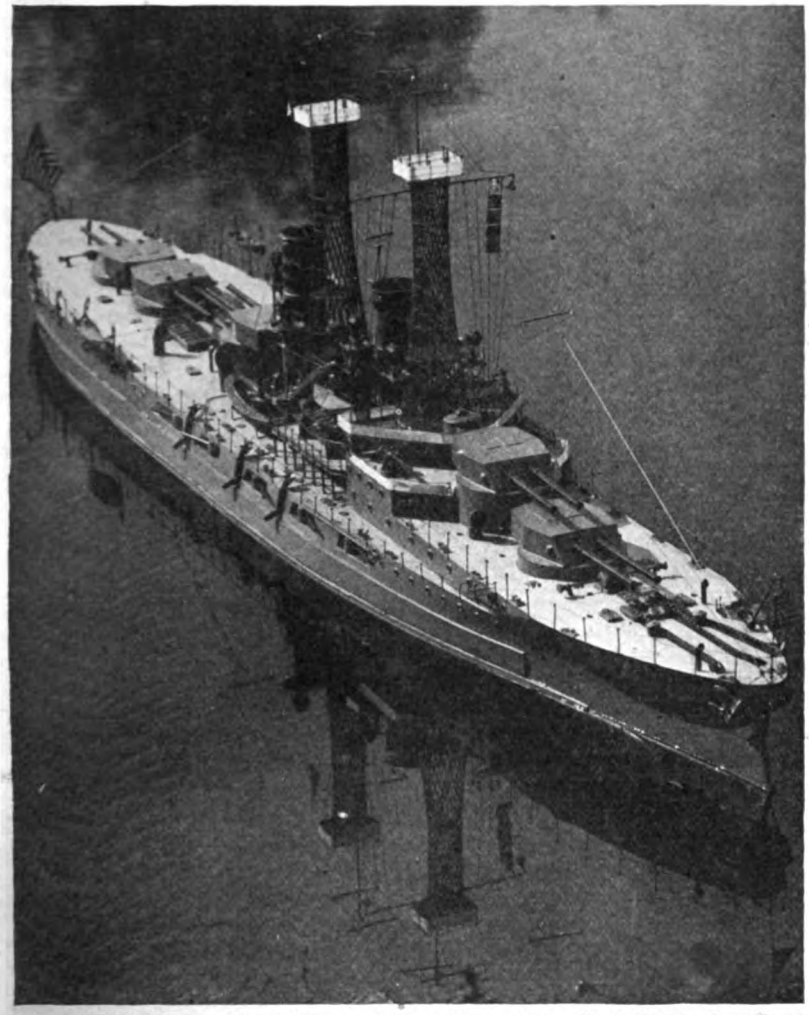
Few readers would believe that this was the photograph of a model if it did not accompany this article

Digitized by Google

anism for the main driving motors, thus obviating the necessity of wheels or levers passing through the deck and avoiding in this way the "top-boat" effect which these instantly give to any model on which they are used no matter how well it may in other respects be constructed.

operator she executes circles, figure-eights, and other complicated manœuvres with a precision that to an onlooker seems almost uncanny.

The writer has devoted a great deal of thought to the problem of radio control for a good many years, having first started it with the idea of steering



We will leave this to the judgment of the reader: Does this look like the "North Dakota" taken from Brooklyn Bridge?

Another unique feature of the *North Dakota* is that it is provided with complete radio control, it being possible to steer the ship when in the water by merely pressing a key on the sending station on shore. The response of the vessel to the wireless waves is well-nigh perfect and at the will of the torpedoes for the Navy, as long ago as 1904. This antedates the efforts of any one else along this line so far as he knows; but his opinion is that while the idea works out very satisfactorily for steering model ships, the wireless-controlled torpedo as a weapon of warfare is a child of the mind and always will be.

Boiling Water in a Paper Bag

A TRAVELING salesman who had some knowledge of physical laws tells how he boiled water in a paper bag over a gas flame in a small-town hotel. The paper is not prevented from burning merely because it is wet as many may believe, but because the water in the bag conducts the heat away as fast as it is produced, thereby preventing the paper from reaching the kindling temperature. The knowledge of this simple fact helped the salesman to provide himself with the convenience of hot water for shaving. It is surprising how often experimenters find everyday use for their knowledge of the sciences.

Removing Old Putty from Windows

THE job of removing old putty from window panes is a tedious and troublesome one that often results in a broken glass. If a red hot iron is used for this purpose, much of the trouble experienced in removing the putty will be eliminated and the work can be accomplished with greater speed. The hot iron, which can be an old file or a stove poker, is run along the putty. The heat will cause the putty to crack and drop off. In doing this, the mechanic should not touch the glass, as the sudden change in temperature would be apt to crack it.

Tricks in all Trades

YANKEE ingenuity is one way of describing the resourcefulness of a job superintendent in charge of the erection of a cotton mill for a large concern of Nashua, N. H. It was found frequently necessary to erect derricks to hoist materials to the upper stories of the structure. The new mill stands in the midst of an oak grove and in clearing the site, many of the trees had been left standing close to the building. Using their trunks as part of the derrick saved the time and



expense ordinarily required to erect a mast, and as the majority of the trees had to come out anyway, for the sake of light, no actual damage was done the grove. A similar "stunt" performed some years ago by an employee of the contractor was the shaking of empty cement bags to recover the dust. This simple trick reduced the cost per barrel of cement by considerably more than enough to pay for the labor of shaking and beating the sacks.

A Good Wood Stain

A very simple wood stain can be made by dissolving bichromate of potassium in warm water to form a saturated solution. The solution is then diluted with more water and in this state the stain is ready for application. When this stain is used the wood needs no rubbing, as it leaves the wood with a beautiful satin finish. This is a little kink worth knowing.

Digitized by Google

Some New Developments in Aviation

How Governmental Aid Encourages European Aeronautical Progress While American Aviation Improvements Depend Almost Entirely Upon Initiative of Individual Manufacturers

By Victor W. Pagé, M.S.A.E.

IN no other country of prominence is aviation being neglected as in our own. We are rapidly losing the prestige we gained by our efforts in aviation development during the World War and due to an unexplained and inexcusable lethargy on the part of our lawmakers, we will soon be in a position where many of the small European countries will have air services and equipment much superior to our own. There is every argument for the development of commercial aviation as well as the military air service in this country and there is no sound reason why we should not be leaders in aviation progress instead of trailing behind countries that are not of the first rank.

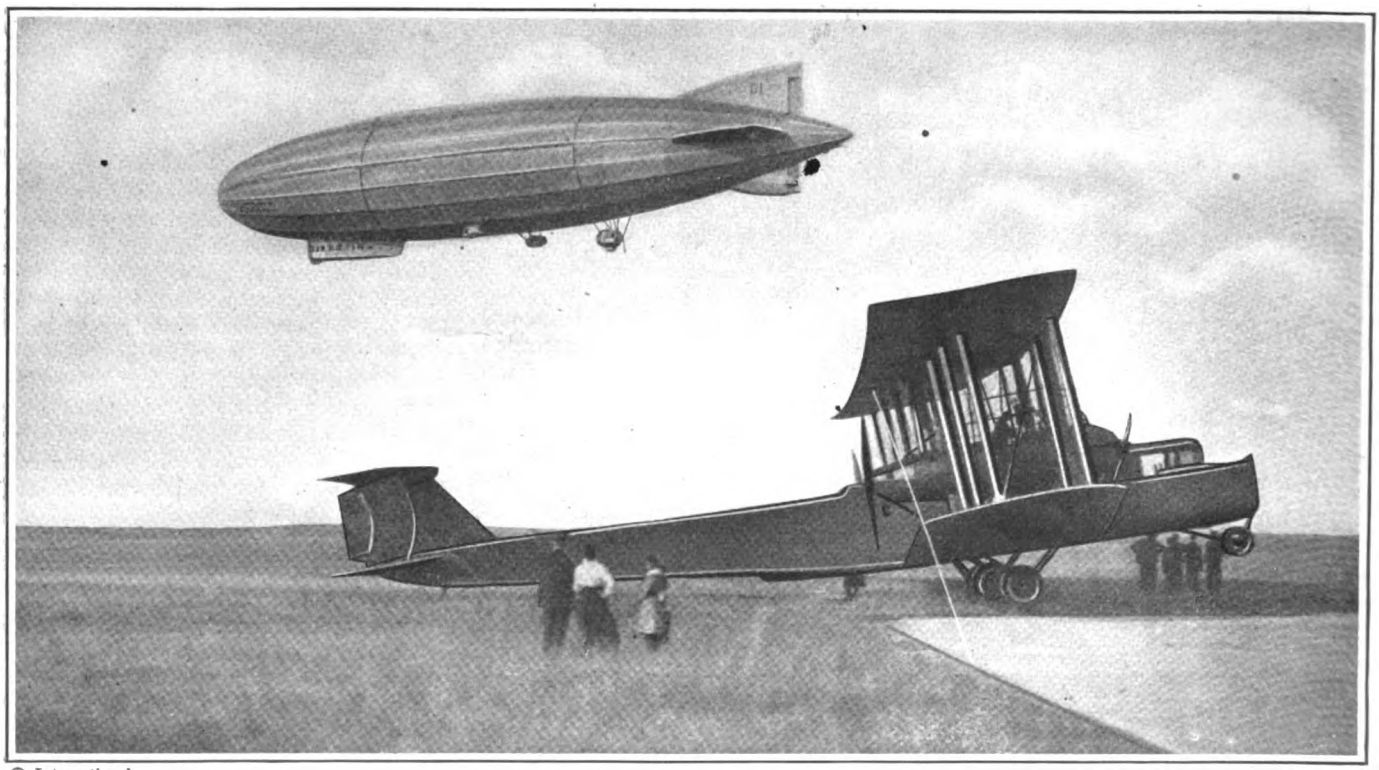


© International

Improved Spad Biplane capable of a speed of 187 miles per hour, uses 300 horsepower Hispano-Suiza engine

Even in Germany, there is great progress noted in the post war development of aviation and various craft are being developed, ostensibly for passenger and freight transport, that have wicked possibilities as military air craft if it should be desired to use them for other than commercial work. In England, France and Italy there has been a constant evolution, with governmental encouragement, of aircraft of both the heavier-than-air and lighter-than-air classes of much greater capacity than any that were used during the war. The leading European countries are not in any sense ideal fields for the development of commercial aviation because they are limited in area compared to our country and authorities concede that long distances are necessary to bring out the advantages of the new rapid aerial transport over the older methods of fast rail transportation.

To date, there has been no definite plan formulated for aerial development in this country that has met with the approval of the lawmakers. The American aircraft industry, which was in such a flourishing condition a year ago and which promised so much for the future has dwindled so that even our leading constructors are working with skeleton organizations and many have closed down their plants entirely. The neglect



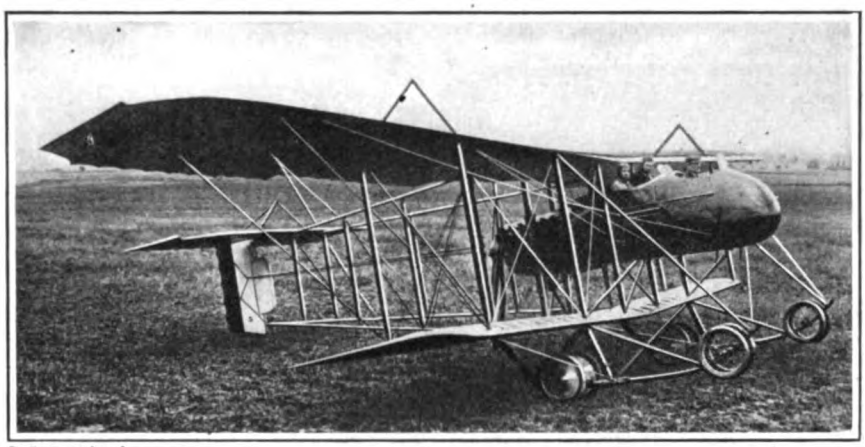
© International

Recent aircraft development in Germany is exemplified by the dirigible balloon, "Bodensee," and a four-engine giant biplane, both used commercially for passenger transport

Digitized by Google

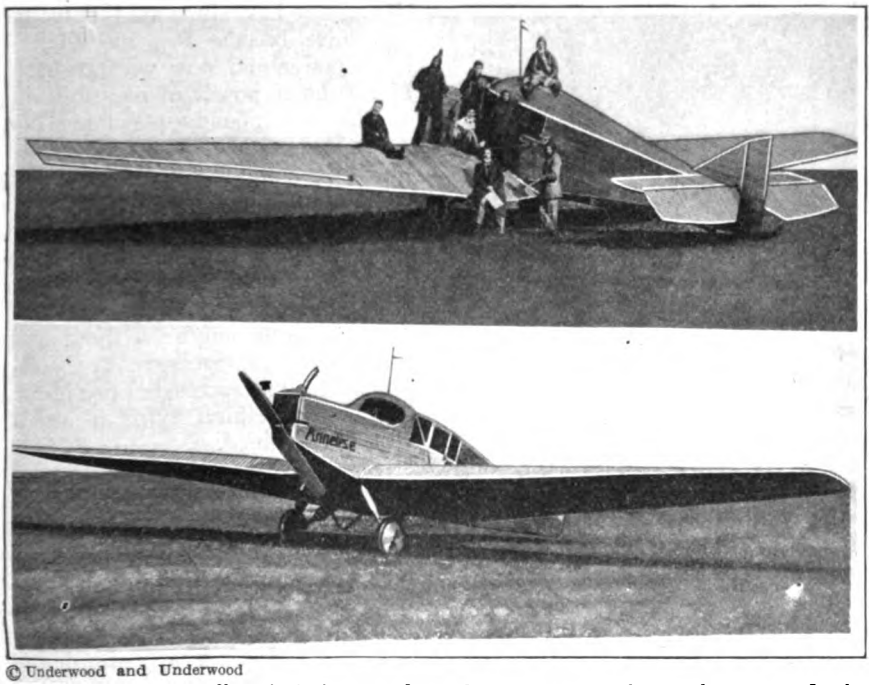
to provide a practical working plan that would encourage private capital in the development of airplanes or dirigibles suitable for commercial or military purposes, if continued another year will result in having our country without any aircraft protection to speak of. Prompt action is necessary to save the situation and it is hoped by all who have the interests of our country at heart that a definite plan of centralized aviation control under competent technical and business executives will be soon adopted that can co-ordinate the various aviation activities of the Army, Navy, Post Office Department and civilians to secure the good that always comes from intelligently directed co-operative effort.

In European countries, the value of aircraft for offensive and defensive operations in military work is so well recognized that every effort is being made to assist aircraft development not only by keeping active the aerial activities of the army and navy air services but also in the establishment of aerial mail, express and passenger carrying services, and encouraging civilian aviation by allowing fliers not connected with the army and navy to use the facilities of the military airdromes.



© International

A German all-metal monoplane, said to have accommodations for six passengers



© Underwood and Underwood

French pusher biplane with special landing gear to prevent nosing over in landing

Let us review what is being accomplished abroad by this policy of encouraging the aviation industry. The French have developed a modified Spad biplane that has attained a record breaking speed of 187 miles per hour in a straight flight and this was accomplished with only 300 horse power. They have also adapted a well-known pusher type biplane for commercial use by providing a special landing gear that gives maximum safety in landing. The machine can carry a pilot and three passengers in a special nacelle carried between the wings. They have also developed a giant four-motored Bleriot biplane, that, as accompanying illustrations show, towers above the normal sized airplane as an ocean liner overshadows a tug. This has a capacity for 26 passengers in a specially designed and strongly built fuselage of exceptionally good aerodynamic properties. The four engines aggregate 1,000 horse power and the plane will fly well with any two of them.

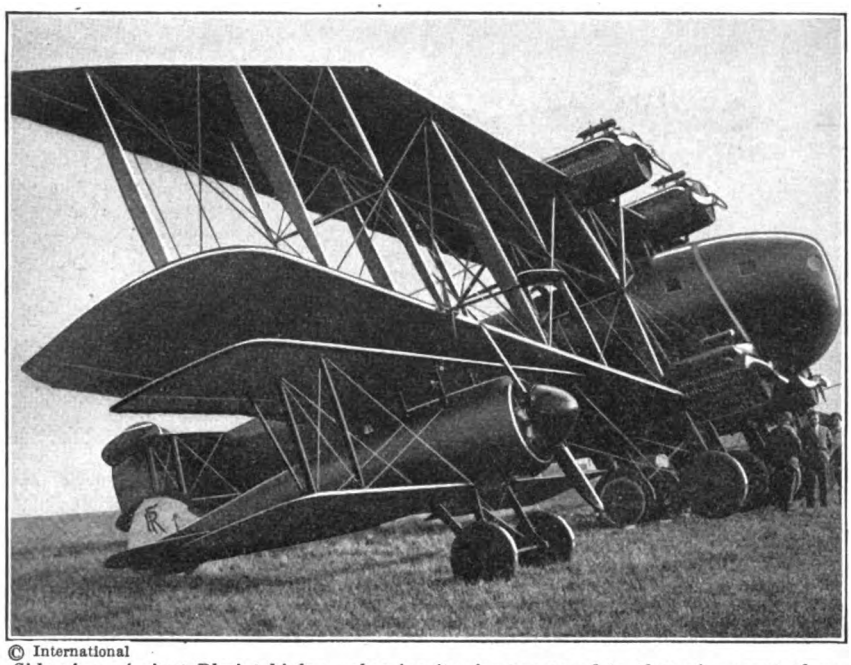
The Germans have also been active in developing passenger carrying aircraft of the two main classes. The reproduction of the photograph herewith was taken at an aviation field outside of Berlin and shows the passenger carrying dirigible "Bodensee" manœuvering above a large four-motored biplane also designed for passenger carrying. This machine has many of the characteristics of the Super Handley-Page, which is used in England for passenger carrying purposes and which has been recently flown in this country.

The Germans are also developing all metal airplanes, the latest craft of this type is a monoplane capable of carrying six passengers. This is made entirely of metal, even the wing structure being composed of duralumin cantilever beams and ribs of the same material surfaced with corrugated sheet aluminum of very light gauge. The fuselage has pressed steel longerons and stamped metal compression members, and the machine is not only fireproof but is said to be much stronger than those of conventional wood and fabric construction. While no engineering details are given it is probable that this machine is a development of the Fokker-Junkers biplane which the writer examined while in Belgium at a German airdrome that had been captured by the American forces. These machines were slow fliers and were intended for trench "strafing" with machine gun armament and had armored pilots and observers compartments. They were very strongly built and the corrugated metal used in surfacing the wings and fuselage was about .016 inch thick with the corrugations parallel to the line of flight. The armor was of hardened alloy steel 5 millimeters thick. It is evident that eliminating the armor and armament and simplifying the machine by making it a monoplane instead of a double surfaced craft will greatly increase its aerodynamical efficiency and make it possible to carry passengers without increasing the engine power used in the war craft.

A point that is evidently lost sight of by our lawmakers is that it is easier to transform commercial aircraft types to military use than to employ strictly military machines for commerce. The large passenger carrying planes can be easily made into bombers, the passenger weight being replaced by its equivalent in bombs and bomb racks; the fast mail plane can be changed to a reconnaissance machine or two-seat fighter; the sporting single seater can

Digitized by Google

be used as a fast scout. The passenger carrying dirigible of peace times becomes a naval scout or bomber of terrible destructive possibilities in times of war. The country that has the best commercial air service in peace times is best prepared for its aerial defense if attacked and has a big advantage if it is the aggressor.



© International

Side view of giant Bleriot biplane, showing its size compared to that of a scout plane. Note body design, which has excellent streamline form

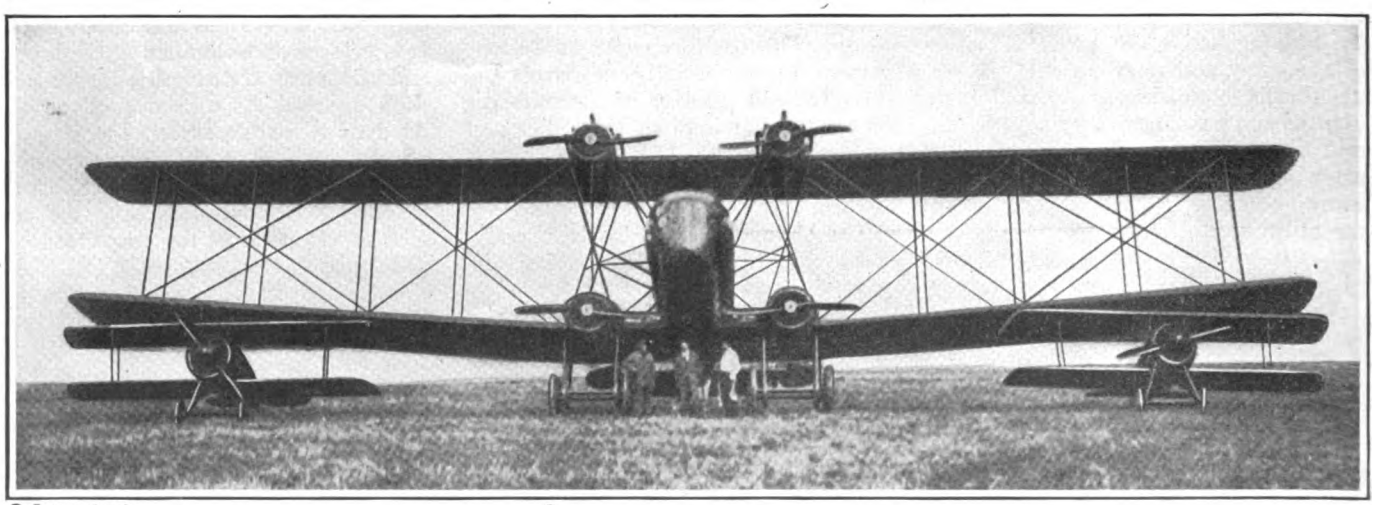
If one compares the modern airplane with the types of five years ago, but little exterior change is noticed. There has been a great improvement in matters of detail refinement, however, and many structural changes have taken place that are not apparent without close study. Considering changes which affect aerodynamical efficiency we find much better body or fuselage forms which greatly reduce resistance. Better wing sections with high lift and reduced drift have been evolved. The framework of wings has been improved and streamline bracing wire has been accepted as a safe proposition. In some airplanes, especially those intended for high speeds, a single strut of the modified "K" form is used for interplane separation and great care is taken, as can be seen by illustration of the modified Spad biplane, to streamline the points of attachment where the strut ends and wing frames join.

Struts are now made of steel or duralumin and we have learned that spruce is not the only material that can be employed for this purpose. Steel struts do not reduce weight appreciably but they can be made of smaller section without sacrificing strength and thus cut down head resistance. Steel spars can be made of drawn tubing or can be built up of two stamped halves welded together if they are to be of varying section at different points as the wood struts are. Specifications have been changed so built-up-spars may be used as tests have been shown that some of the newer methods of building them up gives strength equal to solid spars with less weight and also enables the builders to use wood that might otherwise be rejected.

Materials have been studied and experience has shown that cotton is good as a wing covering if properly woven and that it is as strong and durable as linen. Veneer has been utilized in the fuselage and as rib webs and has also been used in spars. Abroad, wings of very high speed machines have been covered on the top surface almost to the rear spar with veneer. An increasing use of stamped steel fittings is noticed and most of these are designed to be clamped in place without piercing the important structural parts with bolt holes. Fireproof dope and fabrics have also been developed as a result of the war.

Engines have increased in capacity and have become less in weight per horse power and now we have engines of 750 horse power in one unit with a weight of 2 pounds per horse power. Air-cooled engines are now accepted as practical and efficient. Light weight engine starters of various forms are employed, some working on electrical principles, others on air pressure. Carburetor stacks and safety screens have reduced the fire risk. Mufflers that silence the engine without offering too much back pressure are also obtainable. The successful use of the supercharger for high flying is also a recent development.

The greatest aid to navigation of passenger carrying craft has undoubtedly been the radio-direction finder and places the pilot in a position to defy fog or clouds and makes it possible for him to reach his destination. Then again, we have the turn indicator which is a very simple instrument that will give a positive indica-



© International

Front view of Bleriot four-motored biplane, showing location of power plants and comparing its great spread with two typical single-seater scout planes

Digitized by Google

tion of any tendency to turn. It is possible, therefore, to fly a straight course by using the compass and turn indicator together. The radio direction finder will warn the pilot of drift so one can well believe that the problem of navigation regardless of weather conditions, providing it is possible to fly at all, seems to be solved. Then we have the interphone, which permits communication between the pilot and passenger and a dual control release that will be of great value in instruction work because it gives the teacher absolute control in case of the student "running out of knowledge" as the army expresion has it, at the wrong moment.

This progress cannot be continued without building airplanes or dirigibles to try out new ideas with and keeping sufficient men trained to fly and take care of them. Laboratory work must be continued and designs must be worked out so new aircraft can be constructed. This work should be carried on under Government supervision and supported by its funds until an industry is created that is self-supporting. It is only by a slow process of evolution that one can improve mechanical things and if done gradually, the expenditures are very much less than is the case when an emergency arises and billions of dollars are wasted because several years of normal development must be crowded in a few months of feverish activity in endeavoring to catch up with the times.

A definite, well planned aviation policy is needed in this country because it is only by this means that the aviation industry can survive and the Government be assured of an adequate supply of up-to-date aircraft when needed. Commercial aviation should be encouraged and every possible Government aid extended to the courageous pioneers of a new era of transportation.

New Bristol Motor

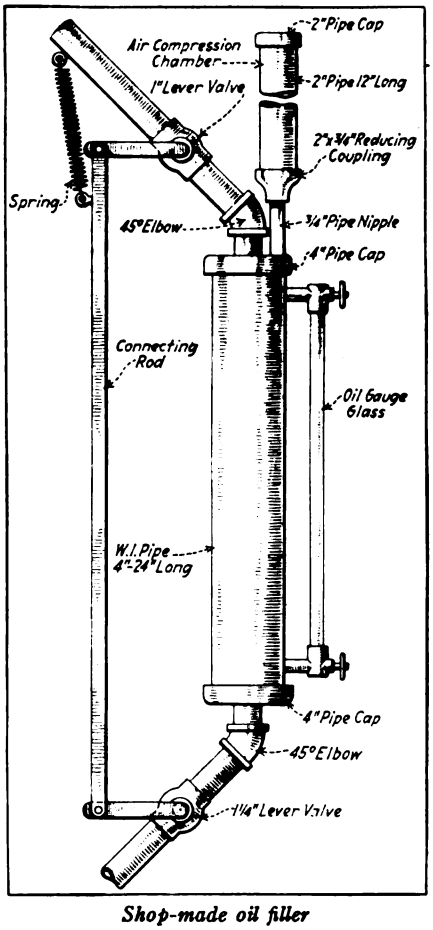
Experts who witnessed a flight by the latest Bristol fighter made recently at Filton, England, were impressed with the performance of both plane and engine. The machine was designed both for fighting and bombing. The engine develops 450 hp. with 9 air-cooled cylinders, and a weight of 636 lbs. The machine is built to fly at a maximum speed of about 150 m.p.h. A patented air cooling system does away with weight and attendant troubles of water. It has been approved by the British Air Control Board and adopted by large airplane firms and is said to cool satisfactorily even on extended flights. The weight-horsepower ratio is 1.41 pounds per brake horsepower, a very good figure and somewhat lower than has been achieved to date in engines of this power.

Shop-Made Oil Filler

By Thos. W. Poppe

IN the modern gasoline motor manufactory each and every minute must be used to speed up and then keep up the speed at which the motors travel from the time the rough cylinder block casting goes to meet the rapidly revolving cutters of the milling machine until they are crated and placed upon the platform ready for shipment.

In a most recent installation of a works of the above nature the motor parts found their way to the assembly line and lost their individuality by becoming a part of what would soon be a power plant for some automobile with



Shop-made oil filler

surprising speed and sureness. But the assembled motors were held up just before going on the gasoline test blocks where they were run under their own power as a final test. Investigation showed that the cause of delay was a very inefficient method of filling the lower crankcase with lubricating oil.

The problem of filling the lower case with oil was put up to the writer for solution, which must be rapid and sure as the delay was proving costly. After some thought the following device was constructed and upon trial proved very satisfactory.

A piece of 4-inch wrought iron pipe 24 inches long was threaded on each end. To each end was screwed a pipe cap. The cap on the top was drilled and tapped centraly for one-inch pipe. The bottom cap was drilled and tapped for 1¼-inch pipe. The top cap was connected through one-inch pipe to the source from whence the oil came and the botom cap became the outlet.

To obtain quick action ordinary lever valves or stop-cocks were placed as shown in cut, and the lever handles connected together by a half-inch round iron rod. This permitted a single downward pull to operate the lower valve and close the upper one. A strong spring placed at the top of the rod as shown in diagram automatically reversed the operation and insured the oil receptacle being ready for the next motor.

The oil was pumped through the one-inch supply line into the oil receptacle. This caused a compressing action, the lower valve was opened, this compression forced the necessary amount of oil into the lower case of the motor in a minimum amount of time. A compression chamber placed on the top of the oil receptacle later improved the action of the oil filler, as we termed it, to such a degree that the hold-up of motors at this particular point ceased.

Antidotes for Poisons

SULPHURIC, nitric, hydrochloric, or glacial acetic acids require magnesia, chalk, whiting, lime water or carbonate of soda administered, stirred up with water.

Caustic alkalies require vinegar or the juice of an acid fruit or extremely dilute acetic, citric, or tartaric acids.

Arsenic — Freshly made hydrated ferric oxide with magnesia.

Copper—White of egg mixed with water and plenty of milk.

Cyanides—Freshly precipitated peroxide of iron with potassium carbonate, coldest water poured over head and down spine.

Lead—A very dilute solution of sulphuric acid.

Mercury—White of egg mixed with milk, the white of one egg to each four grains of mecury chloride taken.

Oxalic acid and oxalates—Lime water or chalk may be used, but alkaline carbonates must not be used.

Silver Nitrate—Common salt in solution.

Zinc salts—Warm barley water may be taken.

In all above cases the application of special remedy must be preceded by the use of strong emetics, except in strong acids, when water should be taken to dilute acids before inducing the vomiting.

For burns and scalds, around the plating room and elsewhere, wet the part with cold water, and sprinkle with bicarbonate of soda (baking soda); the relief is instantaneous and permanent.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

A Powerful Electric Locomotive

ONE of the most powerful electric locomotives in the world has recently been tested at Erie, Pa., where it was made in the shops of the General Electric Company. This giant locomotive takes its current from a 3000-volt source. The current is fed to fourteen direct-current motors which are placed upon as many axles. The motors are directly connected. Tests have shown that a gearless locomotive operates at 10 per cent. higher efficiency, when travelling beyond 50 miles per hour, than those that receive their power through a train of gears from the driving motor. The aggregate horsepower of all the motors carried by the new locomotive is 3240.

This locomotive, which was designed especially for the Chicago, Milwaukee and St. Paul Railroad, is to be used on a new branch of the system to handle a 12-car train of 960 tons against a 2 per cent. grade at a speed of 25 miles per hour. A center cab is provided in which is placed the heating equipment. Oil is used for the heating fuel and a motor driven blower is included in the system for forced draught.

In testing this locomotive on the four-mile stretch of track at the plant of the General Electric Company, two large Atlantic type New York Central engines were used. These engines were coupled together and used to push the big electric locomotive. When the steam engines had started to move the big electric locomotive, current was slowly turned into its fourteen motors. The two great steam engines accepted the challenge and they were soon straining every part and puffing loudly with their throttles wide open to overcome the terrific "push" of their rival. Slowly, but very surely, as the resistance was taken out of the motor circuits, the new giant started to push the steam engines in the opposite direction despite their protests. With the drivers sliding around helplessly on the rails, the steam engines were forced gradually back.

This new electric locomotive is so designed that its motors can be used as dynamos. In this way current can be generated and sent back to the power house as the engine is coasting down grade. On the line that these locomotives are to be used, there are many miles of continuous grade and the use of the motors as dynamos helps to pull locomotives up on the opposite rail.

A New Quadrant Electrometer

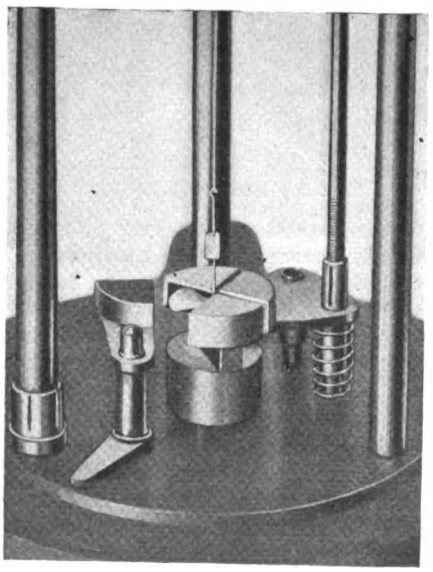
A VERY interesting type of quadrant electrometer has recently been brought out for making measurements of very small current or electrostatic potentials. It is becoming a greatly favored instrument in connection with



the measurement of electronic and radio activity research. It is also used to measure watts, volts or amperes in direct current and for a wide range of frequency in alternating current.

The instrument can also be used for the comparison of small capacities for the determination of dielectric constants, losses and other characteristics.

This electrometer can be used where



it is desired to make measurements and determinations with almost absolute elimination of electro-magnetic effects in the detector or measuring instrument.

The electrometer was designed by Dr. Karl T. Compton and Dr. Arthur H. Compton, both of Princeton University. The complete electrical system is made very much smaller than the popular Dolezalek design. The number of parts is materially reduced and one set of insulated leads are used. Very high sensitivity is obtained from the electro static control nearly neutralizing the restored torque of the suspension.

The construction of the instrument is very noteworthy. The needle and plane mirror comprise one unit and the quartz fibre suspension the other. The needle is of aluminum leaf and is made slightly unsymmetrical in its relation to the quadrants. The degree of dissymmetry can be changed from the outside of the case to suit various conditions.

Notable Export Shipment of Electric Furnace Equipment

ELECTRICAL equipment for twenty electric furnaces which, when placed in operation will comprise the largest electric furnace installation ever made, is now being shipped from the United States to the Glomfjord Smeltverk Company of Glomfjord, Norway.

The apparatus was made by the Westinghouse Electric & Manufacturing Company, and is divided into units, each unit comprising the equipment for one furnace. Each of the twenty units includes a 1300-k.v.a., single-phase, main-power transformer; a 26.2-k.v.a. series transformer, a 26.2 k.v.a. induction regulator, an automatic selector switch, a transformer switch and a two-panel separately mounted switchboard for the control of the elecrical apparatus. Sixteen thousand two hundred gallons of oil for insulating and cooling the transformers and regulators are a part of the shipment.

The general scheme of connections is such that the voltage variation necessary to the heat regulation of the furnace is accomplished by changing taps on the high voltage winding of the main power transformer. A portion of the winding which is proportional to the amount of voltage control desired is provided with taps in a number of equal steps. Switches and induction regulator operate together to automatically change connections on the high tension winding and to provide voltage control on each step. In this scheme the capacity of the regulator need be sufficient to control only the voltage of one step on the tap winding, thus sustaining a high power factor and at the same time providing a voltage control which is equiva- to an infinite number of steps.

Digitized by Google

Testing Incandescent Lamps

DURING the past year about five million incandescent bulbs were offered to the government purchasing authorities. Out of this number 12 per cent, or 600,000 lamps were rejected in the initial inspection at the factory. This inspection covers all the mechanical qualities of the lamp and their rating in regard to power consumption and efficiency. Samples were also selected for the burning or life tests. Three thousand five hundred lamps were subjected to this test, and with few exceptions both the vacuum and gas-filled lamps showed a life considerably in excess of 1,000 hours.

A New Wire Holder

AN American manufacturing concern which produces electrical equipment has just introduced to the trade a new wire holder, which is nothing more than a metal strip carrying one or more porcelain insulators. The porcelain members have a hole through them for holding the wires. The metal strips are screwed or nailed to the wall and the wires pass through the porcelain insulators. This little device will add greatly in reducing electric insulation to a purely mechanical job. The wire holders are said to be made at less cost than the more inconvenient type, are stronger, save tire wires and turn out to be safer than the usual methods.

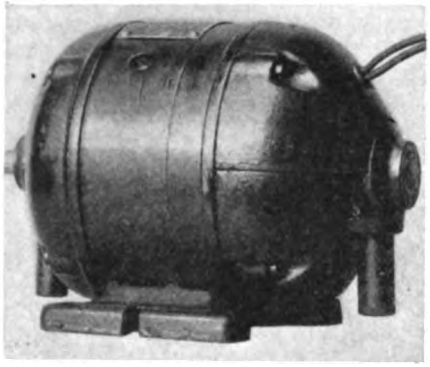
A Small D.C. Motor with Splash-Proof Feature

A SMALL direct-current motor incorporating a splash-proof housing of unique design which completely protects the winding and all live parts from splashing water or accidental contact is proving popular for light domestic and industrial purposes.

Made by the Westinghouse Electric & Manufacturing Company, it is known as the CDH type and is built in ⅛ and ¼ horsepower sizes.

The large commutators and box type brush-holders with large brush area make these motors particularly well adapted for operation from the low-voltage storage battery plants now being installed in great numbers on farms and in suburban residences. Motors wound for thirty-two volts are in great demand in rural communities for application to house pumps, washing machines, cream separators and similar machines.

Also, a wide field of application for motors of this type, wound for 115 and 230 volts, comprises light labor-saving machines used in homes, offices, stores, manufacturing plants, etc. They are interchangeable mechanically with alternating-current motors of similar ratings, and therefore appeal strongly to the manufacturer of motor-driven devices. Their splash-proof feature



makes them especially adapted to use on washing machines.

The frame consists of a seamless forged steel ring to which the cast-iron foot and end brackets are bolted. The pole pieces are bolted to the steel ring, thereby permitting the use of form-wound field coils, easily replaced in case of injury.

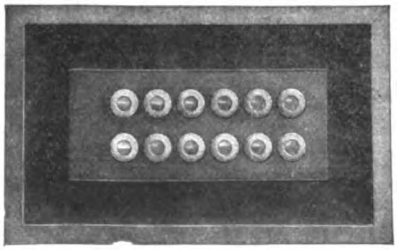
The motors are light in weight, compact, sturdy and uniform in performance.

Extending Railroad Electrification

THE Chicago, Milwaukee & St. Paul Railroad has recently turned on current in another 110-mile section of its main line, reaching from Othello to Cle Elum, Washington. It is stated that by January 1 the remaining 135-mile stretch of the road from Harlotown, Mont., to Seattle, will be completely electrified. This makes the complete electrified lines of the Chicago, Milwaukee & St. Paul Railroad aggregate 885 miles. The last stretch, which covers, 135 miles, will cost about nine million dollars.

A New Safety Push Button Panel

IN order to provide a safety lighting panel of small capacity for apartment houses, residences, etc., a new push button has recently been developed by a large manufacturer.



These panels are made up of push buttons and plug fuses, and all parts accessible are electrically dead, so that the operator is in no danger of getting a shock in turning the lights on or off. Each pair of buttons with their fuses constitutes a unit and should a switch become damaged, all that is necessary is to remove the switch cover section and unscrew the defective part, without disconnecting any wires, exposing other switches or removing the panel from the box.

By reason of its construction, this panel is the narrowest safety panel on the market and the only one of its capacity that can be furnished with a safety-type main switch if desired.

These panels are made for two or three-wire systems, and for from two to thirty-two branch circuits. The capacity of the main ranges from 30 to 200 amperes, 125 volts, and the capacity of each branch circuit is ten amperes.

Petroleum Located Electrically

THE *Electrical Review* recently published an article outlining the work of Eugene Elkins, an inventor, who has produced apparatus with which natural sources of petroleum can be discovered. Mr. Elkins describes his apparatus and its operation in the following manner:

"The system consists in forming an electrical circuit through the earth by dropping an insulated wire to the bottom of a dry water hole, valley or indentation and placing a series of batteries on top of the earth, to the positive pole of which is attached a land wire. This land wire is then taken out over the field in any direction and for any distance, and all of the intermediate territory is combined thoroughly with electric currents flowing from the anode or positive pole to the cathode or negative pole. The earth being simply a huge inverted magnet, the electric currents travel from one to the other of the charged poles by the path of least resistance, much as does the return current of the telegraph system through its ground wires to the point of origin.

"Oil and its constituent components being the only minerals in the earth through which electricity cannot pass, it therefore follows that an oil pool in the path of the electric currents mentioned will offer a great resistance to the said currents; and we register these resistances on an extremely delicate meter in the hands of the operator on the surface of the earth."

Many different plans for locating mineral deposits electrically have been proposed during the past twenty-five years. Some of them have been practical and some have not. A number of different systems working on the same principle as that outlined above have been proposed, but not one of them has been developed to a point where it could be applied in a commercial way.

Digitized by Google

The Everyday Engineering Workshop Contest

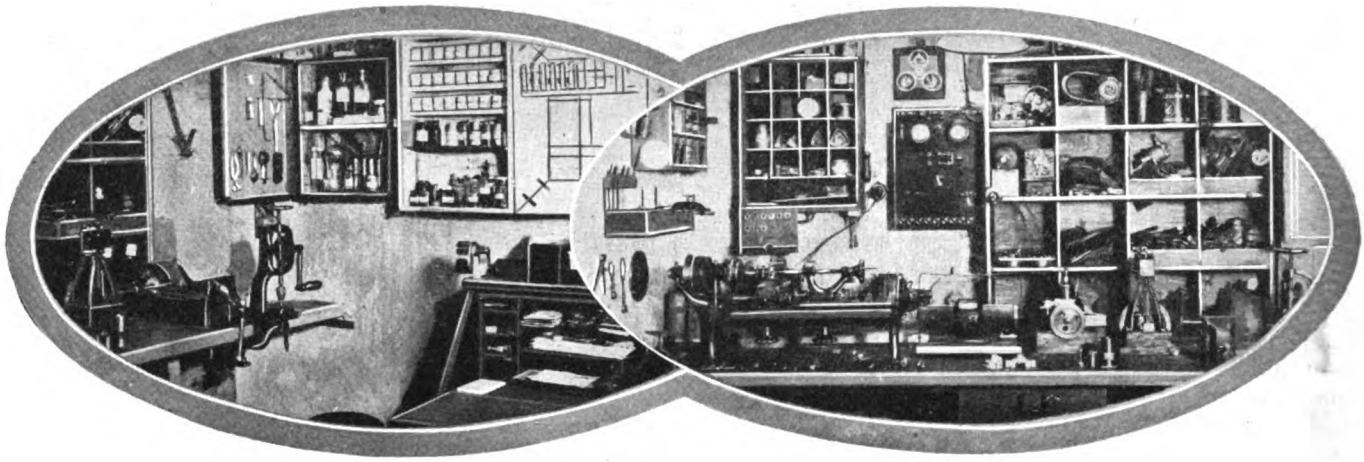
The Winners of the Third Prize

THE photographs of the shops shown on this page belong to H. E. Bitner of Harrisburg, Penn., and S. C. Swanson, Secretary of the Chicago Society of Model Engineers, Chicago, Ill. The judges of the shop contest found it difficult to choose between two shops, and it was therefore decided to award both contestants the third prize.

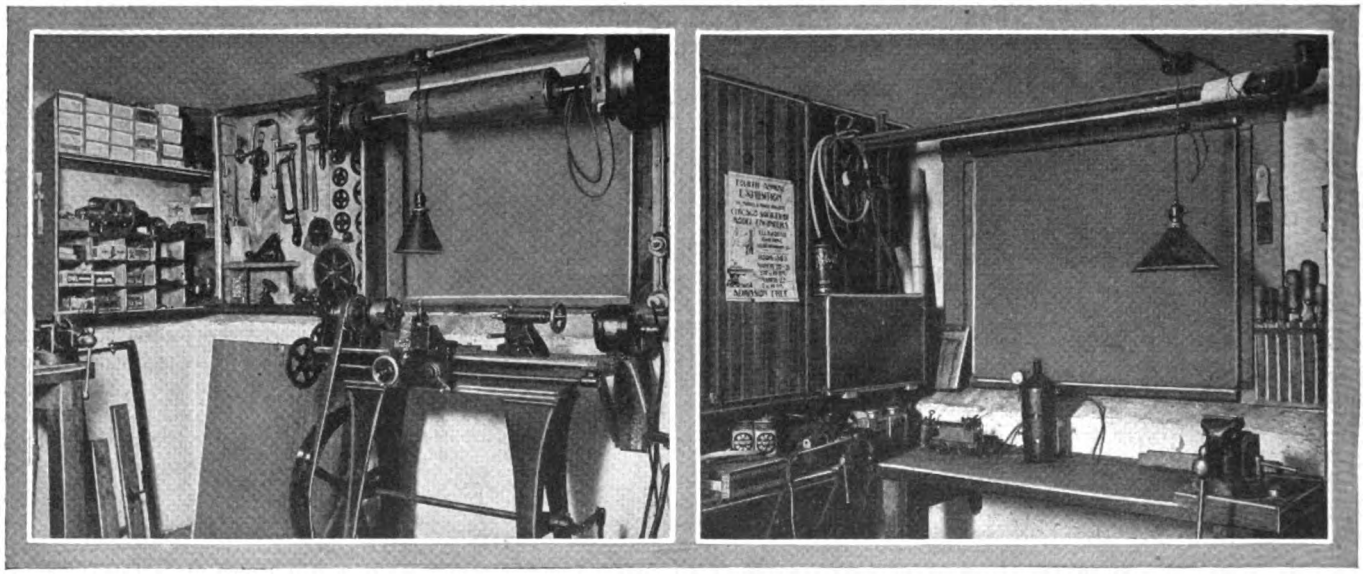
The Editor of EVERYDAY ENGINEERING has decided to publish the remainder of the photographs that were received under a new department to be called "Our Readers' Shops." If enough photographs can be obtained this department will be a permanent feature of "EVERYDAY." Readers who care to send in a short description of their shops together with a photograph will be paid for their trouble when the description is published. All matter of this nature will be paid for at space rate. In describing the shop, the general theme to be followed is "My Shop: What Is in It and How I Use It."

Mr. H. E. Bitner describes his shop as follows:

A part of the equipment consists of a bench lathe with back gears giving four speeds (gears fitted by myself), 6 in. face plate, 3 in. jaw chuck with inside and outside jaw, slide rest, and a ¼ h.p. A. C. motor which also drives a 4 in. grinding wheel. A 61 V. 6 Amp. generator is directly connected to the motor used for charging storage battery and supplying D. C. to the switchboard. The bench drill has a round table and vise, a 3 in. vise and hand drill complete the main part. I also have taps and dies from size 4 to ⅜ in. hacksaw, trimmers, shears and many small tools. Switchboard has 6-V. D. C. 3½-6-8-10 volts A. C. used in operating small motors, coils and lamps; switchboard has A. C. and D. C. ammeters and double throw switch gives either A. C. or D. C. to one pair of binding posts. In the lathe is a crankshaft being turned for the refrigerating outfit described in EVERYDAY ENGINEERING MAGAZINE. Cylinder, piston, connecting rod and both halves of the crank case are shown on table. On the table also is shown a ⅛ h.p. water motor. Back of the bench drill is a casting for an A. C. rectifier just starting construction. The microscope is 25 dia. The Tesla coil is home made and gives 1½ in. spark. On top of the shelf is a complete enlarging printing and developing outfit. The chemical outfit has 60 chemicals and apparatus. I use a Bunsen burner to melt babbit for pouring bearings. My shop is used as a hobby to build models that work and make experiments in chemicals to teach myself and pass pleasant evenings."



The shop of H. E. Bitner of Philadelphia, Pa.



Two views of the shop owned by Mr. S. C. Swanson, who is Secre tary of the Chicago Society of Model Engineers

Mr. S. C. Swanson, who is a well-seasoned model engineer of the A class variety, sent in the following description of his shop:

"I wish our Editor had made the subject, 'What Is My Workshop?' as I

Digitized by Google

would then have had more latitude in my choice of material, as it is not natural to think of my shop as merely an assemblage of 'such-and-such' tools, for a certain purpose. Furthermore, our Editor has evidently not taken into consideration the fact that some of our shops are mere 'two-by-fours' and consequently require more than one photo to properly illustrate.

My shop is located in a dry basement halfway in the ground with fair light from two windows. Directly in front of the brightest window is the lathe, a 9 in. South Bend, with two pedal foot power. A countershaft is shown directly above the lathe, carrying a drum. This is used to drive the lathe in connection with the 1/6 h.p. motor at the right, for rather long, light jobs. The drum is for driving a tool post drilling spindle. The lathe equipment includes plain and compound slide rests, a 4 in. Cushman independent chuck, and a ½ in. Jacobs drill chuck.

The tool board to the left of the lathe contains, besides the tools visible, heavy tools such as chucks, etc. The upper shelf at the left of the photo contains boxes of supplies of all kinds, the second shelf mainly work in progress, and the lower shelf pigeon holes for wrenches, chisels, boring bars, boxes of odd tools, etc.

The second illustration shows the bench, with a 3 in. swivel vise, the tool chest for fine tools, taps, dies, micrometers, etc., and the cupboard for photographic supplies and chemicals.

I use my shop mainly in the practice of my hobby, model engineering. This includes, besides the building of models, such work as special tools from time to time as required. As to how I use it, I will say that everything has its place, and at the end of every 'work' period each tool goes into its place. A rusty tool is an abomination to me, so everything is kept well oiled. Emery is a necessary evil; special precautions are taken to protect the lathe from it. The small motor-driven grinder is kept at its distance from the lathe and other good tools. To fill out my 400, let me add for the benefit of the 'shopless' one: Get a shop, treat it right, and you have the best friend in the world."

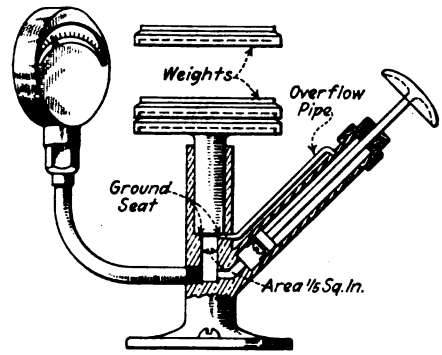
Mr. Swanson's philosophy regarding his shop is good advice for all of those who are not fortunate enough to be in possession of such a luxury. It is very true that a little workshop can be a man's best friend. He can go to it and enjoy himself when "everything is wrong" or when there is just nothing else to do. The little workshop contains tools—the very instruments of creation. Every normal man or boy has the creative instinct in some form. When in the possession of tools and a shop to put them in, he can spend many useful and happy hours exercising his genius and skill in "making things."

Calibrating Pressure Gauges

By Edwin J. Bachman

THERE is really nothing difficult about making small pressure gauges, but it seems that the articles published to date come to a close too quickly when calibrating should be considered.

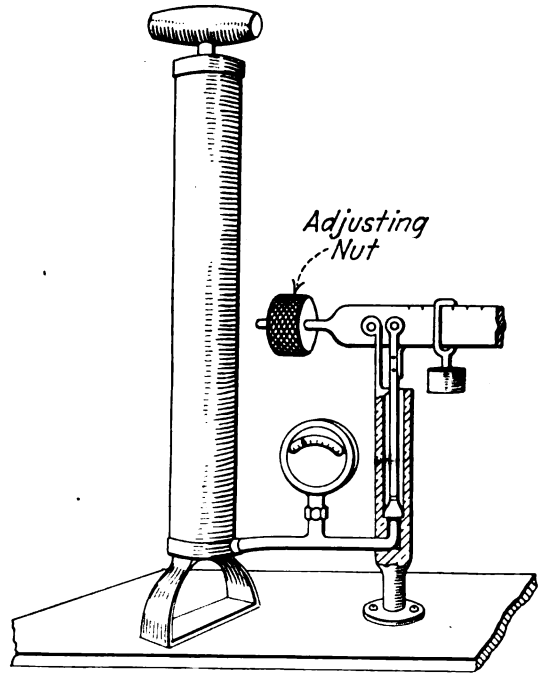
It is all very well to connect the newly made gauge with a standard gauge if you have one, or if you have one and it is accurate; but at that the boys might like to know how the standard gauge was calibrated in the first place. At a gauge factory here in eastern Pennsylvania they make all kinds, from automobile fuel tank and oil pressure gauges that have bent tubes with a wall thickness of only two-thousandths of an inch and indicate 4 to 6 pounds maximum pressure, to hydraulic gauges which indicate upward of 300,000 pounds to the square inch, which have a tube of tool steel, drilled from the solid, bent red hot and finally tempered. When they calibrate these gauges they do not connect them up with a standard gauge.



Calibrating gauges with small weights

The worker who calibrates the newly made gauges or who sets the printed dials so that the hand registers correctly has a small device on his bench made of brass, which consists of a hand-pump opening into an upright column on which is supported a plunger, the bottom of which is flat and rests on a flat seat. There is an opening in the seat whose area is one-fifth of a square inch exactly. The top of the plunger has a circular platform about four inches in diameter on which the weights are placed. Connected to the bottom of this column and open to the pressure from the pump is a standard pipe connection on which the gauge to be calibrated is fastened. The whole thing is then filled with oil.

Now it is evident that if a weight of one pound is placed on the platform it will require a hydraulic pressure of five pounds to the square inch to raise it, since the area of the opening in the seat under the plunger is one-fifth of a square inch. There are about 75 pounds of brass weights, all machined and fitting into one another. The weights weighing one pound actually are marked five pounds, the two-pound is marked ten, etc. The pointer on the gauge having moved according to the pressure will indicate where the mark is to be made on the dial. As each weight is added a new mark is placed on the dial. Thus when a gauge registers five pounds you may be sure that the pressure is that.



The beam type of gauge calibrating instrument

By changing the size of the aperture under the plunger the values of these same weights may be changed.

An amateur could make a simple apparatus similar to the one described, using a set of avoirdupois weights such as are used in a grocery store, or a beam with a sliding weight could be constructed using only one weight. The pump may be a bicycle tire pump. In case the beam type is used, an adjustable weight should be provided for balancing the beam. The distance between the notches on the beam is the same as the distance between the two pivots. The column is shown high. This will prevent the oil from over-flowing when the pressure has reached the point where it will lift the plunger. This upright is shown in section, the rest being simple enough so that anyone can understand.

Digitized by Google

Construction of a Mechanical Vacuum Cleaner

By E. H. Williamson

PART II

Conclusion

GREAT care should be taken to place the bearings so that the spindles are held in a vertical position as to the cover (C) and also that the teeth mesh freely, but neither too close nor too far apart, as the success of the machine depends upon this. The bearing for the bottom end of the spindle of (G) is a brass plate ⅛ in. thick and 2 in. long by 1 in. wide, which is screwed to the face of the wooden cover, the wood being bored out to accommodate the end of the lower gudgeon.

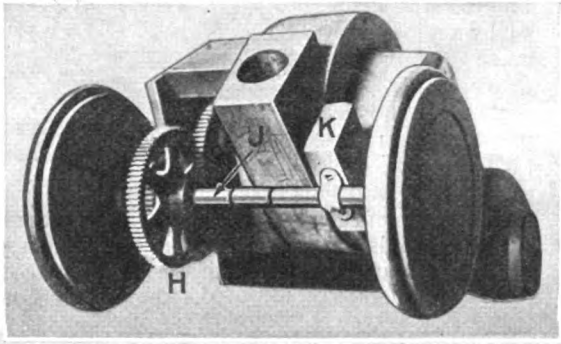
To avoid the expense of unnecessary machine work, the spindle of the gear (G) may be made as follows: A piece of ½ in. round iron rod, 1½ in. long, with a smooth surface is prepared and the ends filed square. Take a centre punch and make a dent in the exact centre of each end, and start the hole with a No. 40 drill. Next take a ⅛ in. drill and bore a hole to a depth of ¾ in., keeping the drill square with the end of the iron. This requires considerable care, but it can be done.

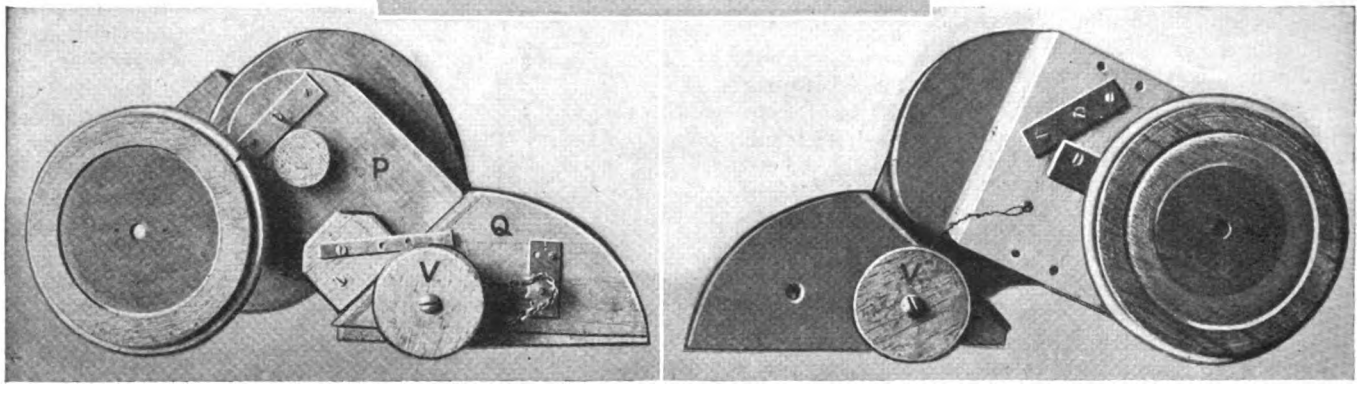
Now take two pieces of steel rod a shade over ⅛ in. thick and 1 in. long and drive them into the holes in the iron, so that they project ⅜ in. Two pieces of broken drill shanks of the proper size will answer perfectly. The photo., Fig. (6), shows the driving mechanism. A 4 in. gear wheel (H) is set on a piece of brass tube (I), 2⅜ in. long. This sets on the driving shaft, which is a piece of round iron rod, 7/16 in. outside diameter and 11 in. long. This shaft is supported at the right side by a bearing sleeve (J) which is a brass tube 2¾ in. long and is fastened by a pipe strap to the bearing block (K), which is made from a piece of 1 in. pine, 4 in. long by 2 in. deep, screwed firmly to the right-hand cover below the air duct, as shown in the photo.

To prevent side play, a 1¼ in. tube is screwed to the shaft between the other two tubes. As it is necessary that the fan and train of gears should continue to revolve of their own momentum if the motion of the cleaner is temporarily stopped, some form of release is necessary, and this device is shown in the photograph, Fig. 5, at the end of the shaft, and also in the diagram, Fig. 7, which gives the dimensions.

The steel ratchet (M), which is 1½ in. diameter and ¼ in. face, has the bore enlarged sufficiently to slip over the end of the brass sleeve (I) and is attached to the side of the 4 in. gear (G) with a couple of 8-32 flat head machine screws, the ratchet being countersunk to receive the heads. The L-shaped block (N), which is of 5/16 in. brass, 1½ in. by 1½ in., is drilled to 7/16 in. to fit on the driving shaft, to which it is fastened with a set screw, driven through the shaft. The dog (O) is made from a piece of ⅜ in. by 1/16 in. iron, sharpened at one end and hardened. It is screwed to a half inch square block of the same thickness of brass as (N) and is pivoted to the side of the latter with an 8-32 machine screw. It is held against the teeth of the ratchet by the pressure of the light spiral spring, as shown.

The driving shaft is supported at the left end by a bearing composed of a strip of ⅛ in. iron, 1 in. wide and 5 in. long, which is screwed to the wooden cover of the gear box. This cover is ⅜ in. thick, 6 in. long and 4 in. wide. The driving wheels are turned from 1 in. pine and are 6 in. in diameter. There is a semi-circular groove ¼ in. deep cut in the rim to receive a tire of ⅜ in. rubber which is cut from a length of baby carriage wire, and fastened to the wheel with sprigs driven down below the surface of the rubber. The wheels are attached to the shaft by metal hubs of the size shown in Fig. (8). These may be made of brass if desired, but in the writer's case were cast from type metal in a wooden mold and smoothed up and trued on a wood lathe. The photograph, Fig. (9), shows the left side of the cleaner, and the air duct (P) which connects the fan box with the floor box (Q). This duct is 4½ in. wide and 6 in. long to the top of the rounded part, and 2 in. deep, outside dimensions. The rounded part is made by turning a circular shell, 4½ in. outside, 3½ in. inside, and 1⅝ in. deep. This is cut in half and one of the halves is nailed securely to the cover of the fan box concentric with the 3½ in. inlet hole. The side pieces are of ⅜ in. pine, 1⅝ in. wide and 4 in long, and are nailed to the cover so as to make a tight butt joint with both the ends of the wooden semi-circle and the slanting face of the floor box. The cover is cut from ⅜ in. pine to conform to the outside dimensions of the duct, and is nailed to the box with small brads. The photograph, Fig. (10), shows a view of the interior





Top, Fig. 6. *Left, Fig.* 9. *Right, Fig.* 11

Digitized by Google

of the floor box. At one end of the slanting side will be noted the opening into the air duct. This is 1½ in. by 3 in. and is arranged to be closed if desired by a sliding cover made of cigar box wood, 4 in. by 5 in., which slides in narrow bevelled strips, and is pulled back and forth by a piece of picture wire, which is run through the sides of the box. If the slide is pulled over the opening, the suction is cut off, and the opening in the side of the air duct can be used to receive an air hose for special work. This opening is normally closed with a stopper, as shown in the photograph, Fig. (9). The dimensions of the floor box are as follows: 8½ in. by 8 in. at the bottom, the sides are 8 in. long at the bottom, 5 in. long on the slanting part, and the curved part has a radius of 4 in. The height is 4 in. from the base to the top of the slant. The slanting side is 5 in. wide by 8½ in. long. The curved part is covered with a sheet of thin tin, fastened with small tacks all around, and all joints are lined inside the box with strips of thin leather, cut from old gloves and glued over the cracks. The revolving brush (S), which stirs up the dust and also collects debris too large to go through the fan, is made from a brush taken from a discarded carpet sweeper. The ends of the wooden centre are cut off to make the brush 6½ in. long, and a 3/16 in. hole, 1½ in. deep, is drilled in the centre of each end. A bit of 3/16 in. round iron rod 2 in. long is driven into one end, and a piece 3 in. long is set in the other, so as to project about one inch beyond the side of the box. The brush is supported in bearings formed from plates

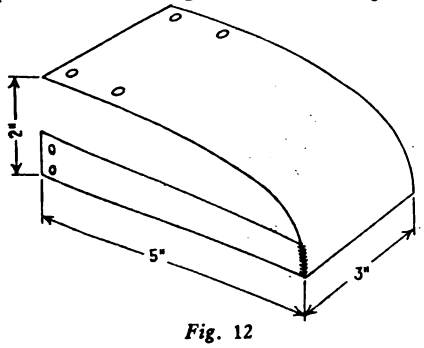


Fig. 12

of ⅛ in. brass, 1 in. by 1½ in., bored to receive the brush gudgeons, and screwed to the inner sides of the box in such a position that the bristles of the brush press on the floor when the cleaner is in use. The brush is driven from a 2¼ in. brass sprocket wheel (T), which is screwed to the side of the small front wheel (V). The sprocket is set out from the side of the wheel by a washer of cigar box wood, so as to give the chain a space to run freely, and is attached to the wheel by small screws driven through the web of the sprocket. The small wheels (V) and (V^1) are turned from ⅜ in. pine, and are 2¾ in. in diameter. A bit of brass tube, ¼ in. inside diameter, is driven through a hole bored in the centre and forms a sleeve on which the wheel revolves. The axles on which they turn are stove bolts. As the sides of the box are only ⅜ in. through, it is best to mount the wheels on reinforcement blocks as shown, the stove bolts passing through both pieces and being locked with a nut

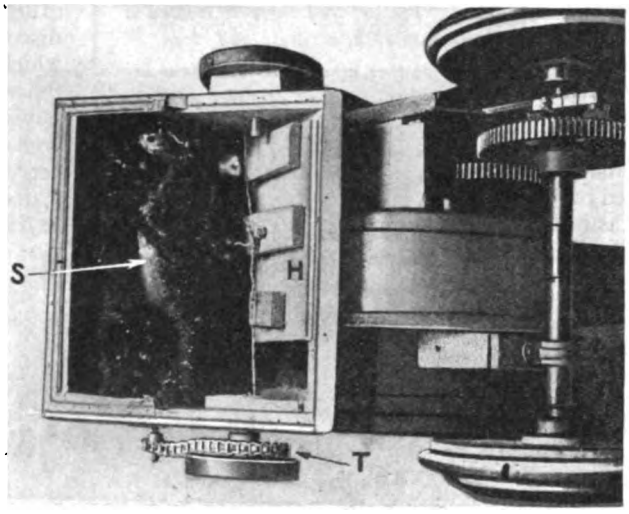
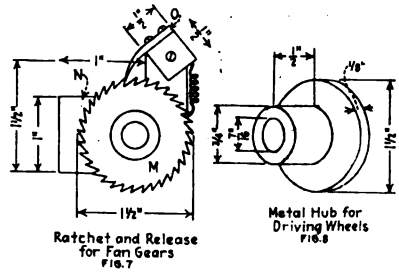


Fig 10

within the box. This makes a rigid job.

A short thick rubber band is sprung over the rim to act as a tire, and secured with a touch of liquid glue. Returning to the revolving brush: A one-inch brass sprocket wheel is set on the gudgeon that projects through the box, and secured by a small machine screw, through both hub and spindle. (See Fig. 11.) The two sprockets are connected by a wire sprocket chain, which should not be drawn tight. The handle (W) by which the cleaner is pushed along is made from a piece of pine, 28 in. long, 1½ in. wide and 1 in. thick. It is provided with an iron fork for attachment to the cleaner made from two strips of 1 in. by ⅛ in. and 14 in. long. Three inches of this length is secured to the wooden bar by two stove bolts driven through the wood, and the ends are bent symmetrically to embrace the sides of the cleaner, allowing a space of 8 in. between the prongs. These are pivoted at the ends on machine screws, size ¼-20, driven into ⅛ in. iron plates, 1 in. by 3 in., which are screwed to the covers of the gear box and air duct, as shown in the photograph, Fig. 11. The dust bag is made from khaki cloth which is close grained and light, and is 24 in. long by 7 in. wide, stitched with double seams at the edges. The lower end is cut so as to make a close fit around a wooden sleeve, 2½ in. in diameter by 4 in. long. A groove is cut a half an inch from one end of the sleeve, and the cloth is bound around in the groove with binding wire to make a tight fit. The interior of the sleeve is 1½ in. in diameter, to receive the metal tube which connects it to the outlet from the fan box. This tube, which is 4 in. long, was made, in the writer's case, from a piece of the barrel of an old bicycle foot pump. The upper end of the bag is reduced in size from seven to five inches, and when in operation the mouth is held together by a clamp, which may be made of two strips of wood bolted together, at the ends, and provided with thumb nuts for easy removal, or an ordinary trouser hanger may be used. Being of white pine, the body of the cleaner may be stained any desired color, but mahogany or rosewood gives a good effect, and the wood after staining should be rubbed down and then varnished with shellac. The operation of the cleaner follows: It is pushed forward by the handle like an ordinary carpet sweeper, and the revolution of the large wheels drives the fan at high speed, producing a strong suction and quickly inflating the bag. Where the space to be cleaned is limited, the cleaner is given a series of short, quick punches and by the action of the ratchet the fan will continue to revolve at a practically constant high speed, due to its momentum. The same method is used, where it is desired to use an air hose attached to the opening in the air duct, for cleaning walls, curtains, etc., in which case, of course, the trap must be pulled over the opening from the air duct to the floor. The method by which the trap is pulled is shown in Fig. 9. A small lever of 1/16 in. strap iron, ⅜ in. wide and 4



in. long is attached to the side of the air duct, being set on a small block to bring it even with the side of the floor box, and the end of the picture cord is attached to this lever. Where the cord emerges from the other side of the box it is formed into a loop and hung over a small screw driven into the wood, (as in Fig. 11). The driving gear and the part of the gear (G) which projects from the gear box are to be protected with a cover, which is not

(*Continued on page* 242)

Digitized by Google

Magic in Metal Casting

The Story of Die-Castings and the Great Industry They Have Created

By Raymond Francis Yates

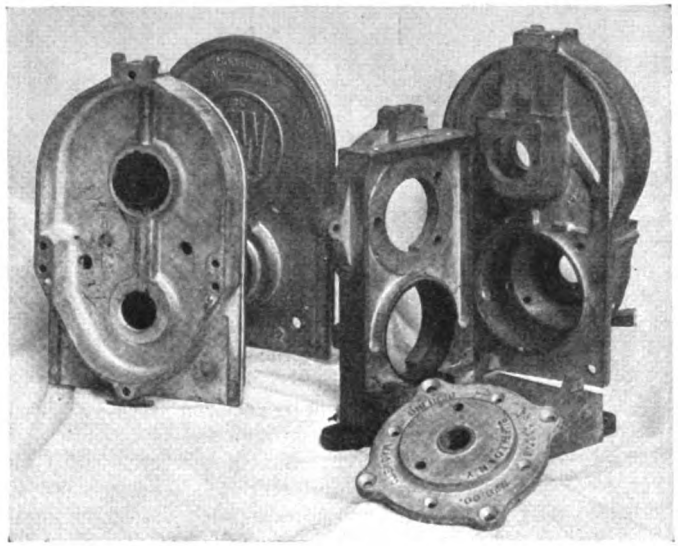
Die-casting is the magic of the metal industry. So rapid and perfect are metal castings produced by this process that it would seem that the machine operator resorts to the magician's "Presto" and there is created a casting smooth, accurate and clean.

Die-casting now forms an infant industry that bears all of the ear-marks of developing into a giant. Ere long, all small castings may be produced by this method, which is far more rapid, convenient, and for large quantities, less expensive than the conventional process of sand moulds.

THE casting of metal in prepared moulds is not a new art. Its beginning is lost in the mists of antiquity. The Egyptians were probably the first peoples to practice this useful art. The Greeks, although they acquired the necessary skill and knowledge at a much later date, were more proficient and succeeded in producing much more creditable work. The great Greek, Chares, who made the Colossus of Rhodes (The Sun God Helois) during the reign of Demetrius in the fourth century before Christ, accomplished one of the greatest feats of metal casting known to mankind. This massive statue took twelve years to make and when completed it stood 105 feet high and weighed in the neighborhood of 360 tons. The relentless shocks of an earthquake destroyed it in the year 224 B.C.

Other famous Greek colossi such as the Apollo of Calamis, the Zeus of Hercules of Lysippus and the Zeus of Olympia, are numbered among the greatest castings of the world.

King Solomon's throne was placed between two massive bronze lions, which showed that the people he ruled had some knowledge of metal casting. Several references appear in the Bible which gives undoubted evidence of ancient knowledge of the casting art.



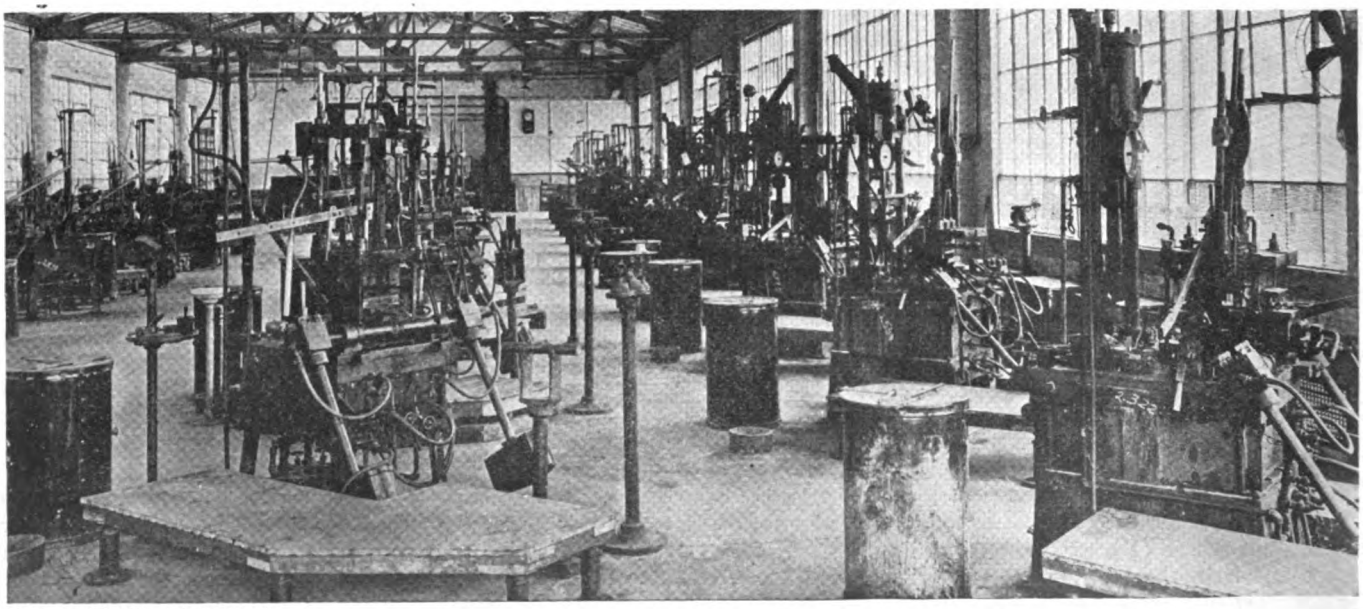
Courtesy of Doehler Die-Casting Co.

A group of castings made by the die-casting process

Archæologists tell us that civilization has passed through three distinct stages in the change from barbarism to civilization. The first, or stone age, is that period in which the people used implements of stone. The second period is called the bronze age, in which mankind discovered the use of the alloy bronze which consisted of the combination of the metals copper and tin. This is disputed in many quarters and some archæologists believe that the metal copper superseded the use of bronze, owing to the fact that copper could be found in its natural metallic state, whereas tin would have to be reduced from its ore. Iron is the chief metal of the next period which is commonly known as the iron age.

The early Egyptians used a smelting furnace which was made by sinking a hole in the ground and setting the crucible into it. The crucible was then surrounded with the fuel. A forced draft was produced by fanning the fire with bamboo matting. In later types of furnaces bellows were used and these were manipulated by foot power. This type of furnace was the forerunner of the modern pit furnace which is used in foundry practice.

The Greeks used furnaces which greatly resembled the cupola furnace of the present era. As early as the fifteenth century the modern reverbera-



Courtesy of Doehler Die-Casting Co.

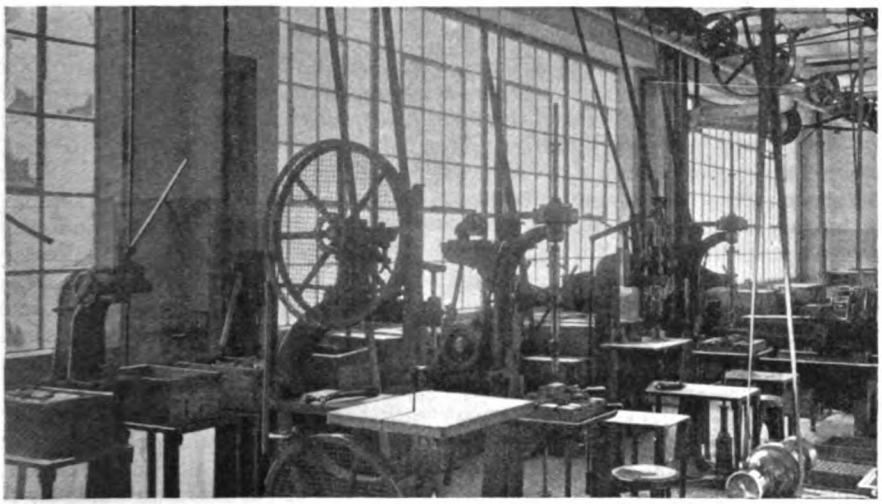
A number of automatic die-casting machines. The molted metal in the base of the machine is forced into the die

Digitized by Google

tory furnace was brought into use.

Archæologists have recently unearthed a series of moulds which they claim to have belonged to the first Dynasty of Egypt. These moulds were carved in thick pieces of clay which were baked into pottery and lined with fine ashy clay. Among the lake dwellings of Switzerland moulds have been unearthed which date back as far as 2000 B.C. Some of these moulds are of rock and others are of clay. These moulds were more or less permanent in nature.

The casting of metal in sand was started commercially in about 1708. A man by the name of John Thomas, who was an apprentice of Abraham Darby in Wales, conceived the idea of using sand instead of clay. An English patent covering the casting of metal in sand was obtained dated 1758.



Courtesy of Doehler Die-Casting Co.

A cleaning room in a die-casting plant

The advent of the metallic mould was brought about in the printing industry in the year 1454. This metallic mould was used for the casting of type and it was probably the first step toward the development of the modern linotype machine.

The casting of the metal by forming moulds in sand is a very unsatisfactory method. It is slow, troublesome, costly and produces a very crude and unfinished result that requires a great amount of machining and finishing to bring it to a usable shape. Modern industry has long felt the need of a process whereby castings could be accurately and rapidly made in an almost finished condition. The manufacturers desire to have metal parts cast that would not need to be ground or filed to bring them to shape. In the year 1906 Mr. H. H. Doehler perfected a system of castings in metal dies. In the year 1907 Mr. Doehler was granted a patent upon his process and from that time to this the art of die-casting has grown rapidly. Die-castings are smooth and accurate and require little or no machining. Castings are made accurately to within one-thousandth of an inch. The die-castings industry is to-day one of the largest and most important branches of the non-ferrous metal trades.

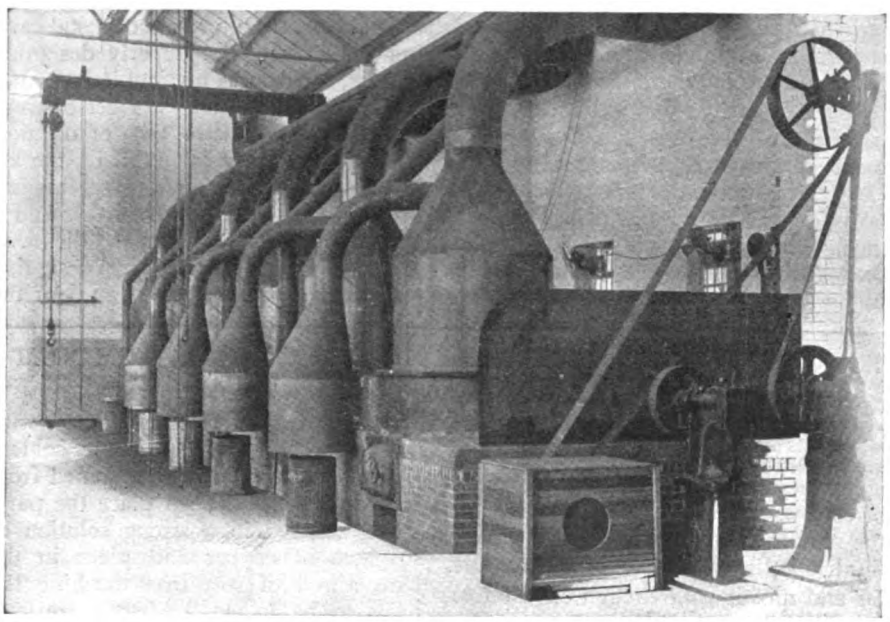
Die-casting can be described as a process in which molten metal is forced under pressure into a metallic mould where it is chilled and extracted. The metal is forced into the mould either by compressed air or steam so that it will reach every nook and corner of the die and form a casting which will be as free from blow-holes and other imperfections as possible.

Die-castings are quite expensive and range in price from one hundred dollars for simple parts to one thousand or more for the castings of more complicated parts. However, when a great number of castings are to be made, the rapidity of the die-casting process rapidly offsets any extra expense involved in the making of the ordinary die, which can be used for many thousands of castings before it is necessary to repair it or replace it with a new one. Expert tool makers are engaged to construct the dies. The employment of veteran tool makers is absolutely necessary in order to produce accurate dies which will make castings of the required size. In making a die, proper attention must be given to the grating, venting and the general design.

The original die-casting machine developed by Mr. Doehler was operated by hand. The molten metal was forced by a plunger into the die. This type was replaced with a gravity die-casting machine. The very latest development is an automatic die-casting machine which is more rapid and convenient than its forerunners. However, many of the hand-operated and gravity machines are still in use. Several batteries of automatic die-casting machines are shown in one of the illustrations.

Prior to the year 1914 about 90 per cent of all the die-castings manufactured were produced with zinc base alloys. The zinc alloy used can be expressed with the following formula: Zinc, 84.5 per cent; tin, 9.0 per cent; copper, 4.5 per cent; aluminum, 2.0 per cent.

These zinc alloys were found more or less unsatisfactory owing to the fact that they did not possess sufficient mechanical strength to withstand great strains and they could only be used to form parts of machines that did not require a great amount of strength. However, there are certain parts that could be made satisfactorily with zinc alloys, such as magneto housings, switch handles, switch locks, oil pump parts, speed indicators, etc. Zinc alloy castings can be strengthened considerably by the use of ribs, webs, fillets, inserts of iron, steel or brass where an increase in strength is required. Zinc alloys are also corroded by water and aqueous solutions of any kind, which is a very bad feature.



Courtesy of Doehler Die-Casting Co.

A metal mixing room in one of the large die-casting plants

Digitized by Google

Zinc alloys of the type used in die-castings show a tendency to fuse at a temperature of 350° Fahr. At 780° they will be in a purely liquid condition. The highest melting point of the zinc alloys is 750° Fahr. Where abnormal temperatures exist it is not advisable to employ zinc alloys, owing to the fact that their sensitivity to abnormal temperatures will cause a serious reduction in their mechanical strength.

Tin alloy die-castings have come into use in the construction of hygienic and surgical instruments, dairy utensils, food container parts, etc. Such alloys are comparatively soft and are found to have a melting point of 425° Fahr. One of the most important uses of tin alloy castings is in the manufacture of babbitt bearings for gasoline motors.

Lead alloy die-castings are used where inexpensive, non-corrosive alloy is desired, at a sacrifice of mechanical strength. Such die-castings find extensive use in fire extinguishers, shrapnel shells, hand grenades, etc.

Aluminum alloys have recently come into use in the die-casting industry after a great amount of research work which finally overcame the many obstacles that stood in the way of successful castings. The melting point of aluminum alloys is in the neighborhood of 1200° Fahr. Such alloys have a tensile strength of about 25,000 lbs. per square foot. These alloys have come into wide use in automobile construction. The strength of these alloys can be nicely controlled by either increasing or decreasing the copper content. Aluminum alloys take a high polish and are able to retain it for a considerable length of time. The freedom from crystalline structure, a greater strength, a lower specific gravity and a higher melting point, make aluminum die-castings superior to zinc die-castings.

After a great amount of development it was found possible to die-cast aluminum parts that were previously die-cast in zinc, which process is much older and better understood. The cost of aluminum die-castings is much higher than zinc castings, but on the other hand, aluminum alloys possess a number of advantages over the zinc alloys.

From the beginning of the die-casting industry manufacturers were desirous of producing castings by the use of brass and bronze. Certain properties peculiar to these alloys made this process a difficult one. At times, after much experimental and development work, metal castings were produced which seem to possess more promising features, but when tried on a commercial basis they were invariably found to be failures.

It was during the year 1917 that brass and copper die-castings were produced on a dependable commercial basis. Die-castings of brass are now used extensively in naval torpedoes, starting and lighting systems, turbines, railroad steam couplings, carburetors and roller bearings.

The strength of die-castings produced by forcing molten metal under pressure into a permanent metallic mould is first obtained by the proper designing of the part to be die-cast. This, of course, rests with the engineer that designs the part. Designing engineers of to-day are becoming more and more accustomed to the design and construction of die-castings and it will not be long before our colleges and universities will be including this important branch of the metal industry in their engineering courses. The strength of die-castings also depends largely upon the raw materials of the alloy and the production of castings that are closely grained by the elimination of casting defects. Great trouble is experienced with blow-holes in the production of die-castings, just as in the ordinary process of metal casting. However, by properly designing the die, this source of trouble is greatly eliminated and strong, perfect castings are produced. In the type of die now used, as the metal is forced in, the air is allowed to escape. However, it is impossible to exclude all of the air and a certain amount remains in the die. Attempts have been made at designing machines which will remove all of the air in the die before the metal is allowed to enter. Actual practice has proven that the vacuum machine which has been perfected, does not possess any advantage over the ordinary machine. This may be surprising to the lay mind, but it is, nevertheless, true.

Casting of practically any shape can be produced by the die-casting process. A number of castings are shown in one of the illustrations which accompany this article. Many of the dies which are used are very costly and from one to six months are spent in their construction. The great advantage, however, of die castings when they are produced cannot be overestimated. When the manufacturer receives them they require little or no machining and the holes are bored, ready for tapping, and in cases where a very accurate bearing surface is required it is only necessary to use a reamer in order to produce it. There is no filing, grinding or scraping, as the castings are smooth and ready to be polished if this is necessary. Even such minor operations as counterboring, and countersinking are done by the die-casting machine, thereby saving a great amount of handling for these operations.

It has been found possible to produce gears by the die-casting method, but, of course, these parts do not possess the strength that cut gears do made by the more conventional method. In certain cases, however, they possess sufficient strength to be used and they are produced much more cheaply than gears cut on gear-cutting machines.

The die-casting industry is still in its infancy. It is safe to say that in the near future all small castings will be made with die-casting machines. Of course, it will never be practical to produce large castings by this method. Experiments are now being made with iron and ere long a workable iron die-casting outfit may be produced. When this happens the industry will probably be developed to a point where it will be both costly and impractical to resort to the old methods of casting small pieces by the use of sand.

TO PROTECT IRON AND STEEL FROM RUST

THE following method is but little known, although it deserves preference over many others: Add 1¾ pints of cold water to 7 oz. of quicklime. Let the mixture stand until the supernatant fluid is entirely clear. Then pour this off and mix it with enough olive oil to form a thick cream, or rather to the consistency of melted and recongealed butter. Grease the articles of iron or steel with this compound, and then wrap them up in paper, or, if this cannot be done, apply the mixture somewhat more thickly.

SOLDERING OF ALUMINUM BRONZE

TO solder aluminum bronze with ordinary soft (pewter) solder: cleanse well the parts to be joined from dirt and grease. Then place the parts to be soldered in a strong solution of sulphate of copper and place in the bath a rod of soft iron touching the parts to be joined. After a while a copper-like surface will be seen on the metal. Remove from bath, rinse quite clean and brighten the surface. These surfaces can then be tinned by using a fluid consisting of zinc dissolved in hydrochloric acid in the ordinary way with common soft solder.

A RADIOGRAM TO EVERYDAY ENGINEERING.

The Editor of EVERYDAY ENGINEERING recently received a radiogram from Chicago via the American Radio Relay League which told of the opening of the first model engineering workshop in Chicago. The text of the message follows:

"We hereby announce the opening of the first model engineering workshop in Chicago.

Chicago Society of Model Engineers." Via The American Radio Relay League. The editors of EVERYDAY ENGINEERING extend their best wishes for the success of the new shop.

Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

Sir Dugald Clerk recently read an elaborate paper before the Royal Society of Arts, his theme being the position gas takes in the scale of efficiency. The modern mantle gas burner compares with the best incandescent electric lamp in light given per power unit. A one watt incandescent electric lamp uses 35 B. T. U.'s at the generating station and a half watt bulb 20.3 B. T. U's per candle power-hour. The inverted mantle gas burner uses 38 B. T. U's per candle power-hour. High pressure mantle gas burners give much higher results, as little as 19 B. T. U's per candle power-hour. The electric flame arc on the other hand surpasses this, using as little as 9 B. T. U's per candle power-hour.

Gas thus appears about as economical in the lighting field as the incandescent electric lamp. In the production of mechanical power the modern gas engine develops 13.6 per cent. efficiency referred to brake horsepower, while the electric motor returns only 10.4 per cent of the energy at the factory. The lecturer strongly advocated internal combustion gas engines for power. The last proposal in the way of electric power development in England is the proposed installation of 16 gigantic electric power stations to work at one and a half times the efficiency of the best modern station and at two and three-tenth times the efficiency of the average station.

With modern mantle burners giving 25 candle power per cubic foot, per hour, where in former times 3 candle power was good practise, and high pressure gas burning giving 40 to 60 candles per cubic foot per hour, he considered that gas still held the preeminence over electric power. As Sir Dugald Clerk is a gas engineer of international reputation, it is natural he should advance arguments in favor of gas for both light and power.

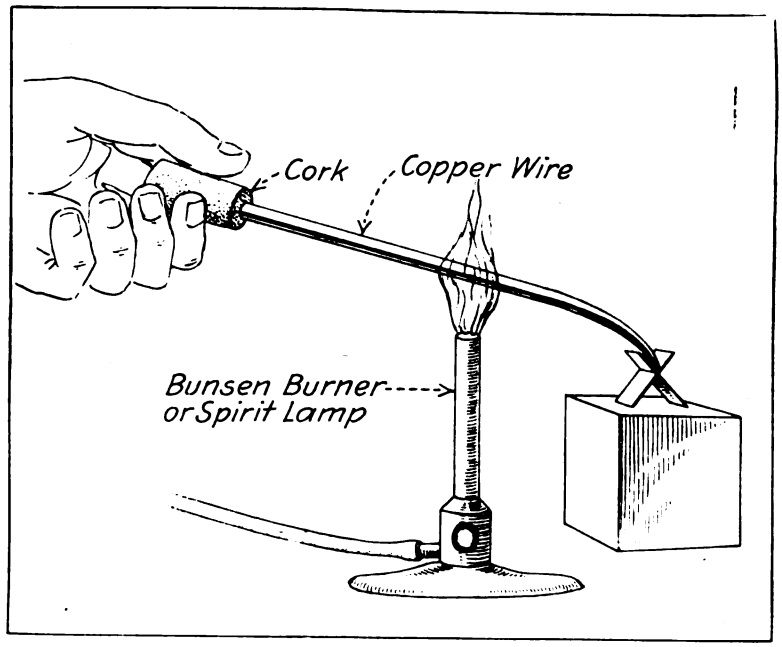
An alloy of 15% magnesium and 85% lead oxidizes with great rapidity in moist air, both metals participating in the reaction. Sometimes an hour or two is sufficient, sometimes eight or more may be required to complete the oxidation of the metals. They fall into a black powder. It is suggested that a method of making nitrogen or nitrogen and hydrogen mixtures might be based on the use of this alloy. The oxygen of the air and that of the water present as water vapor would combine with the metals, setting free the hydrogen of the water and leaving the free nitrogen of the air mixed with it.

Austria and Germany were at one time relatively great producers of radium compounds; now the industry is established in its own home and birthplace in France. The Combeville works make radium salts and are the only establishment producing mesothorium bromide.

The aeroplane record, Turin to Rome with a passenger has been broken, the flight having been done in 2 hrs. and 15 min. for the 362 miles, a rate of 161 miles an hour.

Had the war continued Helium would have been produced at comparatively low cost and at the rate of two million feet a month in the United States and British Empire.

Where small objects or fine and inaccessible joints in places hard to reach with the ordinary soldering iron are to be soldered, the arrangement illustrated in the cut, may be employed. The writer has used it with much satisfaction. It consists of a copper wire inserted into a handle. For very small work a wire not over 1/16 inch inserted in a cork will answer. For larger work, a ⅛th or even thicker wire may be used with a bit of broom-stick for its handle. Don't try to hold it with plyers. The wire is kept hot as shown. The outer end may be taken to represent the copper bit of a soldering iron and may be filed to a flat chisel edge or to a point according to the work to be done.



This end is tinned and the arrangement is used as shown in the cut. The wire may be of any desired thickness and while the soldering is in progress is kept hot by Bunson or common gas burner or other source of heat. The point is kept hot as long as desired—if used as an ordinary iron it would lose its heat in a minute or two. As long as the soldering is being done the wire is kept hot as illustrated, never being taken out of the flame.

China is credited with supplying over 50% of the antimony in the world. The metal is used in alloys, such as type metal, and its compounds are employed in rubber factories and elsewhere.

An Edinburgh firm of publishers are reported to have started the cultivation of bamboo in Trinidad and to have secured the government license to cut the wild bamboo to be used in making paper pulp. Three or four years after the plant is started it is large enough to cut. The knots have given some trouble and the bleaching also has been attended with difficulty, but both troubles are said to have been overcome. It is greatly to be desired that the slow growing trees of the north could be spared. It takes many years for a spruce tree to attain a sufficient growth to answer for paper making—a great contrast to the few years of the tropical plant's life which suffice to give it size enough for the industry in question. Another effort in somewhat the same direction is the invention of a machine to treat cotton seeds after ginning to remove the small amount of cotton fibre which still adheres to them. This fibre can be used in paper making.

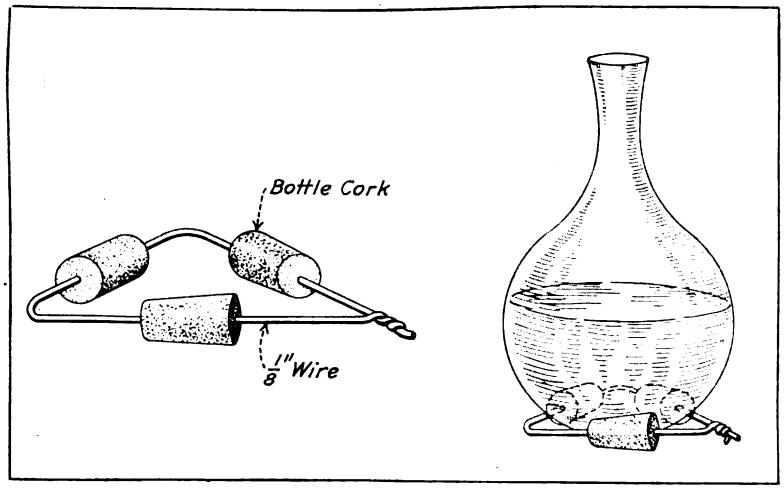
A few years ago the cultivation of flax was regarded as a dying industry, but the great demand for linen during the war gave a great stimulus to the cultivation of flax in Ireland, Scotland and Canada. The great continental sources of flax were cut off by the war. In Parliament the question has been brought up of employing discharged soldiers in the raising of flax in India. One great use of linen has been for the wings of aeroplanes, but later developments have permitted the use of a specially devised long fibre cotton fabric with every success, so the linen available can be employed to greater advantage in its household applications.

One of the Swiss carbide of calcium works, it is reported, is about to make alcohol from acetylene in quantity—7,500 to 10,000 tons per annum of 90% alcohol. There is a strong movement in the direction of using alcohol as a gasoline substitute in motors. It is of interest to note that acetylene as such has been successfully employed to drive automobiles. Here we have the same acetylene as the basis for alcohol, perhaps, to be used for the same purpose. It has been mixed with benzol for motive purposes. Pure alcohol seems not to have been so available.

Grain elevator fires have been traced to incandescent lamps. The dust settling on the bulb would catch fire and cause the conflagration. The danger was overcome by the obvious method of using a double bulb, one bulb as a case inside of which the lamp bulb was placed. The air space between the bulb and case insulated the heat.

Digitized by Google

In a chemical laboratory where round-bottom flasks and retorts are in use, a simple support for them may be constructed with three corks and a bit of wire. The wire is first inserted through the center of the three corks, and is then bent into an equilateral triangle and its ends twisted enough to hold it. This forms an admirable and secure support for a round bottom flask or retort and is a substitute for the old time wicker work or straw ring which was long used for the purpose. An old name for it was a valet —perhaps because it held the flask upright when it was full.



Carbonic acid gas foam has been found effectual in the extinguishing of oil fires. Two solutions, one of the carbonate and the other an acid one are discharged on the fire. A special substance whose composition is not disclosed is added to make the mixture produce a foam. This floats on the top of the oil, discharging the gas and displacing the air, so that there is nothing to support the flame. When all is over, any of the compound left parts with its gas, becomes a liquid again and sinks to the bottom of the tank.

Sound-ranging is the term applied to the determining of the distances of submarine explosions. A recording instrument called a hydrophone is employed which records the period when the sound was received to within the .002 to .003 part of a second. A single station can locate the distance of an explosion under water to within a few hundred yards. With several stations distributed along a base line or lines great accuracy can be obtained. A ship in a fog drops a depth bomb and in a few minutes the shore observers can locate her position with great accuracy, even close enough for artillery practise. The method can be used by aeroplanes; bombs dropped and exploding tell the shore where they are in case their wireless gives out. A ship's position can be given accurately when she is 200 miles distant. Directional wireless can give a ship's position at sea from a single station within about 2°, but with two stations giving cross-bearings the position can be given with great accuracy, both for latitude and longitude. The Leader gear cable on the bottom of the sea excited by alternating current and detected on shipboard can take a ship through intricate channels which are unmarked or in fog.

It is reported that an aeroplane engine is now in use for power in a London factory. It is to be run far below its rated power—75 H. P. instead of 200 H. P. in order to make it last. As it is a comparatively inexpensive relic of the war and occupies a small space, there is no reason why it should not answer as a reserve motor, which about expresses the service expected of it.

By the use of a special form of X-ray tube, the Coolidge, which operates something like the Fleming valve, familiar to radio operators, it has been found possible to detect flaws in the interior of iron castings. In this tube the rays from the cathode are received on a plate of tungsten carried at the end of an arm of molybdenum, the face is set at angle of 45° so as to deflect the stream of rays at right angles and out through the side walls of the tube. The tungsten face is called the target. It is welded to the molybdenum. A steel casting was tried; it was placed 20 inches from the tube, and though it was 2½ inches thick defects were revealed by a radiograph taken with two minutes exposure, on a plate backed by a sheet of lead. The voltage corresponded to that required to produce a fifteen inch spark, and the current measured 1 1-4 milli-ampere.

It is stated that there is enough gold in a twenty-dollar gold piece to cover more than sixteen square yards or 144 square feet of surface if it is beaten into gold leaf.

A good hint has been given for the desuplhating of a storage battery by charging and gassing. The acid with which the operation is started should be as weak as possible, 2° to 3° Beamue is enough. Then as the plates desulphate the sulphuric acid radical goes to the solution in the battery constantly strengthening it and bringing it up towards the proper specific gravity.

Large potash deposits are reported to have been found in Sicily. The Stassfutt mines in Germany have for many years been the great source of potash supply. In the old times when the demand was insignificant, wood ashes were leached or boiled in water to extract the potassium carbonate. As the ashes were boiled in pots, the name of potash was given to the product. The finding of the potash deposits in another nation's limits has international importance. It is provoking to realize that the common mineral feldspar (orthoclase) contains a considerable per cent of potassium silicate but the valuable potassium has never been successfully extracted on any commercial scale.

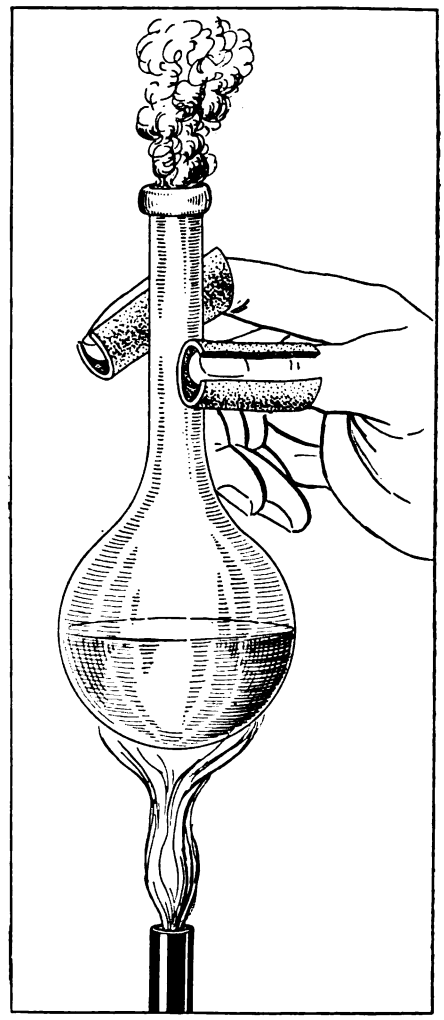
The X-ray has been applied in concrete ship-building to detect voids in the cement and displacements of the reinforcement. The apparatus for this purpose weighs 90 pounds. It has been suggested also to use it to examine the joints in electrically welded steel ships.

A French manufacturer has met the demand for an eight-hour day for human labor by the introduction of a sixteen-hour day for machinery; thus there are two shifts of workmen for a full machinery day.

Georges Claude, the eminent French inventor and engineer, has made the suggestion that ammonium chloride should be used as the regular commercial ammonium salt instead of the sulphate; the latter has always been the compound hitherto made. The idea is that the weight for a given amount of ammonical gas "fixed," as it may be expressed, by chlorine will be much less than when sulphuric acid is used. The Solvay and allied processes, it is said, should be used to yield sodium bicarbonate and ammonium chloride.

The pollution of the air in England by solids, such as soot and the like, has been reported on for the years 1917-1918 by the Atmospheric Pollution Committee. The purest air found was on Malvern Hills. There in the month of May, 1917, 5.15 metric tons were deposited over each square kilometer. In Newcastle-on-Tyne 44 28/100 tons were deposited over the same area in the month of April of the same year. The above quantities for a square mile are about 2.6 times greater.

The chemist and experimenter often is called upon to handle a hot test tube or retort and while tongs are made for this purpose, they are seldom at hand when needed and a makeshift of some kind such as a wad of paper, corner of an apron or other material is interposed between the fingers and hot



glass. Our French contemporary *La Nature* illustrates a simple expedient that gives better control over the vessel than tongs do. The sketch is self-explanatory, the fingers being protected by simple means. Sheet asbestos may be used and held in place by a rubber band or pieces of rubber hose may be cut to the proper length and slit so they will constrict about the fingers.

Digitized by Google

A MODERN ELECTRICALLY PROPELLED DREADNAUGHT BATTLESHIP

The U. S. S. NEW MEXICO

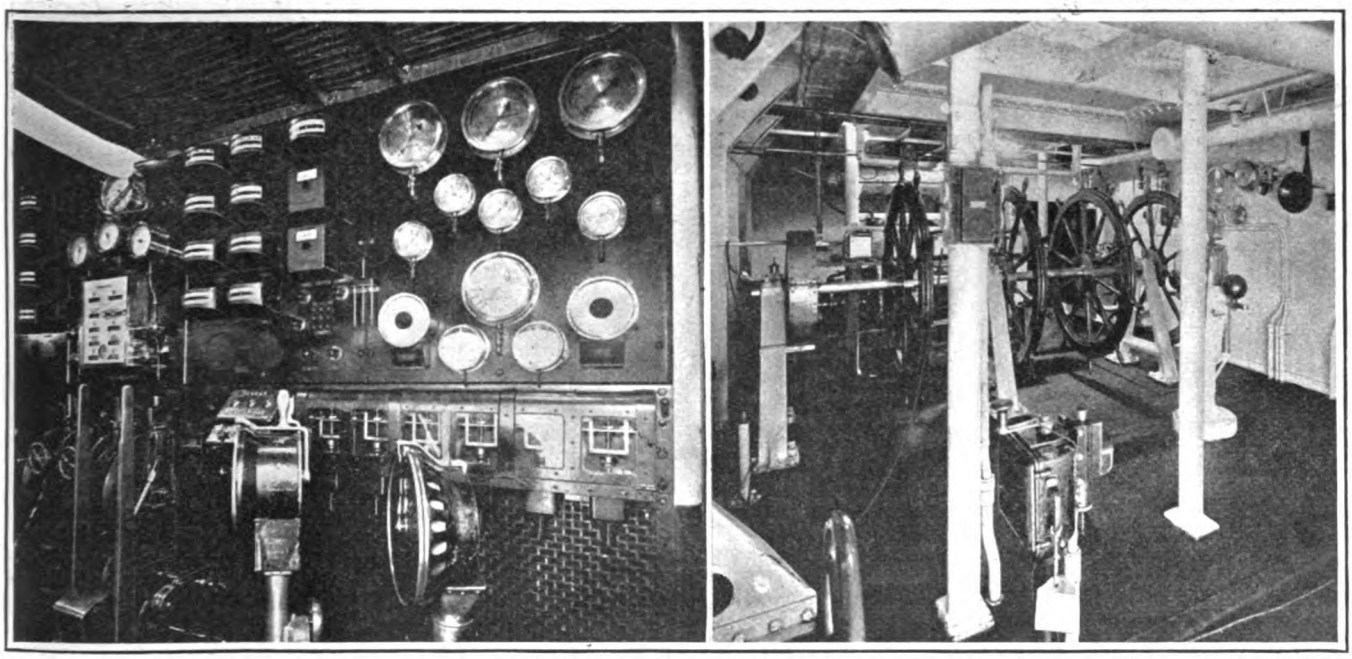
INTERESTING FACTS ABOUT THE NEW FLAGSHIP OF THE PACIFIC FLEET



A RADICAL DEVELOPMENT IN NAVAL ENGINEERING PROVES SUCCESSFUL

By Brewster S. Beach

ELECTRICITY had never been seriously considered as an agency in the propulsion of large marine craft until a few years ago, though the adoption of electrical current in the operation of street cars, automobiles, railroad engines, etc., was an accepted fact. The forward march of electrical propulsion was comparatively slow to reach the ocean. Various applications of electricity as a motive force in driving locomotives and other vehicles of land transportation had reached an advanced stage of development, but the steamboat seemed to have "escaped," due probably to the difficulties surrounding the adoption of satisfactory and efficient electrical means of power generation and transmission.



Main control apparatus and switchboard through which the electrical current is distributed from the power source to the propeller motors at the left. Room for emergency steering apparatus at the right

Turbine Development Helps Electric Propulsion

The possibility of electric propulsion of large craft was talked about as soon as electric motors began to be used, but actual, serious study needed for its application awaited the development of the steam turbine. When the turbine development reached its present advanced stage, combining high speed with light weight, engineers were ready to try electricity as a means of transmission between the turbine and propellers. They have been successful and the United States Navy, as indicated by Secretary Daniels, has been won over to the principle of electric drive and has decided to equip all of the new capital ships with electrical propulsive machinery, while the idea is already receiving consideration in the mercantile marine.

One of the oldest examples of electrically propelled vessels in this country are the fire boats of Chicago, Ill., where the first boat was equipped in 1908. Chicago was the first municipality to accept the theory of electric drive for boats of this class. The popular mind, no doubt, conceives an electric ship to be like a small electric automobile or truck—something that stores the energy necessary to its operation in large batteries, carries it along and draws upon it as occasion may demand.

What an Electric Ship Is

This is not the case, as electric current must be generated continuously within the ship in order that this current may be put to its proper use in propelling the vessel. The current is usually produced by a steam turbine which turns a generator. The apparatus is called a turbo-generator and this unit together with the usual engine room auxiliary, the boilers, constitutes the power plant. The electric current generated by the dynamos is led through copper cables and suitable control apparatus to electric motors, and it is these motors which actually drive the propellers of the ship. Electricity acts as a connecting link between the steam or other motive force and the propellers. The internal combustion engine operating on the Diesel principle is also coming into prominence as a power for the generation of electricity. The dynamo driving means whether it is a steam turbine or an oil-engine, is called the prime mover.

No Mechanical Reduction Gears

No gears are needed in the electrically driven ship. The function usually performed by gears (that is, to make a connection between the turbine which is to be efficient must revolve at a relatively high speed, and the propeller, which to be efficient must rotate rela-

Digitized by Google

tively slow), is accomplished electrically, thus permitting both turbine and propeller to operate at high efficiency. Just as in the automobile, it is sometimes desirable to "shift gears," it may be necessary at times to accomplish the same result on board ship, though not necessarily for the same reason. Electricity lends itself admirably to effecting these speed changes, whereas no practical and reliable means has yet been found to accomplish this mechanically on large ships.

Military Advantages

The primary military advantage of the electric ship, rests on the ability to arrange the propelling machinery in a number of separate watertight compartments throughout the hull placed near the center so that they may be protected from damage due to torpedo attack. shell fire, grounding, collision, etc.

The ability to form new combinations of control and operation by the convenient isolation of defective apparatus, simply by cutting off the electric connections; an estimated low cost of maintenance; the reliabilty of the equipment and an economical operation at many different speeds are also valuable considerations.

Let us now examine these principles in actual practice. The best example today is the U. S. battleship *New Mexico*, the first capital ship of any navy to be equipped for electric propulsion. It was built at the Brooklyn Navy Yards and launched in 1917. The electrical propulsion equipment was made and installed by the General Electric Co., its engineers cooperating with the Government to solve the problem presented.

The New Mexico Described

The *New Mexico* displaces 32,000 tons and requires 28,000 H.P.—nearly one H.P. for every ton of displacement. It is of the oil-burning type with a total oil capacity of 3,400 tons which is 6,800,000 pounds, or about one million gallons.

The oil burners heat nine steam boilers, each of which can produce 4,000 H.P., and deliver steam at a pressure of 250 lbs. to the square inch. The steam from these boilers operates two turbo-generators which constitute the power plant, each capable of generating 14,000 H.P. The current from the dynamos operates four motors—one for each propeller. The motors are twelve feet in diameter. They are controlled from a central switchboard or control station where the engineers on receipt of instructions from the ship's bridge can start the ship forward, or backward and run the propellers at different speeds in either direction. They can run all four motors from one turbo-generator or they can run the two port motors from one generator and the two starboard motors from the other generator.

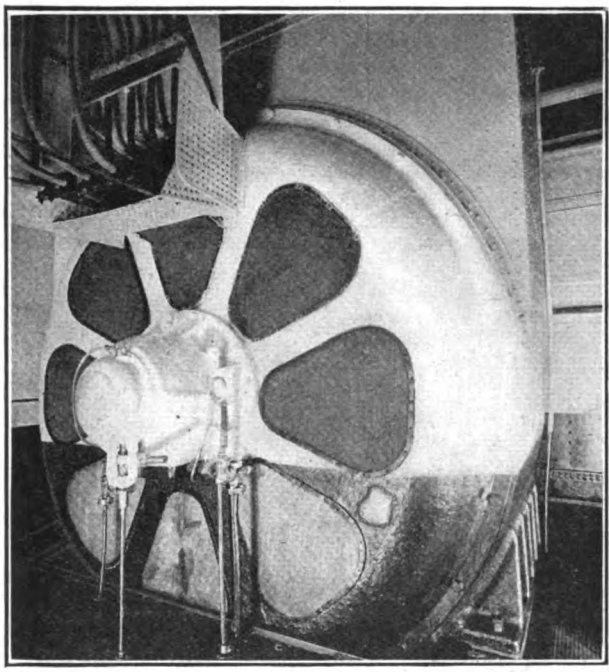
Part of the steam produced in the boilers is diverted to six auxiliary turbo-generator sets located in different parts of the ship and these power plants produce the electricity which operates all of the mechanical devices, outside of the propulsion equipment, including the electric lights.

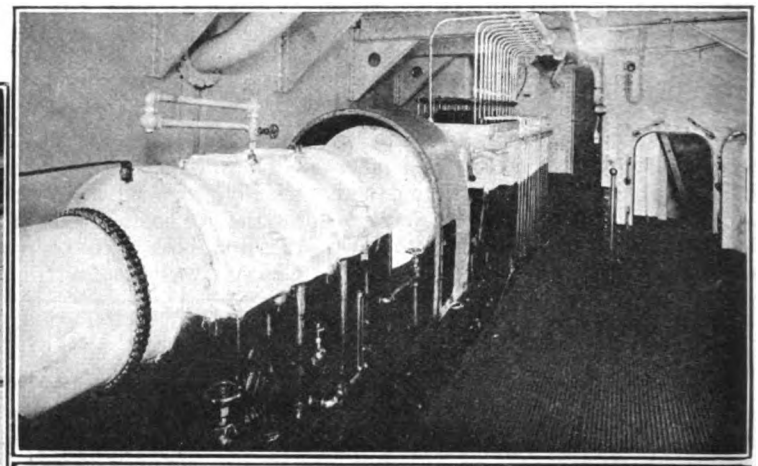
It has been estimated that there are 300 motors on the *New Mexico,* and here is a partial list of some of the uses to which they are put: Operating the steering gear and anchor windlass mechanism, for boat cranes and deck winches, for turning turrets and elevating guns; driving smoke ejector air compressors, operating numerous pumps for sanitary purposes, supplying fresh water, pump oil and driving drainage pumps. The refrigerating system utilizes electric power and there are twenty motor-generator sets for interior communication, gun firing, etc. Motors turn the large searchlights and run the ventilating fan. Eight motors are used in the kitchen for such humdrum but no less necessary purposes as peeling vegetables, mixing dough, washing dishes, and grinding meat. The machinery in the various shops is all operated by individual motor drive.

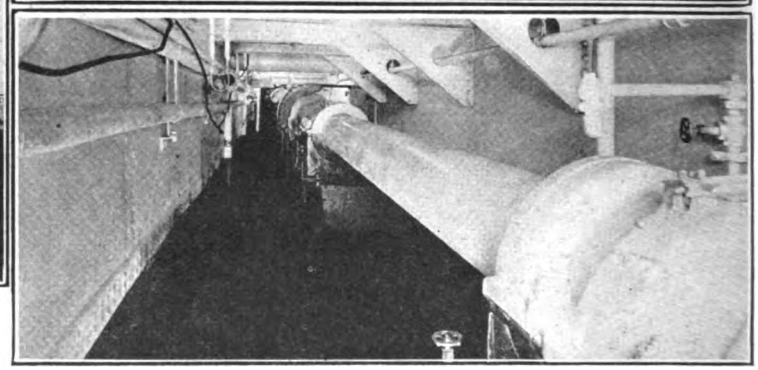
It is stated that the electric lights of the *New Mexico* can be supplied from two independent sources of supply, first the auxiliary turbo-generators already mentioned, and second, a set of storage batteries which is designed to be brought into service in any emergency where the main source of lighting current should fail.

Another interesting feature is the distilling plant which produces 30,000 gallons of pure water from the sea in every 24 hours. The larger portion of this liquid is used in the boilers which require water of the utmost purity. The refrigerating system sup-

Views at right show the large thrust bearing and length of propeller shaft used in power transmission







One of the large propeller driving motors used on the U.S.S. New Mexico is shown above

Digitized by Google

plied is capable of producing six tons of ice each day.

Two electrically driven boat cranes used in hoisting and lowering the boats and loading supplies aboard the ship have a capacity of 4,000 pounds each. The large calibre guns of the *New Mexico* are fired by electricity, ammunition is hoisted from the magazines by electric motors and some of the guns are loaded by electricity.

The ponderous rudder is moved into any desired position by the simple movement of a controller on the navigating bridge, which sets in motion machinery carried in the hold of the vessel for this purpose. There are several steering stations located in various parts of the ship where this operation may be performed in case one station should be disabled. In all, there are five different ways of steering the *New Mexico,* one of which is the hand method, which requires the strength of six men, and which is reserved for emergencies.

The ventilation and heating of the ship is by air—cold air is forced into the vessel in warm weather and hot air during the winter months. The air is forced through pipes by blowers operated by electric motors.

There is a completely equipped electric carpenter shop, machine shop, foundry, laundry, hospital operating room, and a bakery where bread is baked in electrically heated ovens, while the gallery or kitchen is steam operated, the ranges burn oil instead of coal, and there are big steam jacketed pots for heating.

First Experiments with the Jupiter

While the *New Mexico* is the pioneer battleship with electric drive, the Navy began its first experiments on the collier *Jupiter,* built at Mare Island Navy Yard, San Francisco, Calif., and launched August 24, 1912. Among other battleships being equipped with electric drive are the *California, Tennessee, Maryland, West Virginia, Colorado* and *Washington.*

The disadvantage of the direct connected turbine led to the advocation of electricity as a means of propulsion before a successful means of speed reduction was developed. Very soon after, however, active development of mechanical gears for connecting turbines to ships' propellers was begun and succesful forms were evolved. This is known as geared turbine drive and may be considered a direct rival of the electrical method which we have already described.

Merchant Vessels to Come Next

Having established the principle of electric propulsion in the Navy of the United States, attention is now centered on the adoption of the same means of propulsion to the cargo and passenger carrying ships which will make up our merchant fleet. Electric propulsion for this class of vessel has been slower in development than the same principle applied to naval vessels. Many noted engineers, however, are now at work on American Turbo-electric and oil engine-electric systems for cargo vessels in this country, so some authorities believe future growth along these lines to be unusually bright.

It cannot be denied that there is still much divergence of professional opinion over the relative merits of one form of ship propulsion over other methods. A discussion of the question at this time would be out of place, even if it were adapted to the needs of a non-technical popular article. No attempt has therefore been made to compare electric ship drive to the older forms of propulsion. It is hoped that this short article will give the reader an idea of what electric ship propulsion is, how it has been utilized, and through what stages of scientific evolution it has grown up.

CAUSES OF BOILER DEFECTS

An abridged summary of Inspector's Reports compiled for 1911 from the records of the Hartford Steam Boiler Inspection and Insurance Co. distinctly shows that over one-half of the defects generally found in steam boilers are to be attributed to the feed water.

Boiler Defects Ascribed to Water

Nature of defects	No. of defects found	Percentage of total
Incrustation & scale.	43,663	25.8%
Deposit of sediment.	19,471	11.5%
Internal corrosion...	13,781	8.15%
External corrosion..	9,668	5.71%
Burned plates.....	5,174	3.06%
Other defects.....	77,445	45.78%
Total number of defects	169,202	100.00%

It is well known that a deposit of scale greatly hinders the transmission of heat to the boiling water, which is accounted for by the fact that the heat conductivity of mineral substance is very much less than that of metals. Scale 1/16-inch thick is apt to reduce the efficiency of the heating surface 5 to 10%; ⅛-inch thick causes a loss of 10 to 20% depending upon the density of the incrusting solids.

A contemporary states that a medium-sized steam boiler was kept clear of scale for over twenty years by the simple expedient of boiling a bushel of potatoes in it. After these were boiled for a time, the scale loosened and collected in the boiler base from which it was easily removed. This would not work with all boilers because the chemical substances in solution in water varies with locality. In any event, it is a remedy that can have no injurious action even if it does no good which is more than can be said for a number of boiler scale remedies that have been proposed.

SPONTANEOUS IGNITION OF ENGINE FUELS

The engines operating on the Diesel and semi-Diesel principles do not use electrical ignition means but depend on the heat developed in compressing air to pressures of over 500 pounds per square inch and then injecting fuel under still higher pressure into the heated air which causes spontaneous combustion of the resulting air and fuel gas mixture. A British firm of engineers have made a series of laboratory tests to determine the ignition temperature of various liquid and semi-liquid engine fuels suitable for this type of engine, and have tabulated the results as follows:

	Spontaneous ignition temperature in oxygen Deg. C.	Deg. F.
Gasoline No. 1.....	272	522
Gasoline No. 2.....	270	518
Kerosene	252	486
Gas Oil.....	254	489
Petroleum Fuel Oil...	260	500
Shale Oil (Broxburn)..	253	487
Tar Oil.....	470	878
Coke Oven Tar.....	494	922
Water Gas Tar.....	464	867
Blast Furnace Tar....	498	928
Whale Oil.....	273	523
Napthalene	402	756
Alcohol	395	743

From these figures it will be noted that the tar oils have much higher spontaneous ignition temperatures than petroleum oils, and that there is very little difference in degrees required between gasoline and petroleum oil under the conditions of the tests. This means that a degree of compression sufficient to raise the compressed air to a temperature that will ignite petroleum may be insufficient for tar oils—hence engines of the spontaneous ignition type working with such heavy oils should have either higher compression or some external means of raising the temperature of the air, before it is compressed in the working cylinder.

TANKS HOLD PLACE IN ARMY

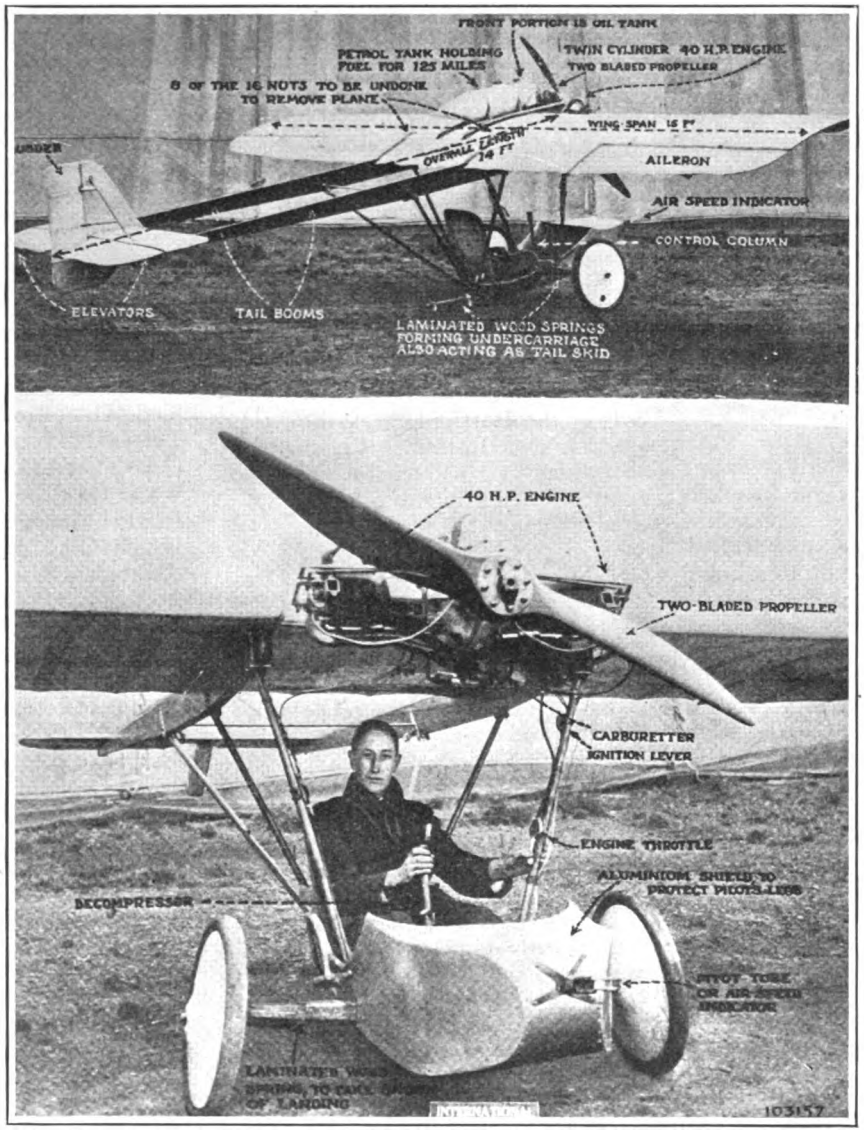
The success of the armored tank in the late war has been so marked that the continuance of the Tank Corps as a peace-time organization has been approved by Congress. A minimum of 1,050 tanks will remain in commission with the army, 330 of the heavy type and 720 of the light type. A third type, the signal tank is provided for each company and battalion commander, 45 being the total for the complete tank organization. The corps will be made up of 377 commissioned officers and 5,862 enlisted men.

Digitized by Google

A New Lightweight Monoplane

An Interesting English Design of Low Weight and Relatively Low Power That Should be Simple to Fly and Economical to Maintain

AN English aeronautical engineer has devised a very small monoplane which is said to weigh but 220 pounds complete and ready for flight. As will be evident from the illustrations, it is a modern modification of the old Santos-Dumont Demoiselle monoplane which was shown at several aviation meets in this country over a decade ago and which was flown in France by its builder with an engine of the same form but of only 20 h. p. The engine used in the machine illustrated is of the 40 h.p. horizontal, opposed cylinder air cooled type made by the A. B. C. interests and is their type "Gnat." This engine, as will be evident from the illustration, is mounted in front of the airplane and forms, with the gasoline and oil tanks, a complete power plant unit that is easily detached. The torpedo shaped fuel tank holds 5 gallons of gasoline and 2 quarts of oil which is said to be sufficient for a flight of 2 hours, which time permits covering a distance of 125 miles under favorable conditions. The maximum speed is given as 65 miles an hour and an exceptionally slow landing speed of less than 30 miles per hour is made possible by the design.



A light weight monoplane that the enthusiastic designer calls "the motorcycle of the air"

It is claimed that if sufficient hangar space is not available, the single plane may be removed by taking off a few bolts. The fuselage is very simple in construction, consisting of two outriggers which carry the empennage consisting of vertical and horizontal stabilizing planes, vertical rudder and elevators at the back end. The outriggers or tail booms are joined to the small undercariage which provides accommodations for the pilot's seat and the "joy stick" and rudder board, by which the machine is controlled. An aluminum shield very similar to the front end of a motorcycle side car is placed in the front of the pilot to protect his limbs.

The wheels are mounted on a laminated wood axle member to which steel tubes are attached, for the wheel hubs to rotate on, this laminated construction having enough spring to take care of the shock of landing. The wing span is but 15 feet and the length over all is given as 14 feet. The machine is extremely simple in construction and as ample power is provided for such a small craft it should prove to be a good flier. The machine seems to be a type that can be readily made by any amateur equipped with very ordinary shop facilities. It is stated that a company is being formed for their manufacture, and that the machine will be sold at about $1500 when it is produced on a quantity basis. The general construction is very clearly outlined in the illustration and the principal dimensions are given.

There are several things that can be criticised about this monoplane, however, one being the location of the power plant above the pilot in such a position that in case of a fall it might become detached from its fastenings and injure the operator by falling upon him. Another disadvantage of the design is that the pilot is sitting very close to the ground and any rough landing that would not injure him if he were sitting higher, might be apt to result disastrously on account of the proximity of the pilot to the earth when landing. The conventional forms of aircraft undercarriage give more protection to the aviator and when he is sitting in the usual type of fuselage, even if a landing is made that is sufficiently rough to break the landing gear, the first shock is taken up and the pilot is not so apt to be injured as in the construction shown where he hits the ground first.

A modification of the design in which the pilot was seated higher would make for greater safety in landing though the craft might not be so easily controlled because of the higher location of the center of gravity. When the pilot's weight is carried below the plane, as in the form shown, it is believed that easier control is obtained when flying as the lateral stability is said to be greater.

Digitized by Google

Building A Two-Passenger Seaplane

(*Continued from page* 196)

Fig. 12. The center of gravity of the three-cylinder Lawrance motor complete with a fifteen-pound propeller of oak or a walnut propeller copper tipped of 6′ 6″ dia. x 60″ pitch is approximately 2 7/32″ back of the center line of the motor attaching bolts and 15/16″ below that point. The manufacturers locate the center of gravity of their motor minus the propeller, as dimensioned on Fig. 13, 19/32″ plus 1 7/8″ to the rear of the point of attachment.

The centers of weight computed are given at 2′ 7 ½″ forward and 2′ 7½″ rear of the static center of gravity, allowing 165 lbs. for motor, accessories, propeller, etc., and a 165-lb. pilot. The passengers' weight and gasoline tank are on the C-G. Any deviation from the above calculations must be compensated for by computing the moment of that difference. The dynamic balance (equilibrium in flight) marked C-L, center of any airplane is influenced by the speed of the machine (the lift varies as the square of the velocity) and the efficiency of the motor, as the center of thrust is below the center of resistance. This will give inherent stability within certain limits up to approximately twelve degrees incidence.

As the torque of the motor tends to turn the machine in the opposite direction to the propeller movement, it is offset by one of two methods. First by the "wash in" and "wash out," a slight increase of incidence in the left wing and decrease of incidence in the opposite wing or by additional supporting surface which is the more popular practice. The dynamic balance may be adjusted by increasing the stagger of the top plane if found nose heavy or decreasing the stagger if found tail heavy.

Changes Necessary for Ford Motor

A complete description of a remodelled Ford motor will be given in a coming issue of this magazine. It is claimed by experimenters that by alterations and the addition of an overhead valve cylinder head that this engine weighing 200 lbs. will develop up to 40 horsepower at 1650 R. P. M. with a maximum thrust of 250 lbs. with a 6′ dia. and 4½′ pitch propeller. Ascertain the center of gravity of the complete motor (approximately 262 lbs.) including the radiator, propeller, water (estimated at three gallons) and the oil in the crank case, place the center at the C-G indicated. This will necessitate locating the pilot seat as indicated. Locate the motor or engine bearers using the fourteen crank case bolt holes as centers, drill through the bearers. The bed bolts will then be also used as the crank case bolts. It is obvious that no flywheel need be used and the propeller hub bolts on that flange on the crankshaft to which the flywheel is normally attached. The motor must have a battery or magneto ignition to replace the flywheel generator, high tension magneto being advised. A flat, oil tight plate is welded to the lower crank case, replacing the portion cut off that acted as the flywheel protector and oil sump. The radiator will require fitting between the longerons and changing the return pipe, which is not a very difficult piece of soldering and riveting for any mechanic capable of building the airplane.

(*Part Six in next issue*)

BILLS OF MATERIAL
TWO-SEATER—FUSELAGE COMPONENTS

Vertical Struts

Station No. of Strut	*Quantity Required*	*Thickness in inches*	*Width in inches*	*Length in inches*	*Material*
No. 1	2	13/16	1	16	Spruce
No. 2	2	"	3	17½	Ash
No. 3	2	"	2¾	21¾	Spruce
No. 4	2	"	3	20½	Ash
No. 5	2	"	1½	17½	Spruce
No. 6	2	"	1½	15¼	"
No. 7	2	"	1½	11½	"
Stern Post	1	1⅛	2	18½	Ash

T-Top
B-Bottom

Horizontal Struts

No. 1	1-T, 1-B	13/16	1	13½	Spruce
2-T, 2-B	1-T, 1-B	"	3	16¾	"
3-B	1-B	"	2¾	19⅜	Ash
3-T	1-T	"	2¾	19⅜	Spruce
4-B	1-B	"	2¾	19½	Ash
5-T, 5-B	1-T, 1-B	"	1½	18	Spruce
6-T, 6-B	1-T, 1-B	"	1½	14	"
7-T, 7-B	1-T, 1-B	"	1½	7	"

Longerons

2	Top 1″	1″	13′-2″	Ash
2	Bottom 1″	1″	13′-1″	"

Formers of ¼″ 3-Ply Veneer

2-F	8½″ x 19″	Shaped as shown at Fig. 2-F
3-F	9¼″ x 21½″	" " " " " 3-F
4-F	8¾″ x 21 1/16″	" " " " " 4-F
5-F	5¾″ x 16¼″	" " " " " 5-F
6-F	2¾″ x 9¼″	" " " " " 6-F
7-F	1½″ x 6½″	" " " " " 7-F
8-F	1½″ x 21½″	" " " " " 8-F
9-F	3½″ x 19¼″	" " " " " 9-F
10-F	16″ x 30″	" " " " " 10-F

Stringers

A	1 piece	¼″ x ¾″	5′- 7″
B	2 pieces	¼″ x ¾″	2′- 5″
C	2 pieces	¼″ x ¾″	5′- 7″
D	2 pieces	¼″ x ¾″	4′-10⅛″

Ford Motor Fuselage

See plate seven.

No. 1	2—Vertical	13/16″ x 1″ x 9″	Ash
No. 1	2—Horizontal	13/16″ x 1″ x 12″	"
No. 2	1—Horizontal	13/16″ x 2½″ x 19″	"
No. 2	2—Vertical	13/16″ x 2½″ x 17¾″	"
No. 4	Extra Vertical	13/16″ x 1½″ x 18¾″	Spruce
No. 4	Extra Horizontal	13/16″ x 1½″ x 19 1/16″	"
No. 4	Bot. 1—Horizontal	13/16″ x 2¾″ x 19 9/16″	Ash
No. 3	Top 1—Horizontal	13/16″ x 2¾″ x 19⅜″	"
No. 4	Bot. 1—Horizontal	13/16″ x 2¾″ x 19 3/16″	"
	2 Upper Longerons	1″ x 1″ x 15′-8″	
	2 Lower Longerons	1″ x 1″ x 16′-1″	
	2 Engine Bearers	1¾″ x 3″ x 38″	Spruce
a	1 Stringer	¼″ x ¾″ x 5′-9″	
b	2 Stringers	¼″ x ¾″ x 2′-7″	
c	2 Stringers	¼″ x ¾″ x 2′-7″	
d	2 Stringers	¼″ x ¾″ x ——	

Digitized by Google



RADIO
TELEPHONE AND TELEGRAPH APPARATUS



A Radio Telephone Transmitter

The Divisional Method, Using Standardized Panels, is Employed in Constructing this Short Distance Transmitter

By M. B. Sleeper

SO many requests for a short-distance radio telephone set have come in that this set was constructed to show the reader of EVERYDAY ENGINEERING what can be done in working out such an equipment. There are many ways, some complicated and some makeshift, to build a vacuum tube transmitter. Plans for this set were made with the idea of steering an intermediate course, to obtain the maximum results from a simple circuit. The illustrations here show such a set as it was constructed in our own laboratory.

You will recognize the audion mounting and rheostat panels from the December issue. The same system has been used for the new instruments. Each panel is a unit by itself and can be removed or replaced by loosening the brass straps as more panels can be added.

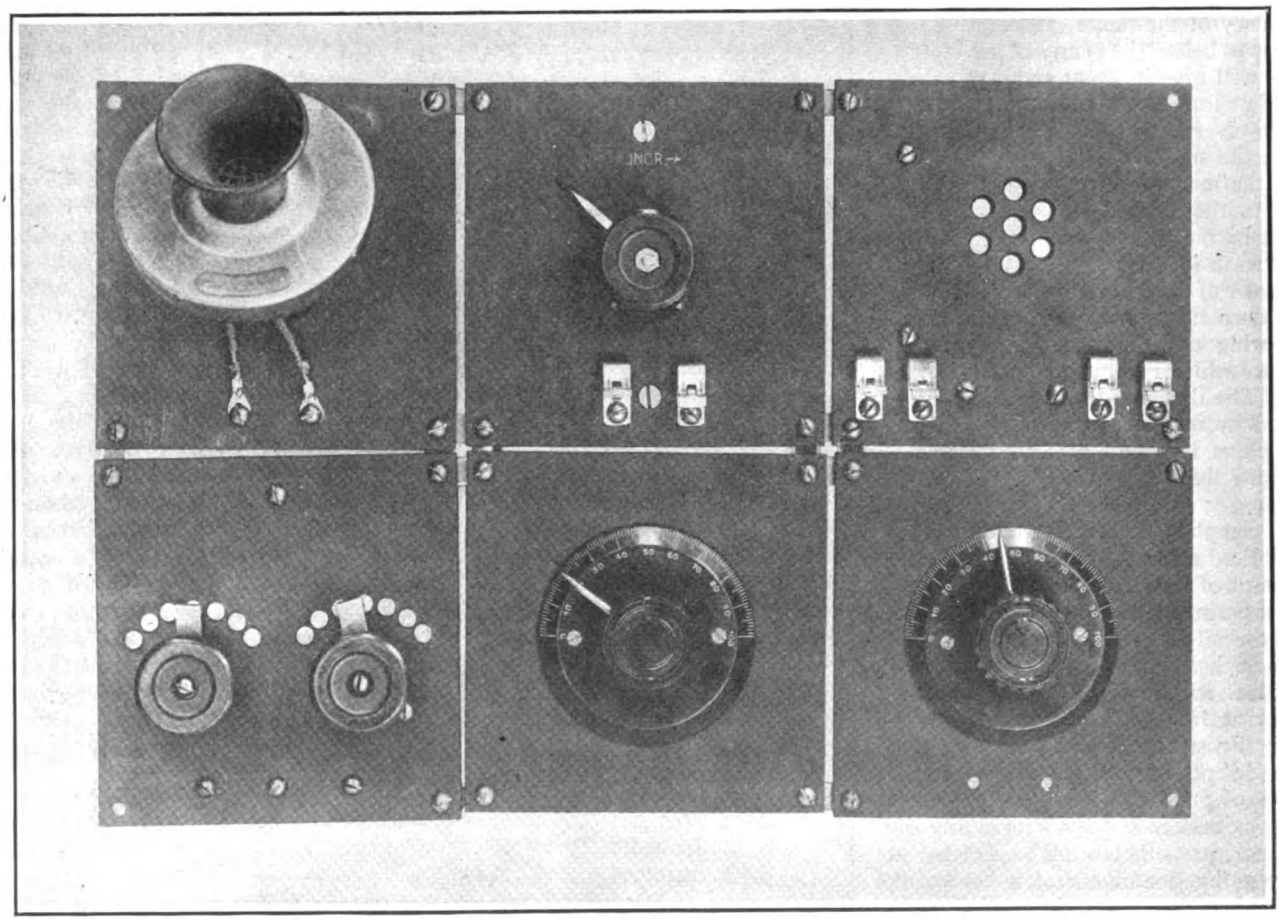


Fig. 1. The true experimenter takes as much pride in the appearance as in the performance of his equipment

This set, with a De Forest-Marconi VT working on two standard Navy type 22.5-volt batteries, was heard over a distance of four miles at a receiving station using a single audion detector. A great distance can be covered with a higher voltage on the plate and an amplifier at the receiving end.

ANTENNA TUNING INDUCTANCE

A SUFFICIENT inductance, 58,000 cms., is allowed to give wavelengths up to 260 meters with a standard transmitting antenna of 0.0005 mfd. and a 0.001 mfd. series tuning condenser.

The tube is 3½ ins. in diameter and, with the mounting legs, 3 ins. long. Three legs, ¾ in. long, are cut out of

Digitized by Google

the tube so that inside contacts can be reached with a soldering iron. They must be laid out carefully before the coil is wound. A knife sharpened on a coarse stone is best for this work.

High frequency cable, 3x16 No. 38, is used for the coil. The winding starts ⅛ in. from the rear end. Taps are taken at 0, 5, 8, 11, 14, 17, 20 and 23 turns. The ground is connected at the 0 end Connections should be made so that the inductance is increased by turning the switch clock-wise.

It is important to lay out the panel and drill all holes before assembling any of the parts on it. The switch points were put in and connected across first and the switches fitted in place.

The switches are simple in construction. Three-ply blades were cut from No. 30 spring brass, then a 1¼-inch, 8-32 screw was put through the knob, the switch blade set on the screw and a nut turned down to secure the blades. A spring washer at the back of the panel and a second nut on the end of the screw complete the switch. To prevent the loosening of the nut, it was soldered to the screw. Finally, a strip of No. 34 copper was soldered to the nut and brought out to the connecting screw.

Small legs of ⅜ by 1/16 in. brass were cut out and drilled for legs to support the inductance. Figs. 1, 2 and 3 illustrate the construction.

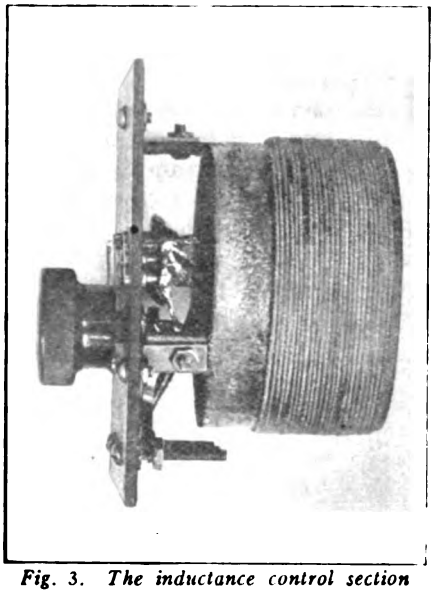


Fig. 3. The inductance control section

Series Tuning Condenser

FIG. 4 gives the details of the condenser and mounting. A 0.001 mfd. Clapp-Eastham balanced condenser was changed over with solid bakelite end pieces in place of the aluminum ones. It was mounted, by means of the front plate, to the panel by screws which also held the scale.

The end plates were drilled with the original as template. Then the front plate, panel, and scale were drilled, for the mounting screws, all at once to insure perfect alignment. At first it was planned to have the scale and handle revolve, but the scale did not run perfectly true because it was pushed out by the set screw. Accordingly, a pointer was put into the handle in place of the screw and the scale fastened to the panel. This method had an added advantage in that the capacity was increased when the handle was turned clock-wise, which is the correct way. The handles and dials were obtained from the A. H. Korwin Company.

The collection of dust between the condenser plates causes series losses in a transmitter. For this reason the plan shown in the illustrations was adopted. The corners of the end plates were rounded off and a length of G-A-lite tubing, 3½ ins. outside diameter, slipped over the condenser. Short lengths of strip brass fitted over opposite supporting rods held the tube in place. This can be seen in Fig. 2.

The Grid Condenser

THIS instrument is similar to the series tuning condenser except that a 0.0005 mfd. condenser was used. Connections were made by soldering di-

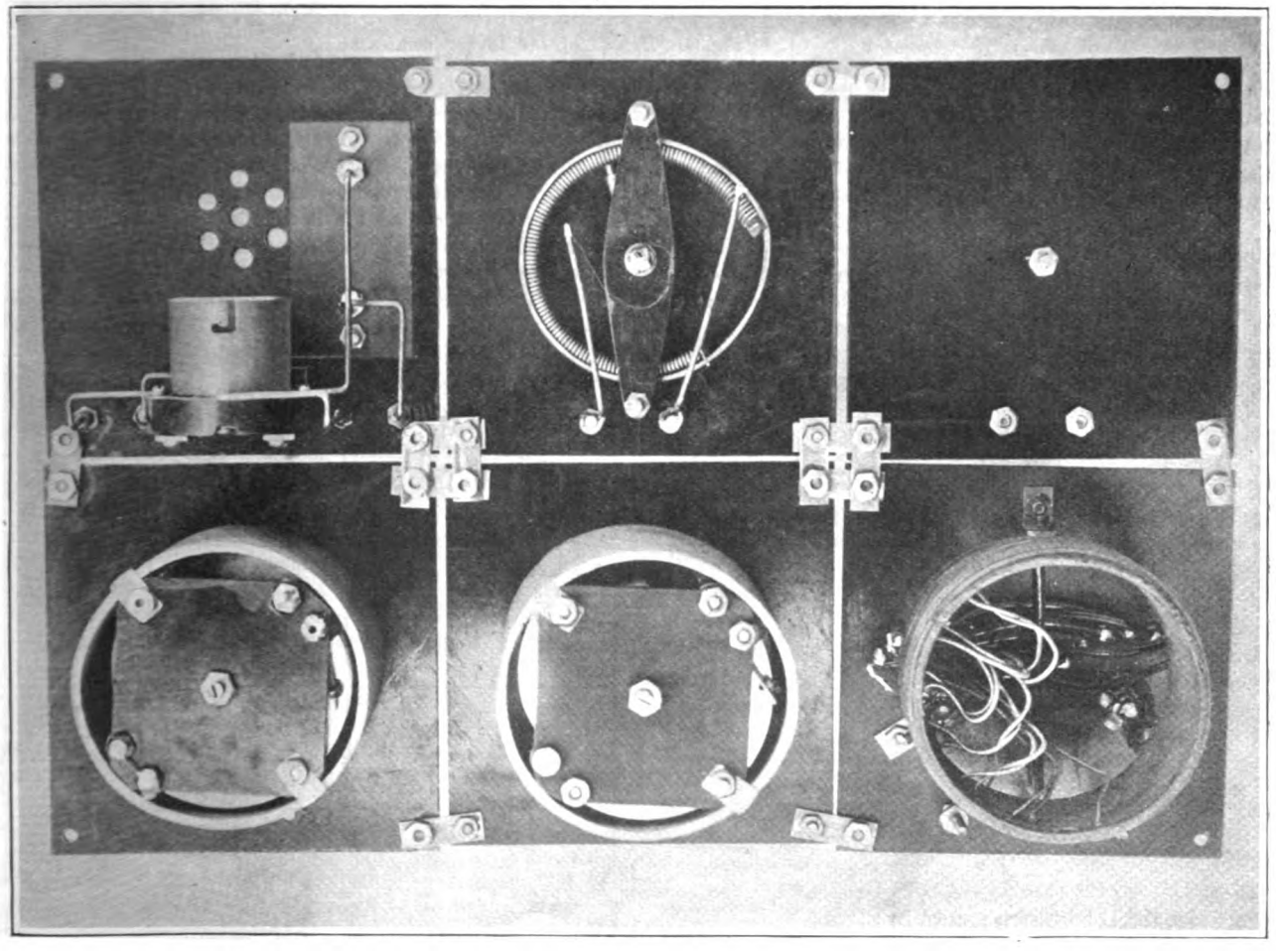


Fig. 2. The rear of the radio telephone set, showing the assembled standardized panels, each carrying a separate section of the apparatus

Digitized by Google

rectly to the ends of the plate supporting rods.

Telephone Transmitter

BY good luck, a telephone desk was picked up in a second-hand store. The stand was cut off and solder melted into the hollow end around a machine screw. The screw, imbedded in the solder, served as a mounting bolt to hold the transmitter to the panel.

Where such a mounting is not available, a standard Western Electric or Mesco transmitter can be purchased and set up on the panel.

Although modulation in the ground lead is not the most efficient method, it is the simplest and, for short-distance communication, serves the purpose admirably.

Connecting the Instruments

FIG. 5 gives a diagram of connections. Binding posts or screws for soldering the wires were put at the rear of the panels, with the exception of the audion mounting and rheostat. Here flexible leads can be run through the spaces separating the panels. All other wiring should be done with No. 16 copper wire, either bare or covered with Empire tubing.

On the audion panel there can be seen two bakelite plates. Between them is a pencil-mark grid leak, made of heavy paper on which marks were made with a soft carbon pencil. The upper plate simply serves as a protection for the leak. The exact adjustment of the pencil lines was made before the top panel was put on and the connections soldered.

By mistake, the B battery is shown in the lead to the switch. This battery must go between the plate and filament.

Operating the Telephone Transmitter

TO put the set in operation, when all the connections have been made, it is only necessary to light the filament of the audion by turning up the rheostat. A hot-wire ammeter is essential to tune the instruments for maximum radiation.

The antenna inductance switch is set at maximum and the plate switch put in a position at which the set oscillates, as shown by an indication on the ammeter. Then the grid condenser is varied and the grid leak rubbed out or put on until, by listening in a coupled wavemeter or receiving circuit, the speech from the transmitter is clear and free from blocking or squealing noises. Once set, the grid leak needs no further attention.

To tune the set for a given wavelength, it is necessary to juggle the inductance switches and condensers until, at the correct wavelength, the hot-wire ammeter shows a maximum radiation.

Output and Efficiency

IF the resistance of the antenna has been measured, the output of the set, in watts, is

$$W = I^2R$$

where W = output, in watts,
I = antenna current, in amps.,
and R = antenna resistance, in ohms.

When a milliammeter is available and the plate current can be measured, the input, in watts, is

$$W = EI$$

where E = plate voltage,
and I = plate current in amperes.
The efficiency of the set then is

$$\text{Eff.} = \frac{100\ \text{W output}}{\text{W input}}$$

where Eff. = efficiency in per cent.

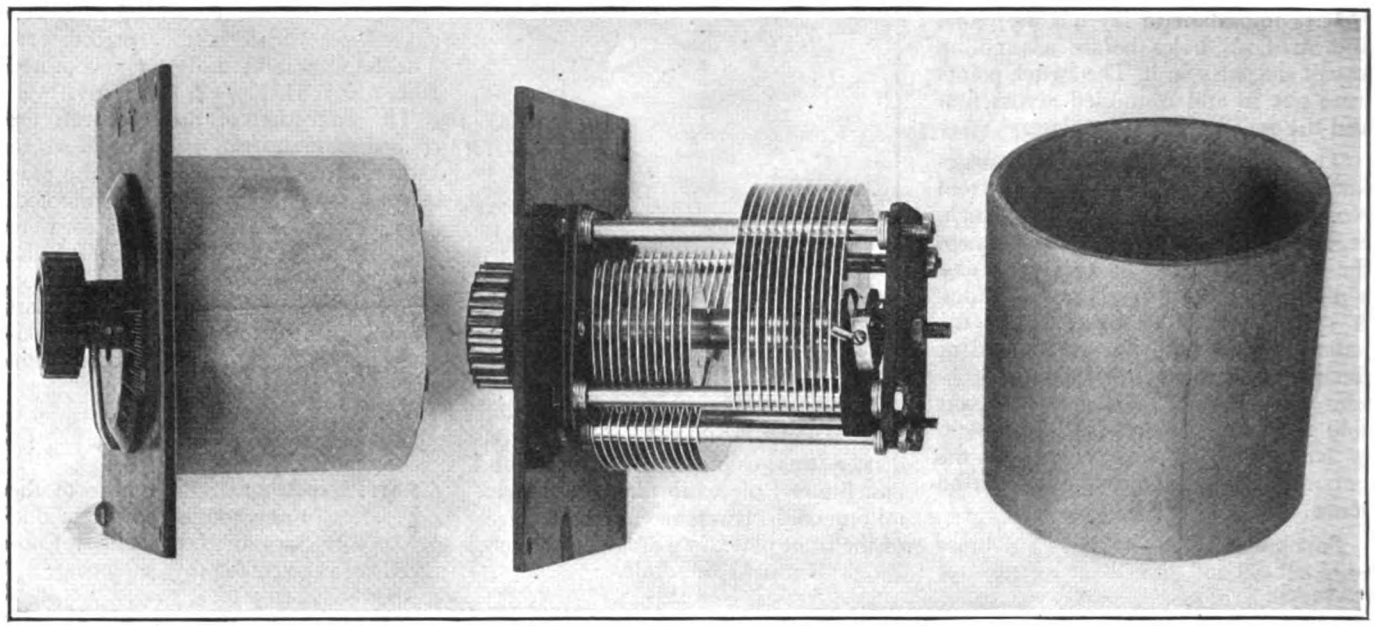


Fig. 4. Details of the tuning condenser

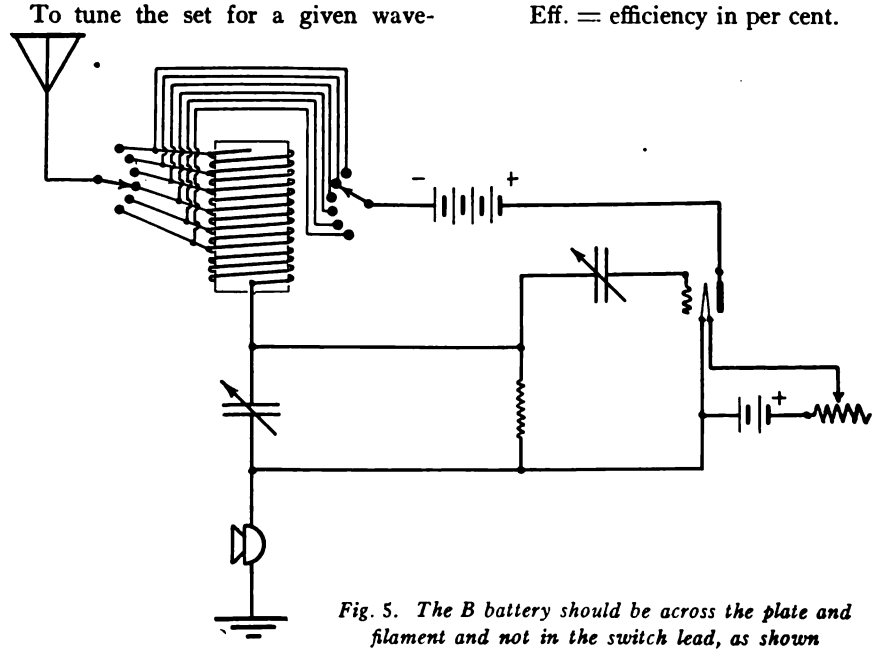


Fig. 5. The B battery should be across the plate and filament and not in the switch lead, as shown

Digitized by Google

Interesting Decisions Regarding Trade Marks

That Descriptive Words, or the Names of Widely Advertised Corporations, Cannot be Used as Trade Marks, is Shown in This Article

RADIO companies have played strongly upon the "service" value of their equipment. There have been a number of trade mark suits over the use of the word "service" and similar terms. While there is no objection to the use of such words in advertising matter, there are some important considerations disclosed in this article about descriptive words in trade marks.

A number of companies have incorporated Service in their trade marked labels, bringing the question of its use into the courts.

The Link-Belt Company has been given an interesting decision in the U. S. Court of Appeals at Washington. This company appealed a decision of the Commissioner of Patents, who refused to register the word "service" surmounting a bar with V shaped end as a trade mark for rubber fabric belts. From the outset the censors at the trade mark division of the patent office held that Service as applied to belting or similar products is descriptive and, therefore, not registerable. The use of the word Service was held to indicate that the product is durable and withstands hard wear and long use. The examiners would not concede that there is any difference between the impression given by the single word Service and such an expression as belts built for service. The company contended that Service in spite of its present use in advertisements is only strikingly suggestive and not descriptive. It does not describe, the company declared, any particular attribute or characteristic of the article, but suggests that the articles on which it appears should be put into service. It does not describe them from the point of view of their quality or their use. To these pleas it was replied that any manufacturer has the same right to use such words as Service in describing and advertising his goods, and accordingly a monopoly cannot be given to any one advertiser.

J. W. Milburn, U. S. Examiner of Trade Marks, referred to the approved advertising practice to support his refusal to admit Service to the trade mark fold. He gave an exhibit of advertisements clipped from various leading periodicals, all of which showed the broad significance of the word. There was the advertisement of the A. A. Cutter Co., in which Cutter boots are advertised by the slogan "For all around comfort, service and dryness"; the Jones Hat Co. claimed "A cap that affords real protection and service"; the Krus Engraving Co. plays up "Quality and Service", and the W. C. Russell Mocassin Co. displayed the phrase "Combines lightness with utmost service."

Backed by this evidence the examiner concluded, "The word Service, because of its use in advertising and by dealers and salesmen, has come to have a well known significance in trade, indicating that the goods so described may be expected to give good service to the purchaser. In the case of belts, the goods here specified, good service would indicate good lasting qualities with little trouble or repair. It is believed that the word Service is descriptive and therefore unregisterable as the word Quality, which has repeatedly been refused registration.

When the belt company went over the head of the Trade Mark Examiner, the first assistant Commissioner of Patents, R. F. Whitehead, who was called upon to review the case, confessed that he was impressed by the showing on advertisements illustrative of the wide use of Service in copy. The endorsement in brief follows:

"The word Service is commonly used in advertising to indicate that the goods will give good service to the purchasers. The word is believed to fall within the same class as the word Quality, which has been repeatedly refused registration, and the words High Efficiency, registration of which was refused in the case of the Crosby Steam & Gauge Valve Co."

This conclusive ruling that Service must be left free for the use of all advertisers rather than appropriated to the sole use of anyone, was forthcoming as a result of carrying a case to the Court of Appeals, where the attitude of the Patent Office was upheld. The Court said, "We are of the opinion that the word Service in this instance would be descriptive of the quality of the goods. It has a fixed meaning in trade generally as indicating that goods so described are serviceable and will not only wear well, but are especially adapted to meet the requirements of the user and the goods to which the mark is applied."

Another decision handed down in a trade mark controversy shows that corporate names cannot be used as trade marks. There has been a long dispute over the word Simplex. The case of Burrel against the Simplex Electric Heating Co. was the first one. Later there was a case between the Simplex Electric Heating Co. and the Ramey Co. Now, as if to make clear the principles already laid down on this important point, the Court of Appeals has upheld the refusal of the patent office to register Simplex as a trade mark for use on brake riggings and similar products of the American Steel Foundries.

The element of prestige attached to well advertised corporate names has entered into this last case to an extent which has arrested the attention of advertisers in general. The rejection of the application of the American Steel Foundries was based on the finding that Simplex was the name of a widely advertised corporation, and the Court of Appeals had already looked with disfavor upon anything that appeared to be an attempt to obtain benefit from wide advertising such as had been done by the Simplex Electric Heating Co. In this case extensive advertising proved to be a protection.

In passing upon this case the Court called attention to the circumstance that several corporations have the word Simplex as the predominating part of their name.

The technical significance of trade names has been taken into account in recent opinions given from the Court of Appeals, in two cases carried up from the Patent Office by the Swan-Finch Co. In the first case, the Court affirmed a decision by the Commissioner of Patents to refuse the registration of SloFlo, a trade mark for lubricating grease for high speed machinery. The trade mark censors considered the fact that a high flash point and the quality of flowing slowly, or great viscosity, are essential in lubricating grease on high speed equipment.

The second case concerned Textul, a trade mark for oil used to clean wool and worsteds. The Court held that Textul is a misspelling of textile, and concluded that because the oil used for cleaning textiles might be properly designated as a textile oil, the corruption must be turned down as objectionably descriptive of the product.

These decisions have been set forth for the benefit of those who are interested in obtaining trade marks for radio or electrical products. It is not possible, of course, to review all the conditions which must be met, but the points made here may guide some applications around difficulties which would lead to refusals at the Patent Office.

Digitized by Google

Manufacturing Details of the B Battery

The First Disclosure of B Battery Manufacture is Given in This Article on the General Apparatus Standardized Type

GREAT reticence has been shown by battery manufacturers in giving details of the processes they use. However, the makers of the G. A. Standardized B Batteries have furnished the photographs and details which are given here.

The first step in making a battery is the mixing of the chemicals which form the coating of the positive electrode. Here lies the greatest and most important secret. The formula for this mixture is known only to the chemist who worked it out. To prevent the discovery of the formula, the weighing scales are not marked in pounds. The beam simply carries marks at which the weights are set for different chemicals. Mostly unskilled men handle the ingredients because they know nothing of what they are doing.

When the depolarizer, as this mixture is called, is ready for use, it is carried to men who mold the cartridges, shown at the left of Fig. 1. The man fits a piece of low resistance carbon rod into a tamping mold, fills the mold with depolarizer, and tamps it into a solid form.

It may be said that the depolarizer contains managanese dioxide, a high grade natural graphite, artificial graphite—purer than the natural grade—and an electrolyte. Due to a chemical action within the cell, hydrogen is liberated which, if not counteracted, would collect around the carbon rod and insulate it. As a result, the resistance of the battery would rise so high that no current would flow.

To prevent such polarization manganese dioxide is used because it liberates oxygen which combines with the hydrogen, making water.

The cartridges are set in trays and put aside to dry. When ready, they are carried to another room where skilled women workers wrap each cartridge with cloths and bind them with a few turns of thread. The result is called a bobbin, Fig. 1. This wrapping keeps the cartridge intact while it is handled, and prevents it from falling apart when it is soaked in electrolyte later on. Before the bobbins leave this room two rubber bands are put around each one to keep it properly centered in the zinc cup.

Again the bobbins are arranged in trays and taken to the soaking room. A rapid and accurate method of determining the length of time the bobbins should be soaked has been developed by this company. Previously the foreman made a guess at the condition of the cartridge, and estimated the soaking thereby, a time ranging from ten minutes to twenty-four hours. The electrolyte is made up chiefly of a sal-ammoniac and zinc chloride solution.

The mounting room next receives the batteries in process. Here the bobbins are put into zinc cups, which serve as the container for the battery as well as the negative pole. A paste to hold the moisture is poured around the bobbin and allowed to solidify.

An interesting automatic machine takes a tray of mounted bobbins and, after pouring a small amount of paraffin in the top of each cell, puts a paper washer around the carbon rod on the paraffin covering. This process prevents the sealing wax from running into the cell.

Another machine picks out the cells

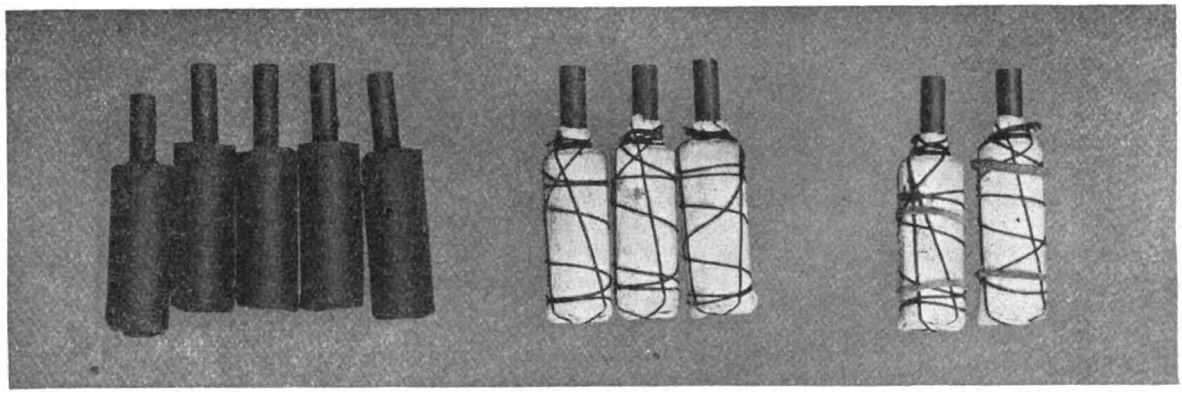


Fig. 1. First three stages of the B battery—the cartridge, bobbin, and bobbin ready for the zinc cup

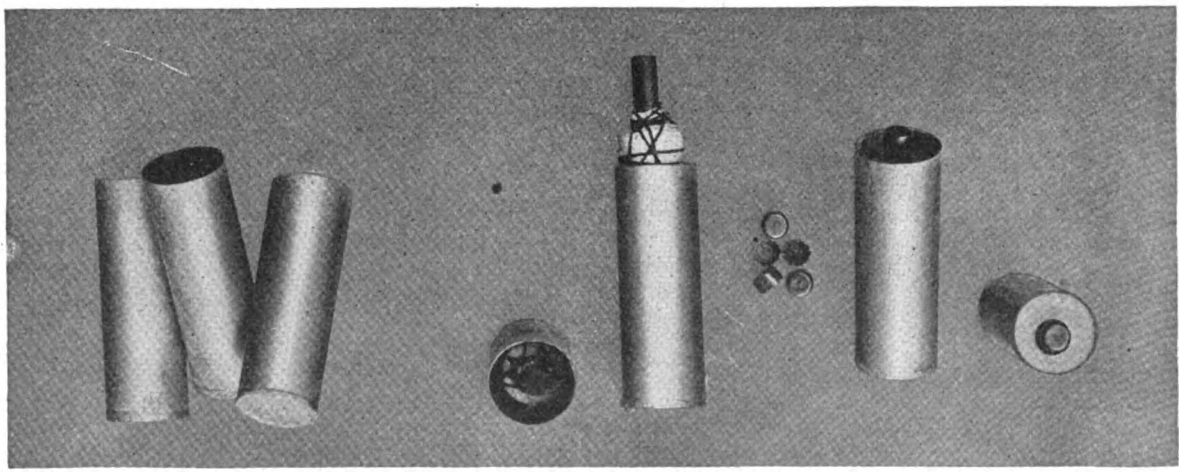


Fig. 2. Zinc cups act as the negative terminals. Mounted bobbins and brass caps. The washer in place, ready for the parafin

Digitized by Google

from the tray and sends them in a long file under a hopper containing the brass caps which top the carbon electrodes. A cap is gently pressed on each carbon. Emerging from this part of the machine, they pass to the next section, where sealing wax is poured around the cell, over the cardboard washer previously mentioned. A number of batteries are treated in this way at one time, because some little time is required to pour the wax, while the brass caps are put on at a much greater rate of speed.

Several grinding wheels are mounted at the end of the machine just described. When the cells reach the end of their journey through this device the grinding wheels touch lightly on the brass caps and the zinc containers, giving clean surfaces for soldering.

Now the cells are ready for a final testing before going into the boxes. They are passed individually through a machine which applies contacts to the carbon and zinc electrodes. If they deliver the rated current they go on to the carrying trays. If not, they drop into a hopper on the floor. This eliminates the possibility of mounting defective cells in the completed battery, where, at the last test, it would be necessary to reject the entire set.

It is necessary to solder the connections between the batteries by hand, although the speed with which the workers perform this operation is almost mechanical. Paper boxes of great strength, impregnated in paraffin to exclude moisture, are used to hold the cells. Flexible leads are put on the terminals and sealing wax poured slowly over the cells.

Fig. 3 shows the type of container used. Paraffined cardboard separators keep the cells apart. By bending over the strips at the bottom, the cells are prevented from forming short circuit in any possible way. Because the box is of waterproof construction no protection is necessary to prevent short circuiting from moisture which would otherwise collect inside the box.

The separators and the sealing wax keep the batteries perfectly rigid, so that there is no trouble from noise due to a change in resistance of the contacts under vibration. Chemical noises have been eliminated by a process which is kept secret with the manufacturers.

During the war the U. S. Government ordered so many of these batteries that they could not be made in one factory. However, the manufacturers were not willing to make public the formulas they had originated. Therefore they mixed the chemicals and sent completed compounds to the other companies.

Although it is not possible to give the experimenters sufficient data that they can make their own batteries, this description will give an idea of the way in which they are made.

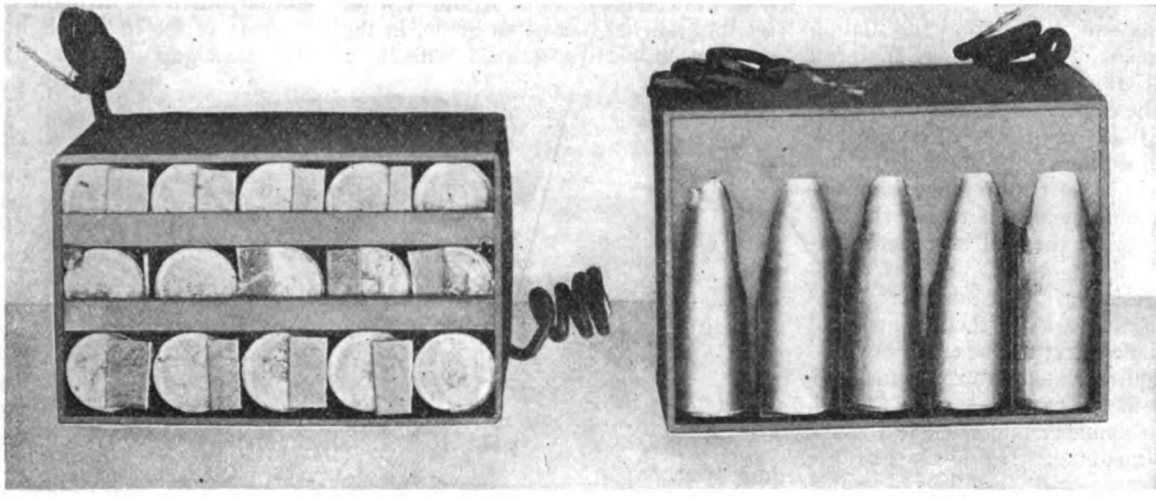


Fig. 3. The side and bottom of a completed battery were removed to show the construction

Book Reviews

STATION X. By G. McLeod Winsor. 317 pages, 7¾ ins. Published by J. B. Lippincott, Phila., Pa.

Station X is a book which will appeal strongly to those whose imagination can carry them beyond the limitations of this earthly sphere. A new possibility in interplanetary warfare has been conceived by Mr. Winsor.

His story, while not intended probably to be at all possible, is founded on facts, though not technically accurate. However, some of the considerations which may come to the minds of those more familiar with radio work are forgotten in the fascinating story of the man on the lost island, who operates the power for the Radio Station of the British Navy.

The interest starts on the moment—but it will not do to tell the story in advance. It is enough to say that Station X is a refreshing change for anyone, after his day's work, to let his mind wander to the realms and people in whose histories Station X played such an important part.

AIRPLANE ANTENNA CONSTANTS. By J. M. Cork. 14 pages, 10 x 7 ins. Published by the Government Printing Office, Washington, D. C. Price 5c.

Radio men will find in this paper considerable interesting data on the method of measuring airplane antenna resistance and directional effects. A number of characteristics are also given, illustrating the action of the different types of airplane antennas on different machines.

The directional effect is particularly interesting as it shows that the radiation ahead of the machine is several times greater than to the rear.

PRINCIPLES OF RADIO TRANSMISSION AND RECEPTION WITH ANTENNA AND COIL AERIALS. By J. H. Dellinger. 60 pages, 10 x 7 ins. Published by the Government Ptg. Office, Washington, D. C. Price 10c.

In this paper Mr. Dellinger gives quantitatively the functioning of the two principal types of radio aerials, worked out from fundamental electromagnetic theory, corroborated by actual experiments.

Formulas for received current in terms of current in either type of transmitting aerials are given and comparison formulas for the relative performance of the two types under various conditions. Some data is also given on the condenser antenna. In the section devoted to the action and the design of aerials, a number of misunderstandings are cleared up.

There are a number of ideas given for the possibilities for future research on antennas which are of special interest to experimenters.

Digitized by Google

A Light Weight Airplane Transmitter

The General Design of this ½ K. W. Simon Set Should Give Experimenters a Number of Suggestions for Panel Transmitters

STURDY and simple construction should be the keynote of the new transmitters which are going into commission now that sending sets are operating once more.

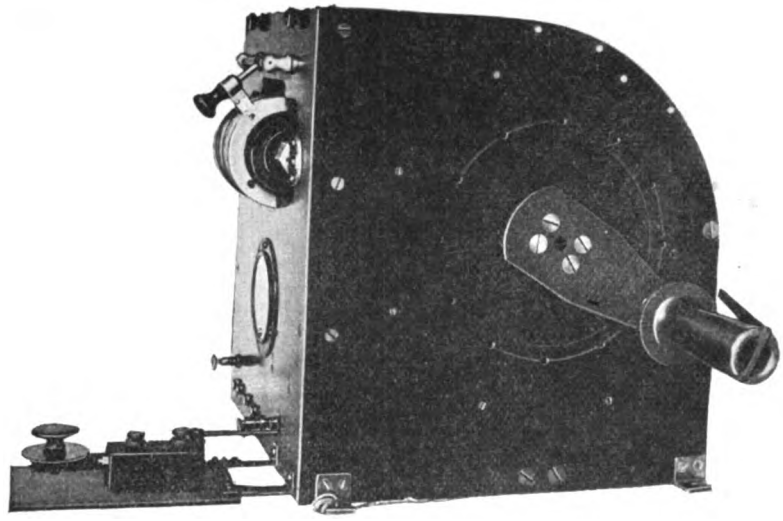
The day of the wobbly oscillation transformers, the connections that fall off, and the condenser that sparks around the edges has passed. Of course, there will be beginners always. Experienced workers must take upon themselves the task of pointing out the proper ways and means to those who are just answering the call of experimenting.

The design of the transmitter illustrated in this article, though intended for airplane work, can be easily adapted to the requirements of an experimenter's set. At the front of the panel, a key, radiation ammeter and quenched spark gap are mounted. Inside the case are the antenna reel, oscillation transformer, condenser and transformer. The case measures 11 ins. deep, 11 ins. wide and 12 ins. high.

Such compactness is largely due to the fact that a 1,000-cycle generator is used to supply current to the transformer. Increasing the frequency reduces the size of the transformer and condenser needed. Nine hundred or 1,000-cycle machines are bound to come into extensive use among experimenters as soon as some company realizes the present unfilled demand for them.

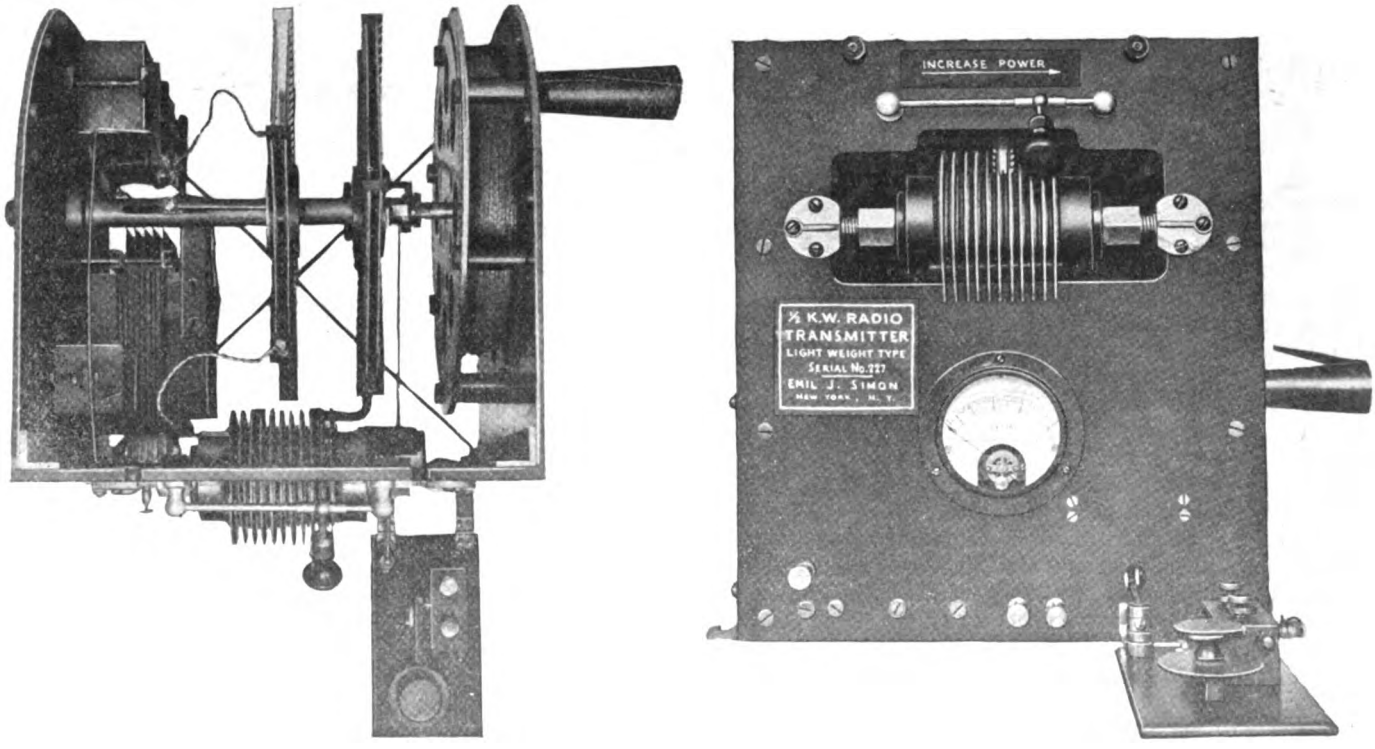
An interesting feature of the oscillation transformer is the winding and supports. Instead of using copper ribbon, the conductor is of stranded wire, set into notches, cut at an angle, in the bakelite supporting strips. This is a simple method construction, and, as in the case of copper ribbon, the wire cannot jar loose from the slots. Coupling adjustment is obtained by moving one of the coils along the bakelite mounting rod.

It will be seen that the quenched gap is mounted in an opening in the panel. At the rear of the case, a 3-in. ventilating tube and scoop are attached so that, when the airplane is in motion, a draft is let in which blows out on the spark gap.



Showing the spark gap mounting, key, and antenna reel handle

Although the generator produces a constant frequency of 1,000 cycles, a spark note of 1,000 or 2,000 cycles can be made by adjusting the length of the gap, or the number of sections. With a short gap, spark discharges occur at



An arrangement of instruments which, with the exception of the antenna reel, might be followed in making a 200-meter set

Digitized by Google

every alternation of the generator, while with a long gap, a greater charge is required in the condenser with a corresponding longer time between sparks. Thus it is that a full gap gives a 1,000-cycle note, and half the gap, 2,000 cycles.

Moreover, the transformer input and the transmitting range are increased by lengthening the gap. The variation is from 250 to 500 watts input to the set.

The side view shows that the telegraph key is hinged. In the horizontal position, connections are made for sending. A rod, passing through the panel, actuates a switch, when the key is pushed up, which disconnects the antenna and generator. In this way the necessity for an antenna switch is overcome.

Notes on Radio Antennas

A Few Suggestions are Given for Overcoming Disadvantages of Large Antennas for Transmitting and Receiving

DEVELOPMENTS made during and since the war have solved some of the problems of experimenters who, for lack of space or funds, cannot put up large antennas.

An antenna, according to the accepted conception, is made up of one or more elevated wires, the length and height of which may be from twenty to several hundred feet. In the minds of most experimenters the fact that an antenna possesses comparatively large capacity and small inductance is secondary, though this is a primary consideration to the engineer. For convenience let us apply the name antenna to a radiating system having elevated wires used in conjunction with an earth connection.

The loop is now familiar to all experimenters. It is made up of a large coil of wire, supported in any of a number of ways. While there is some distributed capacity between the turns, it is essentially a concentrated inductance. Therefore, we shall call the radiating system of lumped inductance a loop.

Now comes an old, yet new type—the condenser antenna. It is formed of two large metal plates insulated from each other and from the ground. This is really a first cousin to the antenna, while the loop is of another family. The condenser antenna, then, is a radiating system of lumped capacity.

In other words, the antenna and condenser operate by radiation, while the loop operates by induction.

The problems of small antennas of the three types and their solution are taken up in the succeeding paragraphs.

The Antenna

Transmitting.—Dimensions of sending antennas are necessarily small because of the Government regulations which limit them to operation on 200 meters. Data given on page 274, Everyday Engineering, March, 1919, show that the maximum efficiency is obtained from an antenna when it is operating at its natural wavelength, that is, with as little loading inductance as possible. However, enough inductance must be used in the secondary of the antenna to take the energy from the primary coil.

In short, a 200-meter transmitter should have an antenna whose height plus its length does not exceed 90 to 110 feet, made up of four wires spaced 3 feet apart, with the lead-in taken off at the center or end. It is advisable to connect the wires where the lead is taken, with a single wire running to the operating room.

Receiving.—For all practical purposes, the single wire, of a length great in comparison to the height, is the best antenna for receiving. The General Apparatus Company has standardized on three sizes, called short, long and super range. They are 100, 200 and 300 feet long, respectively, and are intended for an elevation of 30 feet at each end.

The extreme simplicity of the single wire type, coupled with low expense and high efficiency, has brought about its general adoption. Experimenters have reported, during the summer months, that they copied Nauen and Lyons regularly, using a single audion, with a tickler coil to make the circuit oscillate.

When there is not a sufficient stretch for a super range antenna, the wire can often be formed into a V, 150 feet on a side. The angle should be as large as possible. This construction causes only a slight reduction of efficiency and wavelength if the angle is not less than 30°.

As much loading as desired, either with condensers or inductances, can be used in a receiving antenna. Mica condensers, or those using anything but air dielectric, are not suitable for oscillating receiving circuits. A condenser, shunted around the tuning inductance is all right, but it must not have any considerable losses. Never buy a condenser with fibre end plates. Be careful of those using plates of anything other than hard rubber or bakelite. Some black moulded compositions have high losses. A leaky condenser across a coil is as bad as a resistance shunted around it.

The resistance of the primary of a loose coupler is not as important as the resistance of the secondary. Solid wire may be used for the former, but high frequency cable is essential for the secondary inductances.

The Loop

Transmitting.—Unlike the antenna, the loop operates by magnetic induction, setting up a current in the receiver in the same manner as a current is induced in the secondary of a transformer by the changing lines of force around the primary. Many experimenters think that the field about one side of the loop will neutralize the field about the other, making transmission impossible. This is not so, for the reason that a time difference exists between the oscillations on the two sides since, fast as it is, electricity requires a certain time to travel through the loop. Hence, the two fields are not exactly opposite.

Here is an important point, however. Greater radiation takes place at short waves than at long waves. A little thought will make this clear. Electricity always travels at the same speed, but short waves oscillate at a faster rate than long ones. Consequently, if the loop is large and the wavelength small, a frequency might be found where the time lag between the two sides would be equal to the time for one-half a cycle, in which case the sides of the loop would aid each other, or would be in phase. Unfortunately, this is not practical, and would require a single turn loop.

Under working conditions, it is feasible to use a loop 4 to 6 feet square for 200-meter work. Only a small capacity is needed across the loop. To obtain the maximum size or number of turns, it may be possible to use no capacity other than the distributed capacity of the loop. Although a spark coil or transformer can be used, the vacuum tube telegraph or telephone transmitter is best adapted for loop work.

A loop can be made to approach the efficiency of an antenna by lowering the resistance. 3-16 No. 38 high frequency cable is better than solid wire for transmitting because its resistance is low at short wavelengths. The wires should be wound on notched bakelite strips, as the insulation between the turns is of the utmost importance.

The loop, then, for short distance work, is well adapted to limited space. As a matter of fact, with a three-stage amplifier and a loop receiver, a single tube loop transmitter will cover 40 or 50 miles. Those who are interested in experimental work rather than in operating, will find that the loop transmitter answers their needs. The directive effect adds interest to the work.

Receiving.—What has been said of the wavelength effect on transmitting loops holds good for receivers. Signals sent out from a loop can be picked up on an antenna, of course, in which case the wavelength does not effect the efficiency of the receiving antenna greatly.

Digitized by Google

Using the same length of wire on the receiving loop, efficiency is increased by making the size of the loop greater. Increasing the number of turns helps up to a certain point, beyond which the signal strength is decreased. Resistance should be kept low for sharp tuning. When an audion detector is used, a slight negative potential should be maintained on the grid to make the resistance between grid and filament high.

Small loops do not compare with a short range antenna. To cover great distances, two or three stages of amplification are needed. Some experimenters who have space enough in their back yards have made loops 15 feet on a side, arranged to be turned by ropes from their operating rooms. Others, for transoceanic work, have built stationary loops, 15 or 20 feet high and 20 to 30 feet long, with the horizontal sides pointing east and west. Loops of this size give good results on long distance reception.

For radio compass or directive work, the leads must be brought down together from the mounting shaft. Capacity between the loop and leads, or other metal objects, give an antenna effect which causes directive errors.

THE CONDENSER ANTENNA

Transmitting.—The efficiency of an antenna is rather low because of the dielectric losses which effect its action as a condenser. A condenser antenna, with two metal plates serving as the antenna and ground, has a low resistance, compensating for its comparatively small size.

Since solid plates would be heavy and expensive for experimental work, copper netting may be substituted without any appreciable loss. Here is a new idea for those who cannot put up an antenna or a large indoor loop. A condenser antenna can be made of two squares of copper netting 6 feet on a side and 1 foot apart, suspended horizontally so that the upper plate will be 1 foot or more from the ceiling. This will be entirely out of the way, and small enough to fit almost any operating room. Insulators must be provided, of course, so that there will be no breakdown between the plates during transmission. Increasing the area of the plates will, of course, make the transmitting range greater.

Connections are made as with an antenna. The upper plate acts as the aerial, and the lower is the ground. All parts are insulated, however, from the earth. The efficiency of such a radiator is not equal to a 200-meter antenna, yet it will do good work, and serve as an excellent substitute.

Receiving.—So little work has been done with condenser antennas that it is not possible to give accurate data on them. It is certain, however, that they will accomplish as much or more than a loop.

When the plates are square, there is no directional effect, but, if they are rectangular, there should be an effect in line with the greater length. It has not been possible, so far, to try out the condenser antenna at the EVERYDAY ENGINEERING laboratory. Reports from experimenters who do any work of his kind will be welcome for publication.

The Radio Department

"WONDER who has SOL for call letters," someone said at a gathering of experimenters in one of the New York radio stores.

Now that the Radio Inspectors are busy with the trials and troubles of regulating the thousands of new transmitting stations that are going up, from Maine to Texas, a different purpose can be seen behind the work of the radio experimenters.

In the old days radio sets were largely used to replace the back yard telegraph line as a means of having some fun. While this may be still true of a few, the real work is for long distance, short wave work. Long distance transmission and reception calls for high efficiency. It takes five hundred or a thousand miles to elate the man who used to tell with pride that he heard a station in the next town.

This change is due partly to the keener competition among the increased number of experimenters. The older men who have gone at wireless more thoroughly have helped to raise the standards. Popular presentations of engineering principles in the magazines have increased the knowledge of those men interested in wireless. The American Radio Relay League deserves no small amount of credit for its efforts to make over the toy wireless station into a serious hobby.

If experimenters will heed the warning from the Department of Commerce, sounded in the last issue of EVERYDAY ENGINEERING, the future will give them big things.

THE many friends of Louis Pacent will seek him in a new lair shortly. Scenes shift rapidly in wireless. The little groups of inquiring "What do you know about——", will congregate in new quarters, for Louis Pacent will open a store of his own, about the first of the year, at 150 Nassau Street, New York City.

HAVE you ever stopped to consider that, when you measure distances on the map with a ruler, you do not find the actual number of miles, measured around the surface of the earth? In other words, the shortest distance between two points on a map is a curved line.

Mr. De Loss Martin, well known on the Pacific coast, but now in New York, has worked out a logarithmic scale by means of which the great circle distance between two points can be found, knowing their lattitude and longitude. Later this scale will be made available to experimenters.

A NUMBER of letters have come in asking about the possibility of patent suits in case this or that piece of radio apparatus were manufactured and marketed. There are so many companies building infringing instruments now that it appears as if the only way to find the answer to this question is to try it out. Perhaps it depends upon the company whose patents are infringed.

One company which attempted to sell radio telephone transmitters ran into a snag in the form of the modulation patent. The radio patent situation is so involved that even the companies themselves sometimes find that rights which they thought they owned do not belong to them.

Sympathy might well be extended to the judge who will soon be called upon to determine whether a vacuum tube and a gas tube work in the same way. He may have to decide what a pure electron discharge is or is not.

OCCASIONALLY someone says with surprise, "I didn't know that EVERYDAY was a radio magazine." It depends upon the individual's ideas. In the December, 1918, issue, there were neither radio articles nor radio advertisers. The last issue, a year later, had seventeen pages of articles on wireless and represented thirty-seven companies selling supplies to experimenters.

In a year's time the number of pages in the magazine has doubled, and with the further increase in pages, the Radio Department will be made still larger.

Next month, the first design of a radio frequency transformer ever published will be given to the readers of EVERYDAY. It doesn't call for No. 50 wire either. There will be a complete description with photographs, of a long wave receiver which has been doing some unusually good work. The set is made up by the divisional method, with standard size panels. An audion control set from the Wireless Improvement Company will be illustrated also.

Other things which you will find justify our saying, "Always bigger, always better."

NOTICE

Send in your name for the Radio Register. We want to have on record the name of every radio experimenter or engineer. Get your name in as soon as possible. Help us to make the Register complete.

Digitized by Google

The Radio Club of the Elijah D. Clark School

OUR Radio Club endeavors to give a limited number of our boys a thorough theoretical and practical knowledge of the elementary science and art of wireless telegraphy and telephony.

The club meets once a week after school hours. The work ought not to interfere with the school studies; it will supplement the regular work in elementary science.

There is an initiation fee of one dollar and a weekly due of ten cents, all of which is voluntary and is to be spent by the members for their own personal needs in this work.

The greater part of the apparatus will be constructed in the woodwork shop, some of it will be bought. All apparatus used in demonstration is the property of the instructor.

Parents are invited to encourage any such special inclination on the part of their boys. The field of electrical application is enormous, and for future electrical workers this course will prove helpful.

This course will consist of sixty lessons, running through four terms, fifteen lessons of one hour each term. The work will include theoretical and practical work and visits to radio establishments.

The actual classwork is in the hands of Dr. Herman V. Bucher, an amateur radio worker for many years and in charge of the department of Manual Training of this school. Address all letters to Dr. Bucher, Hollis, Long Island, N. Y.

BOOK REVIEW

THE DETERMINATION OF THE OUTPUT CHARACTERISTICS OF ELECTRON TUBE GENERATORS. By Louis M. Hull. 20 pages, 10 x 7 ins. Published by the Government Printing Office, Washington, D. C. Price 5c.

In this Scientific Paper from the Bureau of Standards, the results of a series of experiments on vacuum tube generators are given. It has been found that the current delivered to the output circuit of such a generator is heavily loaded with harmonics, owing to the saturation and rectification effect in the tube. The frequency in the oscillating circuit is the natural frequency of the output circuit, and this circuit acts as a filter in series with the tube and the d. c. power system.

The useful output current is closely sinusoidal, whatever the distortion of the tube currents, depending for the amplitude only upon the characteristics and the tube current. In this paper general expressions are given for the power and output in terms of static characteristics of the generating tube. Experimental results corroborated the formulas given.



"You've Gone Way Past Me, Jim!"

"Today good old Wright came to my office. All day the boys had been dropping in to congratulate me on my promotion. But with Wright it was different.

"When I had to give up school to go to work I came to the plant seeking any kind of a job—I was just a young fellow without much thought about responsibility. They put me on the pay-roll and turned me over to Wright, an assistant foreman then as now. He took a kindly interest in me from the first. 'Do well the job that's given to you, lad,' he said, 'and in time you'll win out.'

"Well, I did my best at my routine work, but I soon realized that if ever I was going to get ahead I must not only do my work well, but prepare for something better. So I wrote to Scranton and found I could get exactly the course I needed to learn our business. I took it up and began studying an hour or two each evening.

"Why, in just a little while my work took on a whole new meaning. Wright began giving me the most particular jobs—and asking *my* advice. And there came, also, an increase in pay. Next thing I knew I was made assistant foreman of a new department. I kept right on studying because I could see results and each day I was applying what I learned. Then there was a change and I was promoted to foreman—at good money, too.

"And now the first big goal is reached — I am superintendent, with an income that means independence, comforts and enjoyments at home—all those things that make life worth living.

"Wright is still at the same job, an example of the tragedy of lack of training. What a truth he spoke when he said today, 'You've gone 'way past me, Jim,—and you deserve to. Heads win—every time!'"

Yes, it's simply a question of training. Your hands can't earn the money you need, but your head can if you'll give it a chance.

The International Correspondence Schools have helped more than two million men and women to win promotion, to earn more money, to know the joy of getting ahead in business and in life.

Isn't it about time to find out what they can do for you?

You, too, can have the position you want in the work of your choice, with an income that will make possible money in the bank, a home of your own, the comforts and luxuries you would like to provide your family. No matter what your age, your occupation, your education or your means—you can do it!

All we ask is the chance to prove it—without obligation on your part or a penny of cost. That's fair, isn't it? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6065-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark

- ELECTRICAL ENGINEER
- Electrician
- Electric Wiring
- Electric Lighting
- Electric Car Running
- Heavy Electric Traction
- Electrical Draftsman
- Electric Machine Designer
- Telegraph Expert
- Practical Telephony
- MECHANICAL ENGINEER
- Mechanical Draftsman
- Toolmaker
- Ship Draftsman
- Machine Shop Practice
- Gas Engineer
- CIVIL ENGINEER
- Surveying and Mapping
- MINE FOREMAN OR ENG'R
- ARCHITECT
- Architectural Draftsman
- PLUMBING AND HEATING
- Sheet Metal Worker
- Navigator
- CHEMICAL ENGINEER
- SALESMANSHIP
- ADVERTISING MAN
- Show Card Writer
- Outdoor Sign Painter
- RAILROADER
- ILLUSTRATOR
- DESIGNER
- BUSINESS MANAGEMEN
- Private Secretary
- BOOKKEEPER
- Stenographer and Typist
- Cert. Pub. Accountan
- Traffic Management
- Commercial Law
- GOOD ENGLISH
- Common School Subjects
- CIVIL SERVICE
- Railway Mail Clerk
- STATIONARY ENGINEE
- Textile Overseer or Sup
- AGRICULTURE
- Poultry Raising
- Automobiles
- Spa
- Fre
- Ital

Name_____

Present Occupation_____ 7-25

Street and No._____

City_____ State_____

Digitized by Google

The Work of the Bureau of Standards

This Article Gives a List of the Radio Tests Made by the Bureau, of Which Experimenters and Manufacturers May Now Take Advantage

EXPERIMENTERS who are carrying on radio research work should take advantage of the services provided by the Bureau of Standards, at Washington, D. C. For the benefit of those not familiar with the tests and measurements made there, a list, with the prices for various kinds of work, is given here.

Application for Test.—All articles submitted for test must be accompanied by a written request for the test. The request should enumerate the articles, giving the serial numbers or other identification marks of each, and should state explicitly the nature of the test desired. It is also desirable that the conditions under which the apparatus is used be stated.

In submitting radio apparatus, the accompanying letter requesting the test should state specifically the nature of the test desired, giving, in the case of wavemeters, condensers, etc., the number of points on the scale and the frequencies of the wavelengths at which the apparatus is to be tested. In the absence of specific instructions, such tests will be performed as are necessary to determine the ordinary constants or operating behavior of the apparatus. Thus, for a wavemeter, variable condenser or inductor, the results obtained would make possible the use of the instrument as a secondary standard.

For special tests involving measurements not specified in the appended schedule, a charge will be made based upon the time required for the test. When the test is one regularly provided for in these instructions, the fee may be computed in advance and should be sent at the time the apparatus is shipped. In making reference to this schedule, mention: Fees for Testing Radio Apparatus, Feb. 6, 1919, Item (D) (a).

Condition of Apparatus.—Before submitting apparatus for test, the applicant should ascertain that it is in good working condition. When defects are found after a test has been begun, which excludes an apparatus from receiving the usual certificate, a report will be rendered giving such information as has been found. All possible care will be taken in handling apparatus, but the risk of injury or breakage in shipment or under test must be borne by the applicant.

Identification Marks.—All packages should be plainly marked with the shipper's name and address, and, when convenient, a list of the contents. Each separate piece of apparatus or sample of material should be provided with an identification mark or number. The identification mark should be given in the application for the test.

Shipping Directions. — Transportation charges are payable by the person requesting the test. The charge for shipment to the Bureau of Standards must be prepaid, and unless otherwise arranged, articles will be returned or forwarded by express collect. Apparatus submitted for test, as well as all correspondence, should be addressed to the Bureau of Standards, Washington, D. C.

Remittances.—Fees should be sent when the apparatus is shipped, in accordance with this schedule, or promptly upon receipt of bill. Certificates are not given, nor is apparatus returned until the fees due thereon have been received. Remittances may be made by money order or check drawn to the order of the Bureau of Standards.

Nature of Tests.—The general methods used in most of the tests of radio apparatus are described in Circular 74 of the Bureau of Standards, entitled "Radio Instruments and Measurements." A more detailed description of the methods used by the Bureau of Standards in testing radio apparatus will be given in a circular now in preparation.

Reduced Fees for Amateurs—In the case of wavemeters not suited for precision measurements the Bureau will charge a minimum fee of one dollar per coil. Enough points will be measured to give a calibration curve. The Bureau reserves the right to decide upon the application of this reduction in any specific case.

Condensers

Capacity and phase difference (or high frequency resistance), one point at one frequency	$3.00
Each additional point at same frequency	1.00
Each additional frequency	1.00
Capacity of fixed condenser at one radio frequency	2.00
Each additional frequency	1.00
Phase difference (or high-frequency resistance) one point at one frequency	2.00
Each additional point same frequency	1.00
Each additional frequency	1.00
Capacity of variable condenser per point (minimum charge, $2.50)	.50

Inductors

Pure inductance of coil	$5.00
Capacity of coil	3.00
High-frequency inductance one coil at one frequency	1.00
Each additional coil at same frequency	.50
Each additional frequency	.50
Fundamental wavelength of coil	1.00
Resistance (high frequency) one point at one frequency	2.00
Each additional point at same frequency	1.00
Each additional frequency	1.00
Calibration of continuously variable inductor, one point at one frequency	1.00
Each additional point at same frequency	.50
Complete test of a single coil, including unless otherwise specified, high-frequency inductance, pure inductance, capacity, fundamental wavelength	8.00
For a coil having several sections, the capacity and fundamental will be furnished for the whole coil only, and the other tests as described in the preceding item for the maximum inductance	8.00
Each additional section	5.00

Resistors

Resistance (high-frequency) one point at one frequency	$2.00
Each additional point at same frequency	1.00
Each additional frequency	1.00

Wavemeters

Wavelength calibration per point (minimum charge, each coil, $2.50; for reduced fees to amateurs see previous note)	$0.50
High-frequency inductance (see above, under Inductors).	
Capacity of condenser (see above, under Condensers).	
High-frequency resistance (or decrement) of circuit, one wavelength	3.00
Each additional wavelength	.50

Note:—For high-frequency resistance of coils or condenser alone, see above, under Condensers and Inductors.

Electron Tubes

Characteristic curve of receiving tube, first curve	$4.00
Each additional curve on same tube	2.00
Amplification constant and internal resistance of receiving tube, first determination	2.00
Each additional determination on same tube	1.00
Output of power tube, first determination	2.00
Each additional determination on same tube	1.00
Characteristic curve of power tube, first curve	4.00
Each additional curve on same tube	2.00
Amplification constant and internal resistance of power tube, first determination	2.00
Vibration test of power tube, first tube	2.00
Each additional tube in same test lot	1.00

Special fees will be charged for investigations on the detector action of tubes, amplification of amplifiers, tests of power tubes at very high voltages, and other special measurements.

Current Measuring Instruments

Thermocouple and galvanometer, per point at one frequency	$2.00
Each additional point at same frequency	1.00
Each additional frequency	1.00
High-frequency ammeter, range up to 1 ampere, per point at one frequency	3.00
Each additional point at same frequency	.50
Each additional frequency	.50
High-frequency ammeter, range 1 to 20 amperes, per point at one frequency	3.00
Each additional point at same frequency	1.00
Each additional frequency	1.00
High-frequency ammeter, range 20-100 amperes, per point at one frequency	5.00
Each additional point at same frequency	2.00
Each additional frequency	2.00

Insulating Materials

Dielectric constant at one frequency, per sample	$3.00

Digitized by Google

Each additional frequency.....$1.00
Phase difference, or high frequency resistance, same fees as for the determination of the phase difference of condensers.
Effect of high voltages.—Fees for the determination of flashover or breakdown voltage or the effect of high voltage at radio frequencies are computed on a basis of the special modifications of the regular apparatus which are required for test and also the time necessary for its performance.
Note:—Samples of insulating materials should conform to the following sizes where possible. When samples of other sizes are submitted an additional fee may be charged, depending upon the time involved in preparing the sample.

For determination of phase difference and resistance. Laminated materials, 25 cm. x 31 cm. in area, and from 0.3 cm. to 1 cm. in thickness.

Moulded materials, 25 cm. x 31 cm. in area, and from 0.3 cm. to 1 cm. in thickness or discs 25.4 cm. in diameter and from 0.3 cm. to 1 cm. in thickness.

For determination of flashover voltage, samples should be 10 cm. x 10 cm. in area, and 0.63 cm. thick.

Transmitting Sets, Receiving Sets, Buzzers, Detectors, etc.—Certain specific tests are undertaken or a critical study made of the design and behavior of the apparatus as compared with other apparatus used for the same or a similar purpose. Fees for such tests depend upon the special requirements and time necessary in their performance.

A Mounting for Experimental Transformers

A SERIES of experiments on audio frequency transformers required a number of different primary and secondary windings. At first it seemed necessary to make up eight or ten complete transformers, but an idea in the form of a mounting illustrated in this article overcame that difficulty. By its use, only one core was needed.

The illustration shows the bakelite cradle with the transformer assembled. It can be seen that one core, made up of one long and two short legs, is put into the mounting. The ends of the short legs were ground off smooth.

Different primaries and secondaries were assembled on single legs. Then the coils required were put in place and clamped down by the two bakelite strips shown on the side of the instrument.

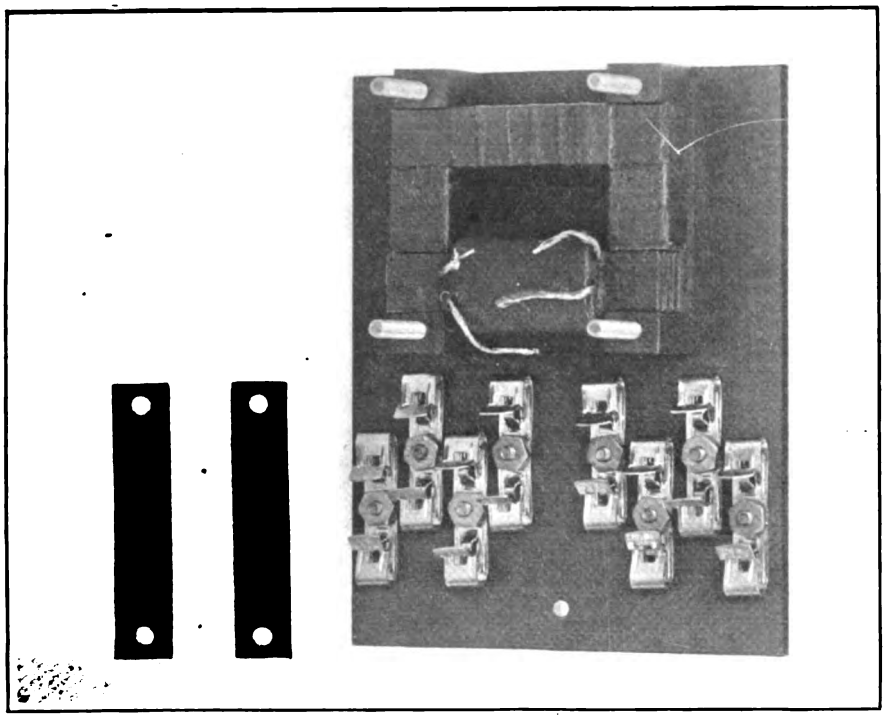
Experiments were also made with magnetic leakage. Enough room was allowed in the cradle so that the leg carrying the winding could be moved a short distance from the ends of the short legs. When the separation was adjusted, by means of shims, the clamping strips were tightened and the shims removed.

Fahnestock clips were provided at the base so that different taps from the primary and secondary coils could be connected. Since double clips were not available, two single ones were put on each mounting screw.

Although there is nothing remarkable about this device, it saved both time and money on a job which called for speedy completion.

NOTICE!

Mr. R. S. Ould has called attention to the fact that the price of patent specifications, from the Patent Office, Washington, D. C., has been increased from five to ten cents each. Remittances cannot be made by stamps; the Patent Office requires coin or money orders.



This transformer mounting makes possible experiments in the different kinds of windings

Don't Be A Miserable Misfit



STRONGFORT
The Perfect Man

You don't have to go through life fit for nothing, sickly, weak, anemic, with your body wracked and your nerves frazzled by constipation, indigestion, catarrh, neuralgia, headaches or any other chronic ailment. *Get rid of those handicaps;* build yourself up into a real man, so you can get some joy out of life for yourself and your family.

YOU can't get ahead, you can't advance in your work or business—you may even lose your grip on your present job—if you don't make yourself fit. You can do it, whatever your present condition and no matter what brought you to it; you can regain your lost health and strength and feel the fire and pep and enthusiasm of youth coursing through your veins again, if you will only

Stop, Think and ACT

Don't think that your weakness and ailments that are dragging you down are a matter of course—something you can't possibly get rid of. You can overcome them and cast them off, if you go about it the right way, as thousands of other men have done and are doing every day. Drug store dope and patented piffle won't cure you; quacks and fake remedies help nobody but the men who make and sell them. Your own abuse of Nature's Laws—perhaps unconsciously—brought your ills upon you, and Mother Nature is the one doctor you want to go to for relief.

SEND FOR MY

FREE BOOK on STRONGFORTISM

Strongfortism is the Science of Living Life as Nature meant it to be lived—the way that gets the greatest enjoyment out of it—and letting Nature work the elimination of any ills in her own way. Every reputable medical man will tell you that Nature is the greatest Doctor in the world. Every surgeon, after an operation, large or small, makes sure that the wound is absolutely free from bacteria and then lets Nature heal it up.

Strongfortism, which is simply a method of utilizing Nature's curative power, will do for YOU what it is doing for my pupils in every part of the world. Strongfortism will show you how to develop every muscle in your body, internal as well as external, and strengthen every vital organ; how to make your blood rich and red; how to clear the cobwebs out of your brain; how to FIT YOURSELF so you can make a success in life.

I Guarantee Results There isn't any guess work about Strongfortism; Nature's Laws are as immutable as the operations of the universe. My whole life has been spent in studying them out, experimenting with them, and applying them practically—first to myself and then to my numerous pupils. I GUARANTEE to improve you so that you will become normal in every respect, if you will follow my directions for a few months. "Premeties and Conservation of Health, Strength and Mental Energy," my free book, will tell you all about the Science of Strongfortism and show you the one quick, easy, simple way back to REAL MANHOOD. Send for it NOW—DON'T WAIT—you would dig deep down in your pocket and pay good money for it, if you knew what it contains. IT'S FREE. Just fill out the coupon below marking the ailments you wish information on and mail it to me today with three 2c stamps for packing and postage, and I will mail you a copy at once.

LIONEL STRONGFORT
Physical and Health Specialist
1155 Strongfort Institute NEWARK, N. J.

.....CUT OUT AND MAIL THIS COUPON.....

Mr. Lionel Strongfort, Newark, N. J. 1155

Dear Strongfort:—Please send me your book "Premeties and Conservation of Health, Strength and Mental Energy," for postage of which I enclose three 2c stamps to cover mailing expenses. I have marked (X) before the subject in which I am interested.

..Colds	..Short Wind	..Poor Circulation
..Catarrh	..Flat Feet	
..Asthma	..Stomach Disorders	..Skin Disorders
..Obesity		..Despondency
..Headache	..Constipation	..Round Shoulders
..Thinness	..Biliousness	
..Rupture	..Torpid Liver	..Lung Troubles
..Lumbago	..Indigestion	..Increased Height
..Neuritis	..Nervousness	
..Neuralgia	..Poor Memory	..Stoop Shoulders
..Flat Chest	..Rheumatism	
..Deformity (describe)	..Gastritis	..Muscular Development
..Insomnia	..Heartweakness	

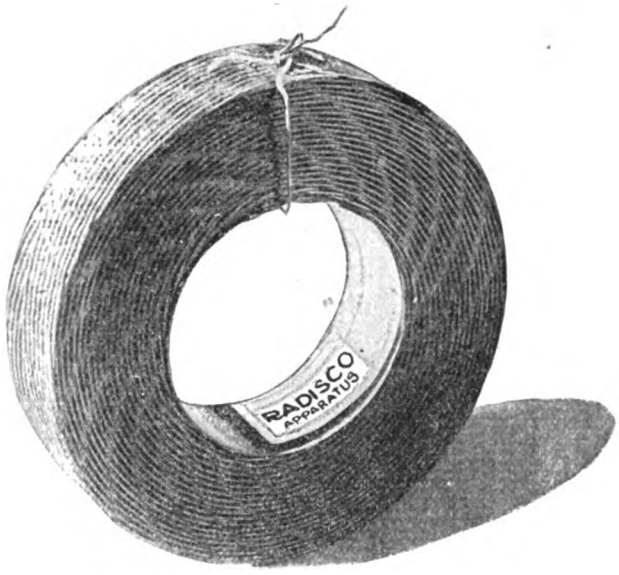
Name.....

Age..... Occupation.....

Street.....

City.....State.....

Digitized by Google



CONTRARY to RUMORS

Spread by a Competitor

The Radio Distributing Co. is still manufacturing their unmounted universal wound inductances and will continue to supply their agents these very efficient coils.

That the RADISCO COILS are superior to any similar type of inductances is the opinion of several well known radio men who have received signals from very remote stations.

The RADIO DISTRIBUTING COMPANY will assure all purchasers that they will experience no inconvenience by reason of any action now pending or to be started by reason of patent on coils purchased. These coils are in stock at all RADISCO AGENTS.

RADISCO AGENTS carry only apparatus of proven merit. Look for the RADISCO trademark on all coils you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the Universal wound inductances and are our agents for all standard radio apparatus of merit.

Communicate your wants to them

ALBANY, N. Y.:
E. L. Long,
21 Magnolia Terrace.

ATLANTIC CITY, N. J.:
Independent Radio Supply Co.
118 So. New Jersey Ave.

BEINVILLE, QUEBEC, CANADA:
Canadian Radio Mfg. Co.

BOSTON, MASS.:
Atlantic Radio Co.,
34 Batterymarch St.

BROOKLYN, N. Y.:
Kelly & Phillips Electric Co.,
312 Flatbush Ave.

BRONX, NEW YORK CITY:
Amateur Wireless Equipment Co.
1390 Prospect Ave.

CHICAGO, ILL.:
Chicago Radio Laboratories,
1316 Carmen Ave.

McKEESPORT, PA.:
K. & L. Electric Co.,
427 Olive St.

NEW CASTLE, PA.:
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave.

NEWARK, N. J.:
A. H. Corwin & Co.,
4 West Park St.

NEW ORLEANS, LA.:
L. A. Rose,
4323 Magnolia St.

PITTSBURG, PA.:
Radio Electric Co.,
4614 Henry St.

PHILADELPHIA, PA.:
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Sts.

PROVIDENCE, R. I.:
Rhode Island Electric Equipment Co.

SCRANTON, PA.:
Shotton Radio Mfg. Co.,
P. O. Box 3,
also at 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
585 Armory St.,
Electric Service Co.

TORONTO, ONTARIO, CANADA:
585 College St.,
Vimy Supply Co.

WASHINGTON, D. C.:
National Radio Supply Company,
1405 U St., N. W.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY - Newark, New Jersey

NEARLY GONE—DON'T WAIT ANY LONGER

A Standard Wavemeter Condenser, 0.00006 to 0.0015 mfd., $10.

The cancellation of a GOVERNMENT WAR CONTRACT has made it possible for the G. A. Company to give Experimenters this unusual opportunity—a double variable condenser built for the Signal Corps wavemeters, worth $50 at a price of $10. As a WAVEMETER condenser, a finer instrument cannot be purchased at any price. This is your chance to own a real meter. This condenser is of such a high grade type that it is specially adapted for use as a LABORATORY STANDARD for making all kinds of measurements. VACUUM TUBE TRANSMITTERS require air condensers of this type which will not break down between the plates. LONG WAVE RECEIVERS must have condensers of large capacity and very low losses to operate with minimum inductance and to give loudest signals. For all these purposes, the DOUBLE CONDENSER is the best you can buy, regardless of the price you pay.

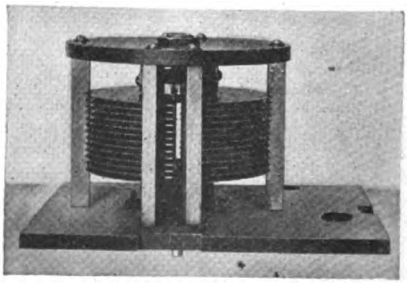
A limited number of these instruments are available. If your order comes too late, your money will be returned, immediately. The G. A. Company gives no credit slips, makes no substitutions.

0.00006 to 0.0015 mfd. condenser, $10.00, sent by express. Capacity calibration curve $1.00.

DON'T LET THIS OPPORTUNITY SLIP BY—YOU WILL NOT HAVE THIS CHANCE AGAIN

Orders accepted by mail only.

15-E WEST 45th ST. **The General Apparatus Company** NEW YORK CITY



CONDENSER AS SHOWN, NEVER USED. **$10** ACTUAL VALUE OF THIS INSTRUMENT, $60



TELEPHONE SUFFERERS!
"THERAPHONE"
High Power Osteopathic Receiver
Earpiece is tuned to the ear. It can't confuse nor fatigue. Absorbs shocks, improves the Hearing and conserves time. For Busy, Deaf, Nervous, Privacy and Noises. Guaranteed to suit. (Check or C. O. D. $2.00 Export $2.20). No Agents.
$2
Get Details
The Evolution Phone Co., Inc.
48 A Greenwich Ave., New York

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute *33rd St.* ***Valparaiso, Indiana***

Digitized by Google

New Detector and Amplifier Units

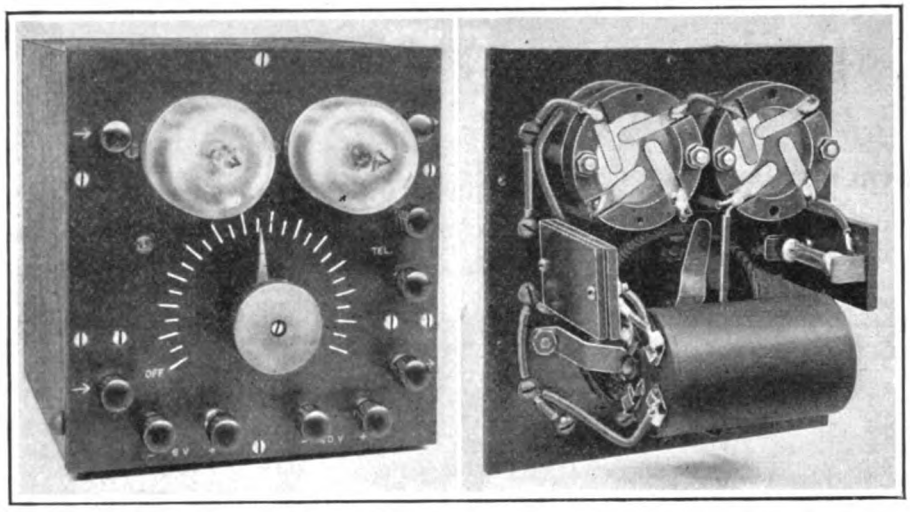
Particular Attention Has Been Given to the Convenient Location of the Binding Posts and the Elimination of Unnecessary Parts in These International Radio Units

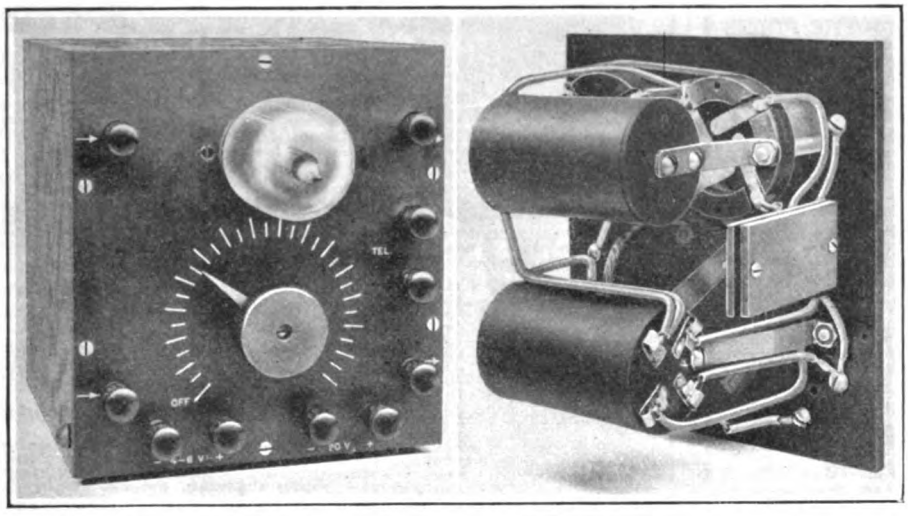
THE tendency towards the simplification of design of radio apparatus for which EVERYDAY ENGINEERING has been working so hard among the amateurs is being brought forcibly to their attention by the new apparatus introduced in the last few months by manufacturers.

Since experimenters so generally take their examples from commercial instruments the detector and amplifier units shown here should impress upon them the fact that the fewer parts and instruments the better the results.

The transformer provided with the amplifier is of a new and interesting type. From its appearances it would seem to be one of the open core type, but as a matter of fact it is a shell type transformer, enclosed in a casing to exclude all moisture, a point often overlooked and one of great importance since the absorption of moisture by the winding greatly decreases the efficiency of an amplifying transformer.

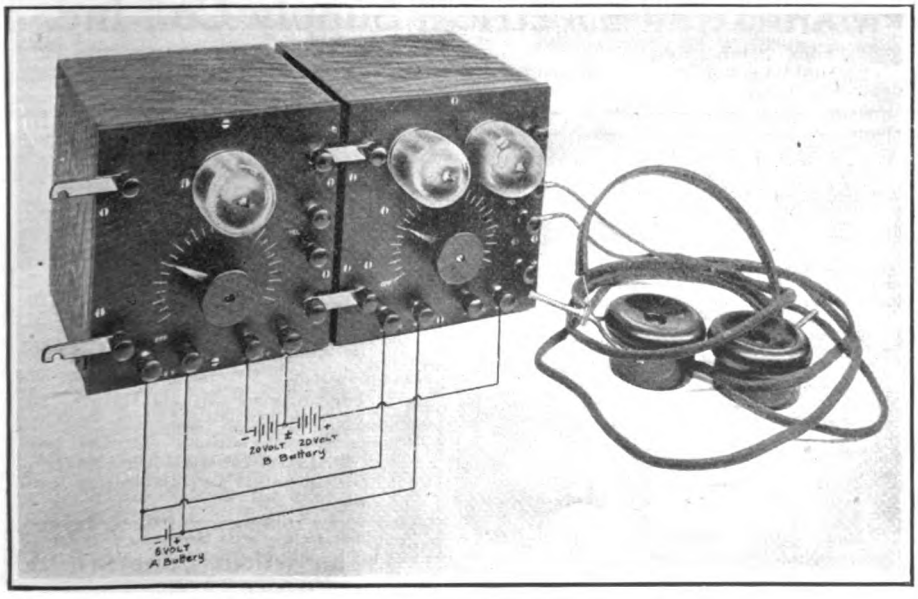
In the lower illustration a detector and two-step amplifier can be seen, the binding posts being so arranged that in each case the input circuit is connected on the left and the output on the right. Either an amplifier or a pair of telephones can be joined to the output side of the unit. Where an amplifier is employed connections can be made by straps, as will be seen by the illustrations. The binding posts for the A and B batteries are on the lower part of the panel. No plate battery controls are needed, as these sets operate with standard 22.5-volt batteries.





Top, a detector and two-stage amplifier in which efficiency has been increased and the cost lowered by the simple and rugged design. Center left, a detector for this series of units. Input and output posts are indicated by arrows

Center right, two stages of amplification are provided in this set. The design of the transformers are such that there is no feed back to cause howling Below, the detector and two-stage amplifier ready for connection to a receiving set

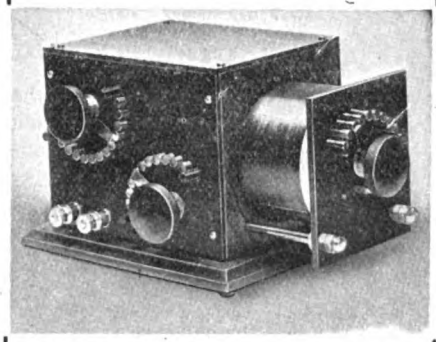


The idea of divisional construction with a cabinet for each panel is new and particularly good because the boxes can be set on each other without any supporting frame. In this way, the advantages of separate instruments are combined in the panel construction.

A little study of the descriptions of new apparatus which have appeared in EVERYDAY ENGINEERING, shows clearly the revolutionary character of post-war design.

Digitized by Google

Buy the Best When You Buy



THE BEST COSTS YOU LESS WHEN YOU BUY FROM US.

This 200 to 2500 meter loose coupler costs $18.00. You cannot buy a better instrument if you pay more.

RADIO EQUIPMENT CO.
630V Washington St. Boston, Mass.



DUCK'S No. 13 264 Pages
Electrical and Wireless Catalog
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

THE NEED OF THE HOUR
Wireless Operators for the Merchant Marine.

Start your boy in a profession worth while

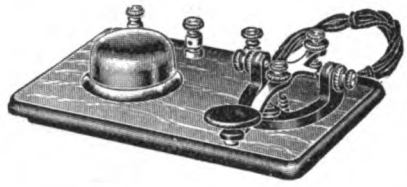
Complete Beginners' Wireless Set, $15.00

Comprising Loose-Coupler, 2,000 Meters; pair 2,000-Ohm Phones, Fixed Condenser, Galena Detector, and instructions book; these are separate instruments and *Guaranteed;* the best value on the market to-day.
Note:—We do special Cabinet and Metal Work for Engineering Students; correspondence invited.

Radio Equipment Company
1525 North Fawn Street - Philadelphia

Wireless Receiving Ban Raised

MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green covered flexible cord.
The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No.		Price
342	Telegraph Practice Set, with Battery and Cord	$3.24

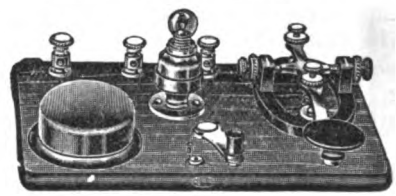
Weighs 4 lbs. packed.
Price does not include postage.

MESCO COMBINATION PRACTICE SET

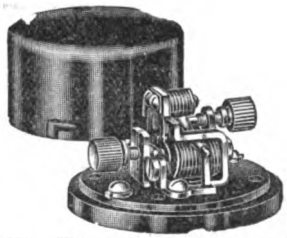
For Learning the Morse and Continental Visual and Audible Codes

This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord $4.05
Weighs 4 lbs. packed.
Price does not include postage.



MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.
It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a bayonet joint.

List No.		Price
55	Mesco Radio Buzzer	$2.05

We carry a large and complete line of Standard Wireless Material recognized by experts as such with competent experienced wireless attendants in charge

Send for the New Edition of Our Catalog K28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarms Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Manhattan Electrical Supply Co., Inc.

NEW YORK: 17 Park Place
BRANCHES: 110 W. 42nd St., 127 W. 125th St.
CHICAGO: 114 S. Wells St.
ST. LOUIS: 1106 Pine St.
San Francisco Office: 604 Mission St.

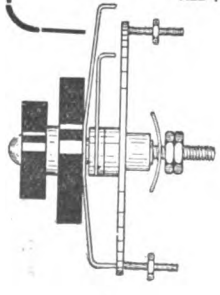
WILCOX PANEL SWITCHES

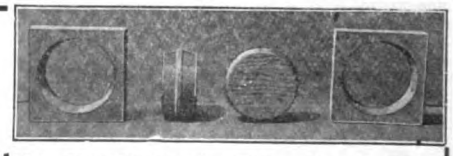
TYPE 101

A beautiful and efficient standardized switch for general use. Furnished in two sizes.
1" Radius, Brass finish....40c Nickel finish....50c
1½" Radius, Brass finish....50c Nickel finish....60c

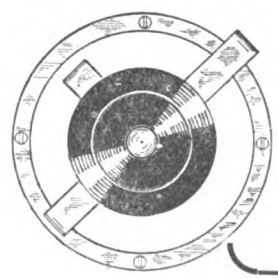
TYPE 102 (Illustrated)

A compound switch especially suitable for the primary of loose couplers. 1½" outside radius.
Brass finish.....$1.10 Nickel finish.....$1.25
ALL POSTPAID





VARIOMETER PARTS



Turned from hardwood. Set as shown consisting of stator (two parts), rotor and form for winding coils.....Postpaid $2.50

Size of stator 5½" sq.
Other sizes made to order

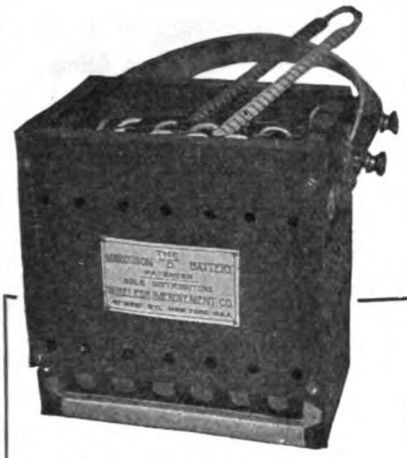
SET NO. TWO contains all parts for the variometer including the above and knob, scale, pointer, shaft, binding posts, wire and instructions for assembly.....Postpaid $5.00

BUILD YOUR OWN APPARATUS

Our standardized parts and materials make it easy to build efficient apparatus that is beautiful and uniform in appearance.
NEW LOOSE LEAF CATALOG READY
Sent for five cents in stamps.

The Wilcox Laboratories
Lansing Dept. D Michigan

Digitized by Google



The Plate Battery Problem Solved!

The Marcuson "B" Battery

eliminates the use of the inefficient Dry Battery and the old-fashioned expensive Storage Battery

The Marcuson "B" Battery possesses four points of perfection,—it is light, compact, dependable, and inexpensive. The Marcuson "B" Battery can be readily charged from any D. C. lighting circuit.

40 Volts. Over all Dimensions: 6" x 6" x 4". Weight 5 lbs. Price: $12.00. The Marcuson Batteries have been in use for more than ten years by the largest Electrical Manufacturers, Cable Repair Ships, Technical Institutions, etc.

Can be replaced at lower cost than new Dry Batteries can be bought for

We are sole distributors of the Marcuson "B" Batteries.

It is but one of our many Radio products.

Simply drop us a card, and let us send you our catalogue No. Two.

WIRELESS IMPROVEMENT CO.

Radio Engineers
Manufacturers and Distributors
47 West Street New York, U.S.A.

INEXPENSIVE BOOKS FOR THE EVERYDAY PRACTICAL ELECTRICIAN

Wiring a House

By Herbert Pratt. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules; in fact, just the information you need. Directions apply equally to a shop. Fourth edition. **Price, 35 cents**

Electric Bells

By M. B. Sleeper. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated. **Price, 60 cents**

NORMAN W. HENLEY PUBLISHING CO.
Dept. EE 2 West 45th Street, New York



TRIODE
(Trade Mark)
Vacuum Tube Socket Type-F

The base of this socket is bakelite dilecto and will not crack and break like the moulded material of the usual socket. Contact springs are stamped with identifying letters. Base is provided with three rubber feet and four countersunk holes for panel mounting.

Price $1.25 Postpaid **Immediate Delivery**

Eaton Oscillators **Two Step Amplifiers**

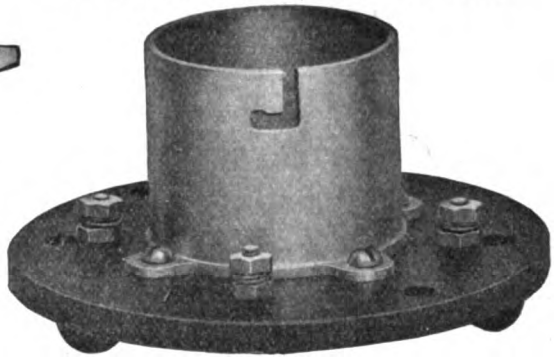
TRIODE
(Trade Mark)
Audio Transformer Type-P

Due to its operation on the principle of voltage amplification thru resonance, this transformer provides a maximum of low frequency amplification and is superior to all others.

Permits reliable daylight reception from European stations.

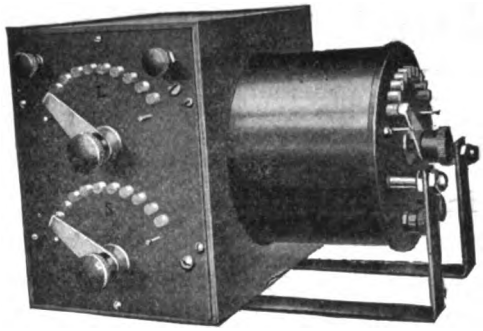
Establishes new amateur long distance records. Renders remarkable amplification of all signals. May be used with all standard tubes.

Price $7.00 Postpaid, Immediate Delivery



WIRELESS SPECIALTY APPARATUS COMPANY
Engineers, Designers, Manufacturers **BOSTON, MASS., U. S. A.**

RADIO ELECTRICAL APPARATUS



New type radion receiving transformer has bakelite panels, two primary and one secondary 10 point switches. Oak cabinet. Price, $12.00.

Our new Bulletin Y offers a distinctive line of radio and laboratory apparatus including transformers, spark gaps, oscillation transformers, variometers, variable condensers, etc., in fact the most complete line in America.

Bulletin R describes the Cambridge alternating current rectifier for

STORAGE BATTERY CHARGING

Send 3c. stamp for both bulletins

CLAPP-EASTHAM COMPANY
131 MAIN STREET CAMBRIDGE, MASS.

REMLER RADIO MFG. CO. 62 Post Street SAN FRANCISCO
Pacific Coast Representatives

Catalog of **RADIO RECEIVING APPARATUS**
MADE BY THE PIONEER COMPANY OF THE PACIFIC COAST. SEND IN A 2-CENT STAMP AT ONCE

AudioTron Sales Company
Lick Building San Francisco

RADIO APPARATUS
on the
INSTALLMENT PLAN

Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.

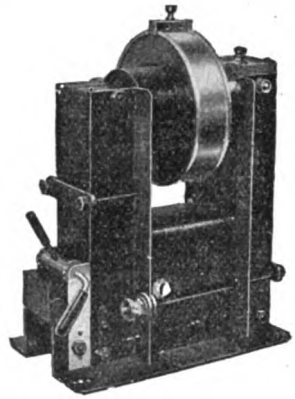
J. DONALD VANDERCOOK
LOMBARD Box 442 ILLINOIS

Please mention Everyday Engineering Magazine

Digitized by Google

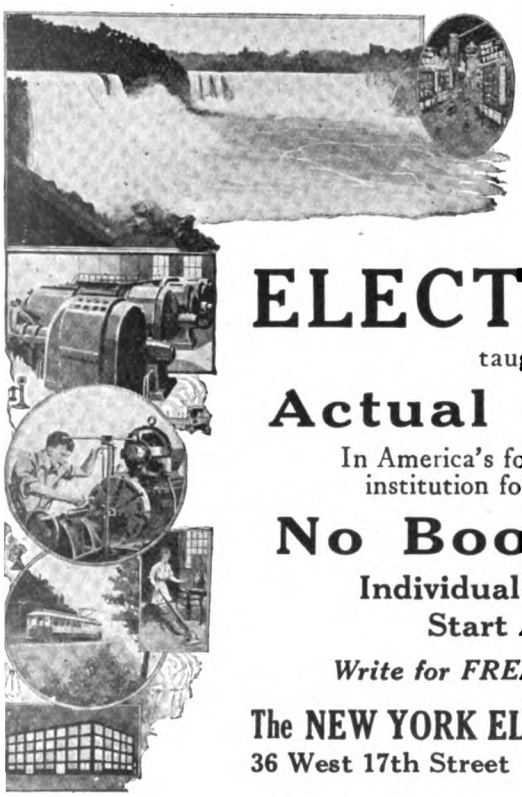
1 K. V. A. 25,000 Volt Wireless Transformer

The Thordarson Wireless Transformer is more than a transformer. It is a machine of efficiency and reliability, a piece of wireless apparatus that every amateur can be justly proud of. A Thordarson Wireless Transformer will make a "Long Distance" amateur of you. Our "20-T" bulletin describes our complete wireless transmitting apparatus.



Thordarson Electric Mfg. Co.

501-515 So. Jefferson St. Chicago, Ill.



Learn By Doing

Every phase of all branches of

ELECTRICITY

taught by

Actual Practice

In America's foremost and oldest institution for trade training.

No Books Used

Individual **Instruction.**
Start **Any Day**

Write for FREE 64-page catalog

The NEW YORK ELECTRICAL SCHOOL
36 West 17th Street New York City

Send for
HALCUN Radio Catalogue
Full Line of
Amateur Requirements
Halcun Radio Co.
San Francisco, Calif.
Formerly Haller Cunningham Elec. Co.

Laboratory Signs

Attractive 8" x 10" signs printed on high quality coated white cardboard in selected wordings for the electrical experimenter.

1.—DANGER! HIGH VOLTAGE
2. EXPERIMENTAL RADIO LABORATORY NO ADMITTANCE
3. GOVERNMENT LICENSED RADIO STATION
4. DO NOT TOUCH THE INSTRUMENTS
5. PLEASE BE QUIET WHILE THE OPERATOR IS RECEIVING

15c EACH, ANY TWO FOR 25c
ALL 5 FOR 50c
Immediate Shipments, Postpaid
THE TAYLOR CO. Box 1043-E
LOWELL, MASS.

Cement for Uniting Iron Surfaces and Filling in Joints

MIX 100 parts of iron filings, free from rust and not larger than rape seed, ¾ part of coarsely powdered sal-ammoniac, and ½ part of flowers of sulphur; moisten the mixture with urine and beat it, with repeated moistening, until it becomes heated, dry and brittle. In this state it is placed in the joints, and forced in as tightly as possible with chisel and hammer, whereby it again becomes moist and soft. Finally, the joints are filled up evenly, and allowed to dry two days, when, as an indication of good cementing, separate black drops must appear upon the hardened crust. The cement does not adhere to tarred kettles or dirty and greasy joints. To keep it, it is rammed into an iron pot and water poured over it. For use, pour off the water, add to the mass taken out sufficient iron filings to give it the necessary consistency, and pour the water back into the pot. The stronger and quicker the cement rusts in the joints the better it acts. The proportions used vary, however, very much. For instance, (*a*) iron filings, 30 parts; sal-ammoniac, 1; sulphur, 1. With this composition the danger of progressive rusting is, however, greater on account of the larger quantity of sal-ammoniac in proportion to iron filings; or (*b*) pulverized cast-iron turnings, 50 parts; sal-ammoniac, 2; flowers of sulphur, 1; or, (*c*) pulverized iron filings, 100 parts, and pulverized sal-ammoniac, 2 parts. The mixtures are kept in well-closed boxes in a dry place, for use moistened with urine, and applied as mentioned under 11. The cemented places must be heated only when entirely dry.

To Solder Without a Soldering Iron

PIECES of brass can be soldered without it being possible to detect the joint by filing the pieces so as to fit exactly, moistening them with a soldering liquid, then placing a smooth tin-foil between them, tying them together with wire and heating over a lamp or fire until the tin-foil melts. With good soft solder almost all soldering can be done over a lamp without the use of a soldering iron. The different degrees of fusibility of solders can also be advantageously used for several solderings and joints on the same piece. By soldering first with a fine solder composed of lead, 2 parts; tin, 1; and bismuth, 2, there will be no danger of melting when close to the jointed part; another piece is soldered on with solder composed of lead, 4 parts; tin, 4; and bismuth, 1. The best soldering liquid to be used is composed of equal parts of water and hydrochloric acid saturated with zinc.

Digitized by Google



RADIO MEN

Make your apparatus up to date. Indicating dials now available at a reasonable price.

These dials are fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. The edge is bevelled. The hole in the center will pass 8-32 screw and there are three holes around the center hole to fasten on knob. (These holes are not shown in cut.) We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted...$1.30 Postpaid

Bulletin No. 1 describing these parts has been sent to all who sent for our July 1st catalogue. If you have not received our catalogue send 5 cents in stamps and get on our mailing list for future bulletins free.

For sale at all Radisco Agencies

A. H. Corwin & Co.

4 West Park Street Newark, N. J.

"ASK ANYONE WHO HAS USED IT"

"The Best I Ever Worked"

"The Brandes Headset Is The Best I Ever Worked. Others Look Like a Plaything Beside It." (Testimonial from an expert, Name on Request.) Professionals as well as amateurs, the world over are enthusiastic about the range and absence of blurring in the

BRANDES WIRELESS HEADSET



"Superior", 2000 ohms, $7

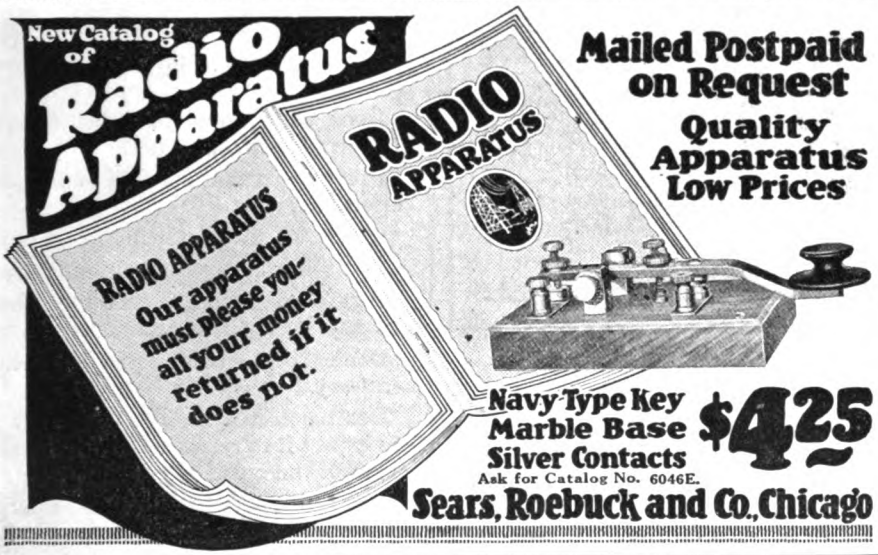
TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. 32 Union Square, Room 822 New York

WIRELESS RECEIVER SPECIALISTS

New Catalog of **Radio Apparatus**



Mailed Postpaid on Request

Quality Apparatus Low Prices

Navy Type Key Marble Base Silver Contacts $4.25

Ask for Catalog No. 6046E.

Sears, Roebuck and Co., Chicago

Telegraph Pictures

BY ELECTRICITY



A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.

L. J. LEISHMAN CO. Dept. L, Ogden, Utah

INSIST

on getting

"PACIFIC RADIO NEWS"

FROM YOUR NEWS DEALER WHEN BUYING A MAGAZINE DEVOTED TO RADIO COMMUNICATION.

GET THE BEST

Don't Fool Yourself

15c. PER COPY - $1.50 PER YEAR

PACIFIC RADIO PUB. CO.

50 Main St., San Francisco, Cal.

Your Opportunity!

to secure quickly and thoroughly a

Practical Electrical Education

is open at the School of Engineering of Milwaukee.

A large faculty of experts, extensive and fully equipped laboratories, drafting rooms and class rooms train you to become a high grade **Electrician** in **One Year.**

Institute of Electrotechnics

Junior and Senior Units. 1½—3 Years.

Electrical Engineering

B.S. Degree in three years.

Electrical and Mechanical Drafting—1 year course Armature Winding and Motor Generator Repair—6 mo. Automotive Electrotechnics. 3 mo. to 2 year courses. Wireless Telegraphy. Extension Department.

New Term January 2d

"Earn While You Learn" system. Athletics, Frat House, Board at cost. R. O. T. C. advantages (optional). Write **Today** for bulletins and full particulars **FREE.** Mention course, age and education.

SCHOOL OF ENGINEERING OF MILWAUKEE

140-373 Broadway Milwaukee, Wis.

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS

Official Organ: American Radio Relay League

Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work all A. R. R. L. News, Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER

Regular price $1.50 per year, 15 cents per copy. Introductory rate: 9 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

Enclosed find $1; please enter my trial subscription to QST for 9 months.

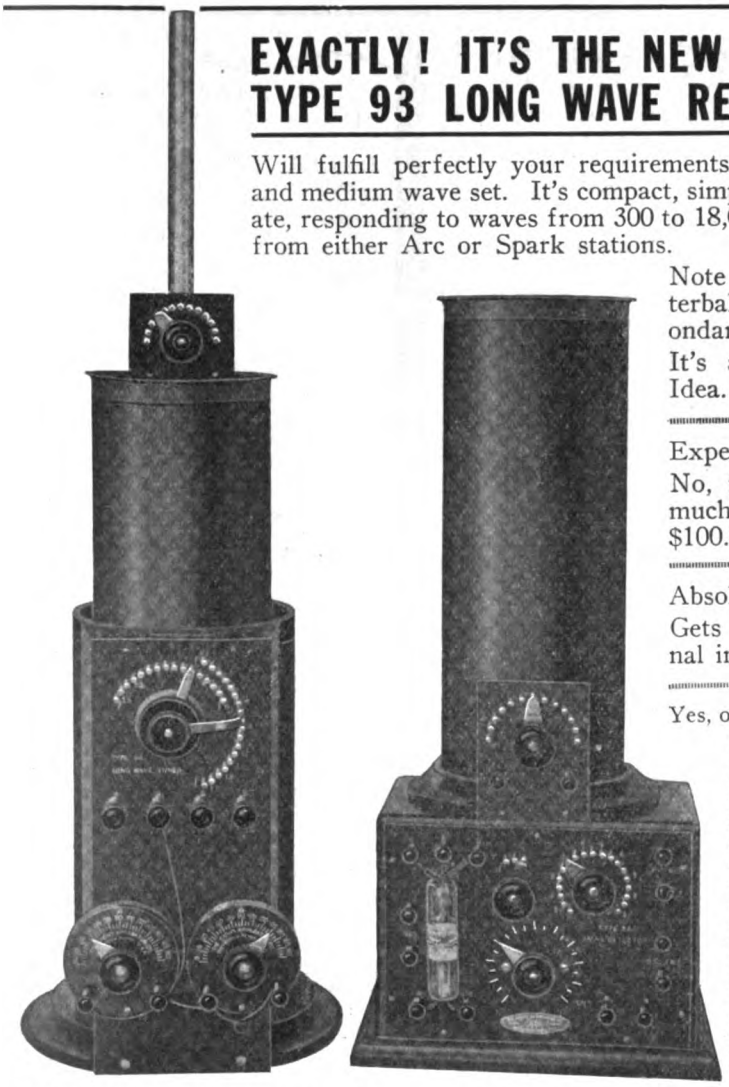
Name_____

Address_____

Digitized by Google

EXACTLY! IT'S THE NEW TRACO TYPE 93 LONG WAVE RECEIVER

Will fulfill perfectly your requirements of a long and medium wave set. It's compact, simple to operate, responding to waves from 300 to 18,000 meters, from either Arc or Spark stations.



Note the counterbalanced secondary.

It's a TRACO Idea.

Expensive?

No, it sells for much less than $100.00.

Absolutely!

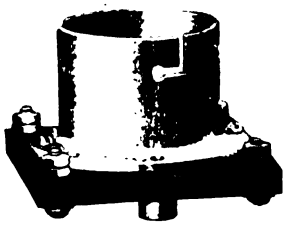
Gets every signal in the ether.

Yes, our customers are reporting fine results. They are copying undamped stations here and abroad using antennaes 300 to 500 feet long and 40 to 60 feet high.

Send us a few stamps and we will tell you all about it.

The Radio Apparatus Co. - Pottstown, Penn., U. S. A.

The "ACE" Vacuum Tube Socket



$1.50 each complete with grid leak

The Ace Vacuum Tube Socket is designed to fit the Standard four prong vacuum tube. The top part consists of a finished aluminum casting, mounted on a formica base ¼ inch thick. This base will not break under any condition of service, as moulded composition bases will. Heavy phosphor bronze springs are mounted on the under side of the base for connection to the tube prongs.

This is the only vacuum tube socket on the market which has the grid leak built in as part of the socket. It may be used for back or front of panel mounting. The best socket on the market regardless of price.

We manufacture a complete line of Radio apparatus.

The PRECISION EQUIPMENT CO., Inc.

Manufacturing Engineers *Department B.*

2437 GILBERT AVE. **CINCINNATI, OHIO**

Don'ts for Experimenters

By Louis Kasper

DON'T use a file or rasp without a handle; it is dangerous.

Don't try to catch a chisel when you drop it. A nick in the chisel is better than one in the hand.

Don't forget that good tools are cheaper in the long run.

Don't fail to clean up shavings when you stop for the day; it lessens the danger of a fire starting.

Don't let your tools get rusty; keep them oiled.

Don't dabble with chemicals without first reading something on the subject.

Don't fail to keep a record of all experiments.

Don't use glue which is too thin. Fresh glue is best.

Don't expect to do good work with dull tools.

Don't strike wood with a hammer; use a mallet.

Don't set a plane flat on the bench; it is bad for the cutting edge.

Don't buy all your tools; make some of them. It is good experience.

Don't overlook non-essentials (so-called); sometimes they are the most important.

Don't add warm water when making glue; cold water is better.

Don't forget that old files make good chisels, etc.

Don't fail to be systematic; it pays.

Don't overheat your soldering iron.

Don't forget that a grinding wheel will pay for itself in a short time.

Don't fail to make drawings when necessary.

Don't polish a metal surface dry if you expect it to retain its lustre for any length of time; use oil.

Don't forget, when drilling a large hole in metal, that it will be done more accurately if first drilled with a smaller drill.

Don't use nails where strength is desired; screws are better.

Don't fail to carry a notebook—and use it.

Don't forget that glue may be made waterproof by adding an ounce of bichromate of potash per pint.

Dissolve potash and add slowly.

Don't be afraid to swap your knowledge with other workers.

Don't fail to mark all parts of a complicated piece of work; it may be necessary to take it apart some day.

Don't be too quick in throwing away old material; "junk" sometimes comes in handy.

Don't forget that cheap and good tools can sometimes be bought in a pawnshop.

Digitized by Google

Don't ridicule the other fellow's opinion; he may be right.

Don't forget that a piece of soft brick is good for polishing metal.

Don't fail to keep a scrap book.

Don't always talk about your particular line of work; give the other fellow a chance.

Don't forget that although a piece of work may be theoretically correct; it may not work in actual practice.

Don't cuss if things go wrong; there's a reason.

Don't get discouraged; keep plugging away.

Don't fail to join the A. S. E. E.

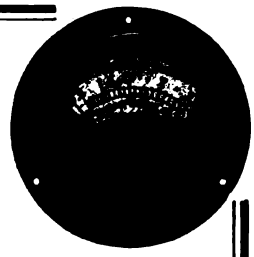
Utilization of Red-Brass Turnings

TURNINGS from red-brass works are frequently sold for a low price, even by establishments having facilities for casting in crucibles, because they are apparently not fit for casting. These turnings can, however, be profitably utilized for new castings as well as an addition to other charges. The process is as follows: The turnings are melted by themselves and during the melting process mixed with manganic oxide in the proportion of five parts of weight of manganese to 100 of turnings. In charging for melting it is advisable to cover the bottom of the graphite crucible 0.39-inch deep with manganic oxide; upon this is placed a layer of turnings about 1.18 deep, and so on until the crucible is full. During melting the impurities contained in the turnings settle on the surface and can be readily removed with a graphite ladle. The melt is best cast in buttons (square pieces). When cool each button is cut, in order to determine the qualities of the metal by the fractured surfaces. The metal melted in this manner shows a reddish, nearly coppery fracture, and is very tenacious and dense. An addition of manganic oxide not exceeding, however, 2½ per cent, to new material for melting is also recommended.

Cement for Fastening Brass to Glass

FOR cementing brass on glass the following recipe will be found to answer very well: Take resin soap—made by boiling one part of caustic soda and three parts of resin in five of water—and knead it into half the quantity of plaster of paris. This cement is used largely for fastening the brass tops on glass lamps. It is very strong, is not acted upon by petroleum, bears heat very well and hardens in one-half to three-quarters of an hour. By substituting zinc white, white-lead or slaked lime for plaster of paris it hardens more slowly. Water attacks only the surface of this cement. Of course, as it sets shortly after mixing, only as much as may be needed for immediate use should be made at one time.

Is Your Transmitter Really Tuned?



You may think that your transmitter is tuned, but you don't know unless your station is equipped with a reliable Antenna Ammeter.

These Roller-Smith Hot-Wire Ammeters were made for the U. S. Army Air Service for use on fighting planes.

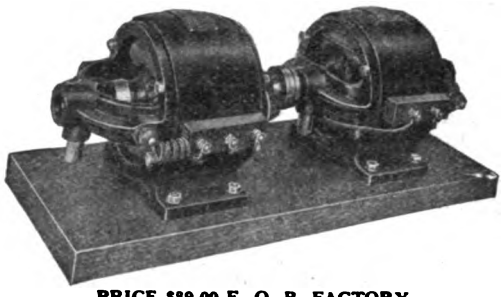
Regularly $13—Our Special Price $7

With the Armistice came a cancellation of contracts and these Ammeters, which had successfully passed the exacting Government tests, were returned to the manufacturers. Each is in perfect condition, packed in its original carton and ready for immediate shipment.

The scale reading is: 0-2.5 Amperes.
Shunt giving double or triple this range, 75c extra.

By buying the entire surplus we are able to sell these Ammeters at less than the Government paid for them in lots of one thousand. Better order one today as they are going fast. Remit by check or money order.

A. H. GREBE & CO., 71 Van Wyck Blvd., Richmond Hill, N.Y.



PRICE $39.00 F. O. B. FACTORY
SHIPPING WEIGHT 80 LBS.

INTERNATIONAL RADIO

HIGH VOLTAGE—DIRECT CURRENT

Motor Generators

This unit has a normal output of 100 watts (200 milliamperes at 500 volts) with a voltage range of 200 to 500 volts. The generator is compounded to insure constant voltage under variable load. It is furnished to operate on either D.C. or A.C.; a shunt motor being supplied for D.C. and an induction motor for A.C. The generator is equipped with a commutator of 48 segments reducing the commutator hum to a minimum.

Unit is complete with insulating coupling and mounted as illustrated on a finished base 8″ x 20″. Shipment can be made immediately.

The motor generator illustrated above is only ONE of the many newly designed radio specialties which we have ready for you. Write us for descriptive bulletins which are being issued covering all International Radio products. Address Dept. No. 21.

INTERNATIONAL RADIO TELEGRAPH CO.

326 Broadway **New York City**

A MARK of QUALITY

96-Page Book Catalogue Sent Free

WE have just issued a 96-page Book Catalogue listing about 2,500 of the most recent Scientific and Technical books. This is all the more welcome by reason of the fact that both the publishing and importing of books have been very much upset by the war, and many books can only be supplied with great difficulty. This catalogue will be sent to any address in the world, free on request.

Manuscripts Considered for Publication

The Book Publishing Department of the SCIENTIFIC AMERICAN will be glad to give an examination of any manuscript of Scientific or Technical nature. Submit as much of matter as possible, including illustrative material. There was never a better field for books of this nature than at the present time.

Scientific-American Publishing Company

Woolworth Building **235 Broadway, New York**

Mathematics Made Easy



The Arcgeoscope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.
Dept. U, L. J. LEISHMAN CO., Ogden, Utah

MODEL AND MACHINE WORK
INVENTIONS DEVELOPED
SMALL DEVICES MANUFACTURED
Before you make a decision, communicate with
KAUFMAN MACHINE CO.
1357 Odell Street New York

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Special For This Month

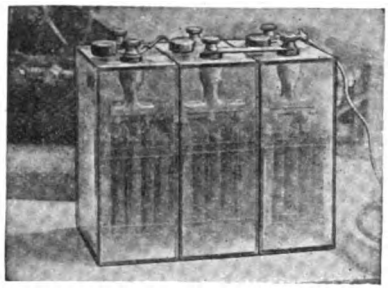
New type Variable Condenser. Low high frequency resistance. Mounted in seamless satin finish nickeled case. Bureau Standards scale. Furnished with calibrated curve, thus making excellent wave-meter when used in conjunction with our calibrated inductance units..... $10.00
Same condenser, unmounted, for panel use..... 7.00
Copper foil, mica dielectric Stopping Condenser 1.50
Navy Type copper plated Leyden Jars for your Transmitting Set, .002 mf. 8.00

Send for descriptive literature on latest type Receiving Cabinets, calibrated inductance units in both Litz and solid wire, parts, etc.

THE COLIN B. KENNEDY COMPANY
Special Radio and Electrical Apparatus
140 SECOND STREET—Phone Kearny 5980 SAN FRANCISCO, CAL.

POROX STORAGE CELLS FOR
MODELS, ELECTRICAL, AND RADIO APPARATUS

Porox Storage Batteries are made up of separate 2-volt cells in PY-RA-LIN jars, designed for high efficiency, low weight, and long life. They are lighter, more powerful, last longer, and cost less than dry cells. Can be charged at home. Porox Cells are designed for the requirements of the



MODEL MAKER AND EXPERIMENTER

2 volts, 10 amp.-hrs., 3 x 1¾ x 4¼ ins. 3.75
2 volts, 15 amp.-hrs., 3 x 2⅜ x 4¼ ins. 4.60
2 volts, 16 amp.-hrs., 3 x 1¾ x 6 ins... 4.60
2 volts, 25 amp.-hrs., 3 x 2⅜ x 6 ins... 5.20

Any number of cells put together for any required voltage. Batteries are also furnished in oak cases for ignition and lighting.

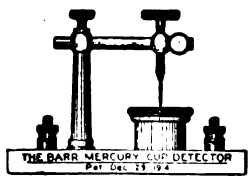
ALBERT MULLER,
8758 Queens Boulevard,
JAMAICA, LONG ISLAND, N. Y.

DO YOU LIKE TO SEE WHAT YOU BUY?

Don't buy blindly. Come to the busiest wireless store in New York City and see what you are getting. It is worth while to wait a day if it isn't convenient to stop in just when you want something. You can see the best apparatus from all the manufacturers, de Forest, Grebe, Arnold, Clapp-Eastham, and others. Complete instruments, parts—everything for the radio experimenter. Be sure to see our transmitting equipment before you buy any new apparatus. If you live away from New York, send 10c, for our new catalog. Our service to distant customers makes mail order buying quick and easy.

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.
235a Fulton Street New York City

THE BARR
Mercury-Cup Wireless Detector



The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Co.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct.

Instantly adjustable at a constant pressure.

For full information and price—write
The Barr Mercury-Cup Detector, Dept. C, The Wyoming, Washington, D. C.

A Mechanical Vacuum Cleaner

(*Continued from page* 211)

shown in the photograph, but is to be screwed to the side and top of the gear box. It is made of sheet iron or tin, the shape and dimensions being in Fig. 13. The gearing gives a fan speed of twenty revolutions of the fan to one of the driving wheels, and as the latter will turn about 150 times a minute when the cleaner is in use, we get a fan speed of close to 3000 rev. per minute, showing the necessity for a correctly balanced fan. This speed does not equal that of the electric cleaners, which runs to 5000 r.p.m. and over, and therefore will not produce as strong a vacuum, but will be found very satisfactory if the electric current is unavailable, and will take up a great deal of dirt.

In order to be able to remove the debris taken up by the brush, which does not pass through the fan, the bottom board of the floor box is hinged at the back, and held by a couple of latch hooks, and can be dropped when desired. This board, which does not show in the photograph of the inside of the floor box, is 5½ in. wide and 8½ in. long, and is made of ¼ in. pine, with two cross braces of ¼ in. stuff, 1 in. wide and 4½ in. long, nailed to the inner side to prevent warping.

A TEXTBOOK ON HEAT ENGINES, by Prof. Jamison and Ewart S. Andrews. Size 8 x 5½ inches; 500 pages, bound in cloth; price $3.00. Published by J. B. Lippincott Company, Philadelphia, Pa.

Many of our older readers will not need any introduction to Prof. Jamison's well-known treatment on heat engines. In the revising of Prof. Jamison's standard textbook it was found necessary to include so much new material that the treatment had to be extended to two volumes.

In the 26 chapters, the entire development of the steam engine, from its earliest form, is covered. It includes the laws of heat as applied in the construction of steam engines; a thorough study of all the forms of steam engines now in use and all collateral machinery such as pumps, valves, governors, etc. The book is filled with important diagrams, folding plates and drawings to illustrate the different problems and subjects presented. The appendix of the book contains valuable tables and examination questions used by the Institute of Civil Engineers.

For those who desire one of the most complete books on steam engineering this book will surely meet their needs. It is a thoroughly practical, authoritative and worthy treatment.

Digitized by Google

DE FOREST

Here's a Receiver With Eight Distinct Advantages

DeForest Agencies are located in all Principal Cities. Ask your regular Electrical Dealer to get you DeFOREST Apparatus.

A complete, compact and inexpensive Receiving Set having improvements and refinements which increase efficiency and eliminate many objectionable features of receiving apparatus.

No longer is it necessary for you to have two or three expensive, inconvenient and cumbersome tuners spread all over your operating table when working all wave lengths. With this new DeFOREST tuning system you can work any and all wave lengths with the one tuner shown at the right. This Set has distinct advantages of minimum table space and of convenience in coupling not equaled in any other type of apparatus. The entire Set is complete in the two cabinets shown here. The Genuine DeFOREST "Honey Comb" Coil System of Tuning is employed—no superior system has ever been invented.

This is a new DeFOREST production embodying a unique and superior tuning system. Possession of this Set means more efficient and satisfactory operation; more pleasure and practical benefit for every Amateur. Its price is remarkably reasonable for the quality of apparatus and the distinct advantages the Set offers. Find out more about it at once—

These Eight Advantages

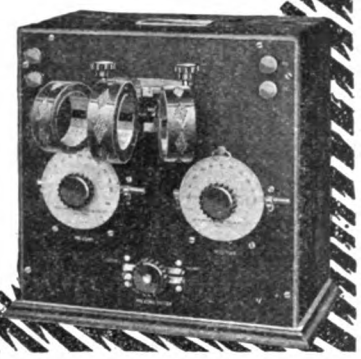
are not duplicated in any Receiving Set at double the price:

1—Responds to any wave length, 150 to 25,000 meters.
2—More flexible in coupling.
3—Lower distributed capacity; less high frequency resistance and decrement values.
4—Eliminates cumbersome switches, inefficient taps and losses from dead ends.
5—Vernier Air Condensers of unusual design.
6—Signals come in louder and clearer.
7 Superior in efficiency, workmanship, convenience and appearance.
8—Requires minimum table space; note sizes of cabinets.

Combination Audion-Ultra Audion and One-step Amplifier; Type P-300. Size 12½"x9⅜"x7⅝". Price, $73.50. Vacuum Tubes, $7.00 each extra.



Tuner; Type T-200. Size 13⅜" x12½"x8". Price, $77.50 without Coils.



Send for a DeFOREST Manual

A 56-page book containing full information about this and many more DeFOREST instruments, as well as giving much useful information for the Amateur. Mailed anywhere upon receipt of 10 cents.

DE FOREST RADIO TELEPHONE AND TELEGRAPH CO.
Inventors and Manufacturers of High Grade Radio Apparatus
1403 Sedgwick Ave.
New York City

PERFECTION TUNERS

WONDERFUL RESULTS-UNIQUE DESIGN

20,000 Ms—Hook up on bottom. Involute coils—Beat the Honeycomb. XDA—comes in on 1st tap—N.S.S. on 4th. Any aerial—overhead, underground or loop. Size 4¾ x 4¾ x 2⅛. Formica top. Nickel finish. Weight 2 lbs. 200 M. Regenerative tuner same size but with tickler coil and 10 taps P & S. Good for wireless phone and relay work. Every instrument tested by old 9xE. Send for bulletin.



TRESCO DAVENPORT, IOWA
$15.00 DELIVERED TO YOU

RADIO AMATEURS—HERE IS THE VARIABLE CONDENSER YOU HAVE BEEN LOOKING FOR—AT A PRICE YOU CAN AFFORD TO PAY

The best of materials and workmanship. Bakelite end plates. Heavy aluminum plates and accurately machined spacers. Copper ribbon connection to movable plates. Extremely rigid construction.

PRICES

2 plate Vernier	$1.85	23 plate, .0005 m.f. max. capacity	$3.25
7 plate, .0001 m.f. max. capacity	2.15	31 plate, .0007 m.f. max. capacity	3.90
13 plate, .0002 m.f. max. capacity	2.50	43 plate, .0010 m.f. max. capacity	4.75
17 plate, .0003 m.f. max. capacity	2.85	63 plate, .0015 m.f. max. capacity	6.75

Include postage for one pound.

THE WIRELESS SHOP
A. J. Edgcomb
511 West Washington St., Los Angeles, Cal.

EVERYDAY ENGINEERING MAGAZINE
2 WEST 45th STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for.....years at $1.50 per year (Canada, $1.75; foreign, $2.00). Please let this start with the..... (Date of issue) issue. I enclose $....., and according to your special offer send me copy of book checked off.

Name .....
Street .....
City .....
State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS
Check off title desired here

1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google

To cut down the cost per cut

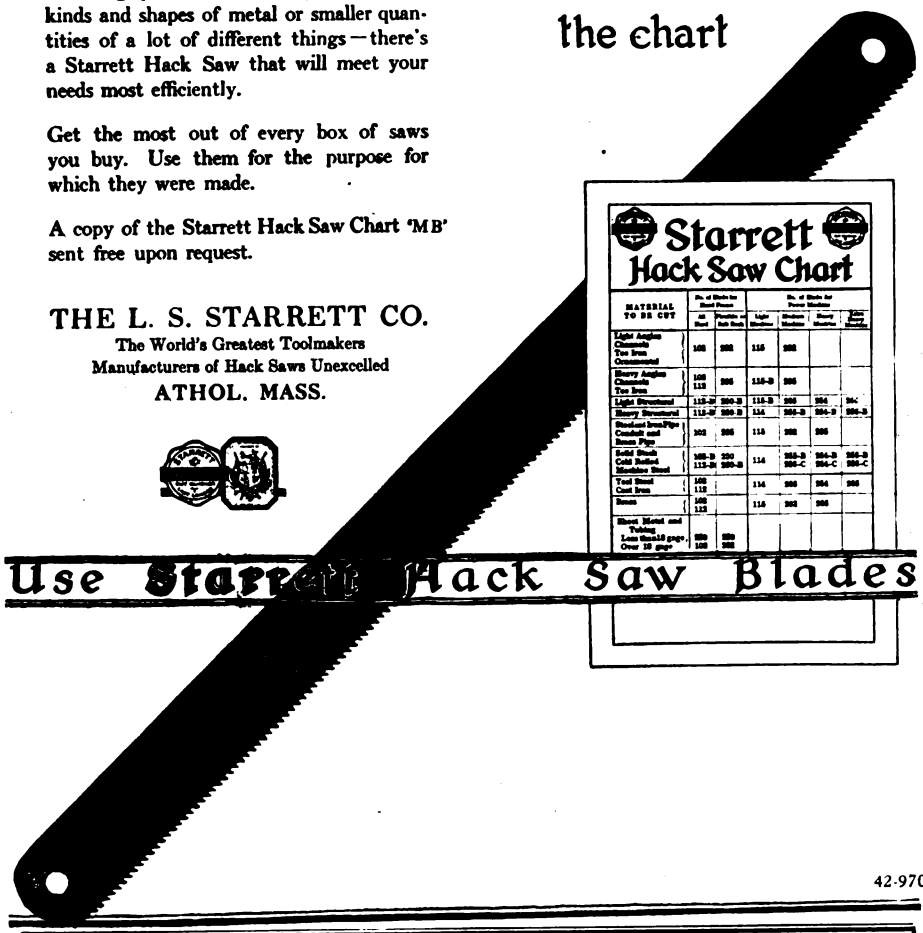
Follow the Chart

Make your hack sawing just as efficient as any other machine tool operation. Choose your blade according to your work. You can't cut cold-rolled and heavy angle iron with the same blade without a waste. Whether you are cutting by power or by hand, big quantities of a comparatively few kinds and shapes of metal or smaller quantities of a lot of different things—there's a Starrett Hack Saw that will meet your needs most efficiently.

Get the most out of every box of saws you buy. Use them for the purpose for which they were made.

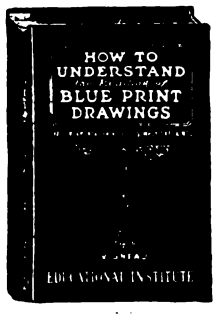
A copy of the Starrett Hack Saw Chart 'MB' sent free upon request.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



Use Starrett Hack Saw Blades

42-970



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

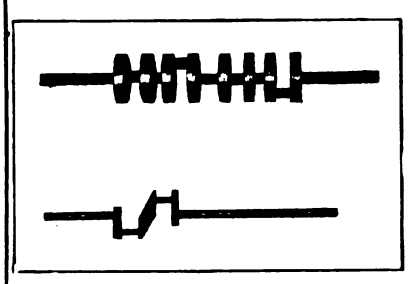
Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr.,
U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE, YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
180 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 132 Rowland Bldg., Detroit, Michigan



CRANK SHAFTS

For Model Steam and Gas Engines Our Specialty—Any type or number of throws to specification. Also needle valves for blow torches. Quotations on receipt of specification.

Send Stamp to

MODEL MACHINE SHOP CO.
415 E. 71st St. New York

Green Coating on Zinc

ZINC articles may be provided with a permanent dark or light green coating resembling enamel as follows: Dissolve 50 parts of hyposulphite of sodium in 500 of boiling water, and at once pour the solution in a fine stream into 25 parts of sulphuric acid. The milk of sulphur that separates will soon ball together in lumps and settle. The hot liquid containing sulphate of sodium and sulphurous acid is decanted and the cleansed zinc placed in it. In a short time it will acquire a very brilliant light-green coating, which only needs to be washed and dried. By exposing it for a longer time to this hot bath the coating grows thicker and the color darker and more brilliant. To insure a fine, brilliant deposit the temperature should not be allowed to fall below 145° F. By dipping the articles thus treated in diluted hydrochloric acid (one acid to three water) sulphuretted hydrogen is evolved, and this enamel-like coating loses its lustre and becomes lighter in color. Aqueous solutions of aniline colors have little effect upon this dull surface, and none whatever on the brilliant coating.

The effect of marbling may be obtained by moistening the gray zinc and applying hydrochloric acid in spots with a sponge, then rinsing off and, while still wet, flowing over it an acidified solution of sulphate of copper which produces the appearance of black marble. As this has a dull surface, it should be varnished.

By adding 15 parts of chrome alum and 15 more of the hyposulphite to the above solution, the article treated will take on a *brownish* color.

Lacquer for Tin Foil

DISSOLVE 7 oz. of shellac in one quart of alcohol, and filter the solution. Allow the slime remaining upon the filter to drain off, covering the funnel with a glass plate to prevent as much as possible the evaporation of alcohol. To the shellac varnish thus obtained add 3½ oz. of best white gum elemi and 14 drachms of Venetian turpentine, and let the whole stand in a moderately warm place, stirring frequently. Then filter, press out the residue, consisting almost entirely of gum elemi, and add it to the filtrate. The varnish thus obtained may be colored as desired.

To Bronze Small Brass Articles

OXIDE of iron, three parts; white arsenic, three parts; hydrochloric acid, thirty-six parts. Clean the brass well to get rid of grease, etc., and apply with a brush until the desired color is obtained. Stop the process by oiling well, when the article may be varnished or lacquered.

Digitized by Google

Useful Books

Complete Practical Machinist
by Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations
Price $3.00

Metal Worker's Handy-Book of Recipes and Processes
By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations
Price $3.00

Techno-Chemical Receipt Book
Edited with Additions by Wm. T. Brannt and Wm. H. Wahl

This well-known Receipt Book is a mine of accurate information that everyone may work to great advantage. It is encyclopedic in range, yet gives only the best formulas for each preparation or operation, and thorough tests by competent men guarantee their intrinsic merit.

A compact and reliable collection of approved receipts and processes, containing thousands of receipts covering the latest, most important and most useful discoveries in chemical technology and their application in the useful arts and industries. It is indispensable to every practical man and contains 500 pages, closely printed, giving an immense amount of matter on a great variety of subjects. Every care has been taken to select the very best receipts of each kind and there are few persons, no matter in what business or trade they may be engaged, who will not find in this volume something of use and benefit to them. The library of the laboratory, factory or home is not complete without a copy of this handy and useful book of reference.

516 Pages. 78 Illustrations
Price $2.50

Friction, Lubrication, Fats and Oils
By Emil F. Dieterichs

When we realize that it is no figure of speech, but a bald statement of fact, to say that lubrication alone keeps the wheels of industry turning, then we must look respectively upon this as a question of vital importance in this mechanical age. The author, himself a chemist and an inventor and manufacturer of lubricants, wrote this manual for the mechanic and manufacturer of ordinary education, that the busiest man might learn the main facts of friction, the origin and charteristics of fats and oils, their uses, their adulterations, their practical testing and the best ways to make them serve his own particular ends.

Price $1.50

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.
Publishers of Mechanical and Industrial Books
110-116 Nassau St., New York, N. Y.

To Cleanse Guns With Petroleum

CLEANSING a weapon with fats and oils does not entirely protect it from rust, the so-called drying oils get gummy and resinous, while the non-drying oils become rancid, and by exposure to the air acids are formed, and these attack the iron. For these reasons petroleum is to be preferred for this purpose. Petroleum is as great an enemy to water as are the fatty oils, and hence it keeps away the water from a gun-barrel covered with it. It is very essential, however, that the petroleum employed be perfectly pure, for impure oil, such as is often met with in commerce, attacks the metal. Care must also be had not to allow it to come in contact with the polished stock. When about to clean a gun, some tow is wrapped around the ramrod and enough petroleum poured upon it to thoroughly moisten it; it is then pushed in a rotary manner through the barrel and back a dozen times, and the tow taken out and unrolled, and the upper and lower ends of the barrel rubbed with the clean part, after which it is thrown away. This removes the coarser portion of the dirt. A round brush of stiff bristles, and fitting the barrel, is now screwed to the ramrod, then moistened thoroughly with petroleum and twisted into the barrel, running it back and forth at least a dozen times, thus loosening the dirt that is more firmly attached. The first operation is now repeated, except that the tow on the ramrod is left dry, and the rubbing with this must be continued in all directions as long as it comes out soiled. The use of wire brushes is objectionable for cleaning guns, as the numerous steel points cut into the tube. Only soft tow, hemp, woolen rags, or the like, should be used, as the petroleum dissolves the dirt sufficiently.

Welding of Platinum

PLATINUM does not oxidize when in a red hot state and may be welded without the use of welding powder by simply placing the red hot pieces upon each other and uniting them by blows of the hammer. Nevertheless the welding together of two pieces of platinum is a difficult operation, since platinum possesses the property of yielding up the absorbed heat with great rapidity and cooling off to such an extent that the two pieces are no longer soft enough to be united. This cooling off takes place with such rapidity that the joining of the hot pieces must be hastened as much as possible, it being advisable to allow the flame of the hydrogen-gas blow-pipe to act upon the pieces of platinum during the entire operation of welding.

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6067-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE ☐ Spanish
Sheet Metal Worker	Poultry Raising ☐ French
Navigator	Automobiles ☐ Italian

Name .....
7-25-19
Present Occupation .....
Street and No. .....
City ..... State .....

Battery Charging Your Biggest Money-Maker

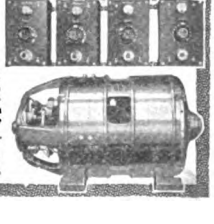
$150 to $350 Clear Profit a Month with this HB-32 Battery Charger

You can recharge 32 6-volt auto batteries, or equivalent in 12- or 24-volt batteries, at one time, for 10c to 15c each. Customer pays 75c to $1.50. Figure the profits yourself. Others are making BIG PROFITS with HB Battery Charging. Why not YOU? Get busy NOW—add those extra profits to your income.

Small Investment Puts this Money-Maker in Your Garage

Balance on easy monthly terms. Outfit easily pays for itself. Absolute Money-Back Guarantee. No burn-outs, or renewals. Easy to install and operate. Only attention needed is occasional oiling. Write TODAY for full information.

HOBART BROTHERS COMPANY
Box EE123 Troy, Ohio
Successful Mfrs. Since 1893



Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.

Free Book on PATENTS

Write today for a Free Copy of "How to Obtain a Patent." Contains valuable information and advice to inventors. Tells how to secure Patents. Send model or sketch of your invention for opinion of its patentable nature—Free. (20 years experience.) Talbert & Talbert, 4368 Talbert Bldg., Washington, D. C.

How to obtain a Patent

PATENT-SENSE
The Book for INVENTORS and MANUFACTURERS
SIXTH EDITION

"The Book for Inventors and Manufacturers"
SIXTH EDITION
By return mail FREE.
Write LACEY & LACEY
Dept. S. Washington, D.C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

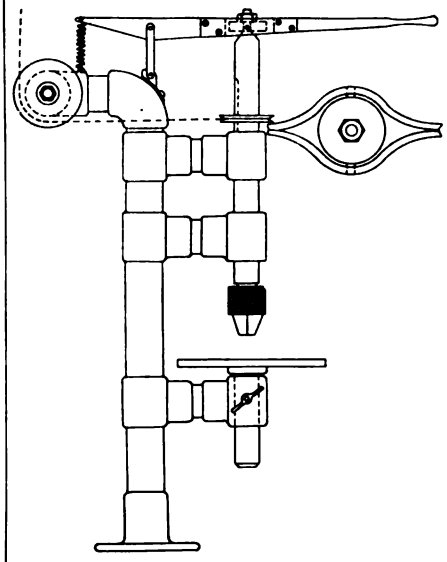
PATENTS
Record your invention. Upon request, I will forward to you my form "Fixing the Essential Dates of Invention", together with full information concerning its use and the best way to secure patent protection. Prompt, personal efficient service, by an attorney-at-law, having over twelve years experience in patent matters. Reasonable pre-war charges.
B. P. FISHBURNE,
321 McGill Bldg., Washington, D. C.

Making Your Invention a Financial Success
How best to dispose of your invention
What kind of agreements to make for your protection
What kind of offers and mistakes to avoid
Valuable tables and other data
By M. G. Delaney, an experienced Inventor, in
The Inventor's Manual of Valuable Information
$1.50 per copy, postpaid
Additional information and Table of Contents will be mailed on request.
G. E. Perry Co., Publishers, 1328 Broadway, New York

A Simple Drill Press

The drawing is simple and explains itself. The frame work is made of pipe fittings and designed to any size that suits the builder. I used ½ in. The spindle was made of cold rolled steel slightly smaller than the opening in the pipe, turned or bored to fit the chuck. I used a chuck with a tapered hole, and turned the spindle to suit, as it is easier to turn the spindle than to bore it.

The table was a piece of cast iron faced off and bored to fit a cold rolled shank, which is the same size as the spindle. The bearings were made by placing the spindle through the three fittings, parallel with the upright and pouring with hot lead or babbitt.



A simple drill press

The feeding mechanism is plainly shown and is very simple to make. The detail explains it more fully. The spindle being keyed to the pulley by means of a long spline in the spindle, thus allowing the pulley to slide as the spindle is raised or lowered.

The drawing shows only one set of pulleys, as I had a motor set directly at the rear of the base, being a direct drive, but it is a simple matter to place two pulleys at the bottom joint, one loose and one for driving.

STUDIES IN THE CONSTRUCTION OF DAMS: EARTHEN AND MASONRY, by Professor E. R. Matthews. Size 6 x 9 inches; bound in paper; pages, 30 diagrams. Published by J. B. Lippincott Company, Philadelphia, Pa.

This book is intended to be of assistance to engineering students who may be preparing for the society membership examination of civil engineering societies or other similar examinations. The text takes the question and answer form, which has been found by experience to be a most useful method of enabling the mind of the student to grasp the essentials of the subjects involved and at the same time to learn how to express his knowledge.

Genuine Armstrong Stocks and Dies



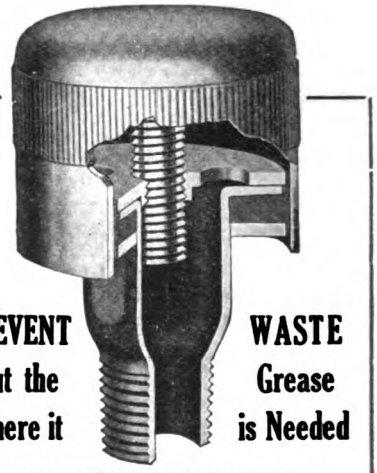
Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.

Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.

Send direct to us if your dealer cannot supply you.

Descriptive Catalog on Request

The Armstrong Manufacturing Co
701 Knowlton Steet Bridgeport, Conn.



PREVENT WASTE
Put the Grease
where it is Needed

THE BRIDGEPORT
Center Thread Grease Cup

This cup will squirt more grease than any cup of the same size made.
Equip your machine, auto or boat with this new type of grease cup, one that does not leak, that cannot be cross-threaded and that forces the grease to the bearing points.
The cleanest Grease Cup made.

Send for Circular and Price List

THE GARRISON COMPANY
348 George St. Bridgeport, Conn.

Big Profits Every Month in Battery Charging

MAKE BIG PROFITS IN WINTER BATTERY CHARGING IN LARGE AND SMALL GARAGES

Steffes & Steffes Garage, Chilton, Wisc. (pop. 1500), "Income per month $125.00, cost $15.00"— Adams Cooper Sales Co., Ft. Smith, Ark. (pop. 27,000), "Income per month from HB Charger is $120.00—cost $16.00." Alamosa Battery & Starter Co., Alamosa, Colo. (pop. 3,000), "Average income per month $275.00, average bill per month, $14.00 for current."

This HB 500 Watt Charger Can Bring You Big Profits This Winter

Small cash payment, balance on easy monthly terms. HB Absolute Money-Back Guarantee recharges 1 to 8 6-volt batteries for 10c to 15c each, customer pays 75c to $1.50. No burnouts, no expensive renewals: steady, reliable service. Easy to install and operate. No electrical knowledge required. Pin this ad to your letterhead and mail TODAY for information.

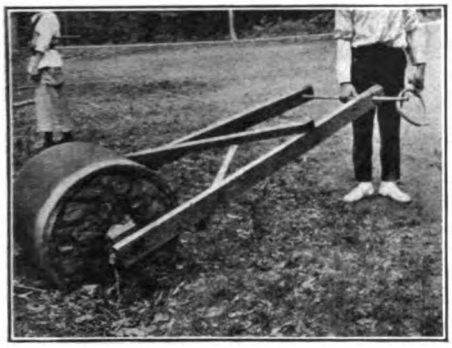
HOBART BROTHERS CO.
Box EE122. Troy, Ohio.
Successful Mfrs. since 1893.



Digitized by Google

An Improvised Roller

AN association located in the Adirondacks desired to place a tennis court on the side of a mountain, where it would be very hard to transport a heavy iron roller. The ground could be easily leveled off, but how to get a roller in position to keep the court in shape was the problem. To meet the need an ingenious mind devised an improvised roller that has done service for several years. What is more, this roller was made on the spot, cost almost nothing and takes care of the tennis court as well as an expensive iron roller. Such an improvised roller can be constructed by the amateur builder for grading and rolling the lawn, leveling and packing the dirt in a newly made driveway, smoothing any surface of the ground, and the many general duties demanded of the hand roller.



An improved roller made with ordinary materials

The part that rolls on the ground for this home-made roller was made from a short length of tile two feet long and eighteen inches in diameter. The piece of tile was easily carried to its destination on a pole supported on the shoulders of two men. The center for this tile roller consisted of pieces of stone and rocks picked up on the spot and held in place by cement.

To locate the center of this tile in order to place the shaft in its central position was something of a problem. This was done by laying out with a compass a circle of eighteen inches on a board platform and then placing the tile on the circle marked out. Up through the center a half-inch pipe thirty inches long was placed to act as the shaft. The space between this shaft and the sides of the tile was filled with concrete in which was imbedded coarse gravel and stones. When this was dry the roller was mounted on a frame convenient for use. The only cost of this roller was for the cement, and but little was required, the remainder of the material being picked from the junk pile or found on the spot.

F. E. BRIMMER.

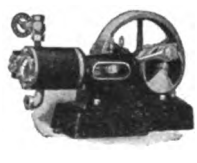
Difference Between Heartwood and Sapwood

IN over 300,000 tests which have been made at the Forest Products Laboratory, Madison, Wisconsin, on the various species of wood grown in the United States, no effect upon the mechanical properties of wood due to its change from sapwood into heartwood has ever been noticed. Any difference in the strength of heartwood and sapwood can usually be explained by the growth and density of the wood.

In other than mechanical properties, there are differences between heartwood and sapwood which have an important bearing on their use for various purposes. The sapwood of most American species is considerably less resistant to decay than the heartwood, and where the wood used without preservative treatment in situations which favor decay, the sapwood is likely to have a much shorter life. In these particular cases, therefore, strength requirements may have an indirect bearing on the choice between heartwood and sapwood, inasmuch as wood infected with decay is likely to have its strength properties, particularly that of shock resistance, greatly reduced.

Electric Steel in Germany

OF the total output of crucible and electric steel in Germany, for 1917, statistics show that 349,480 tons or 62 per cent. was produced in the electric furnace. One-third of this quantity was produced in induction furnaces and two-thirds in arc furnaces, the induction furnace seemingly being preferred by the producers of high-quality steel. The average capacity of the electric furnaces built in Germany during the war was 6.7 tons.



Small Steam Engines & Boilers, Gas & Gasoline Engines ½ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.

MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.



The Mysterious Ghost

Perfectly visible in the dark. Affords great amusement to the old and young. Never gets out of order. Lasts indefinitely. Postpaid. Life size 40c; half size 20c.

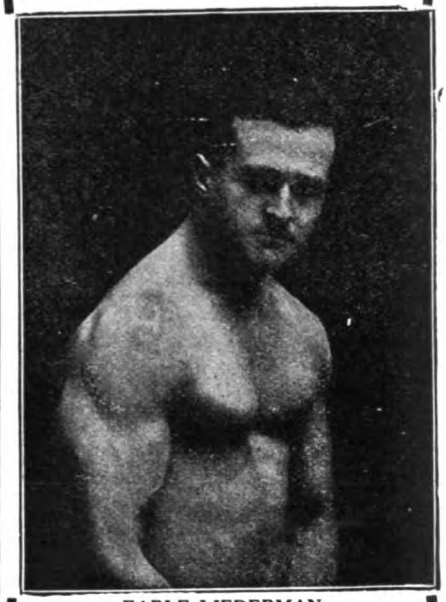
Canadian Chemical Products Co.
Box 133 St. John, N. B.

UmakeM Lathe You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $25. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

You are Judged by Your Appearance

The world sizes you up by your own opinion of yourself—as expressed in your looks, your actions, and the force of your ambition. Look at the photographs of any of the world's business leaders. Note that clean-cut, sharp, alert look in each one's eyes, the firm tilt to the head and chin, the square set of the shoulders. It's the strong, virile man, the man of tireless energy, that gets to the top.

You can't be alert, you can't have full control of your faculties, you can't have that inexhaustible supply of vitality and energy that means success in life unless you have PERFECT HEALTH. Your physical condition is the root of your whole life. Build up your body and muscular strength and you build up your mind and vitality and insure success.



EARLE LIEDERMAN
The Acme of Physical Perfection

There is a Short-cut to Health

I have found it and applied it to my own body and proven its results. And I have trained many of the world's strongest men by this same method—taken them when they were mere physical wrecks and made powerful athletes of them. I can do the same for you. No need for you to drift aimlessly along—merely existing. Get a grip on yourself. Resolve right now to start on the road to success—the first step of which is better health.

Send for MY NEW BOOK
"Muscular Development"

It tells the secret. Handsomely illustrated with 30 full page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN
Dept. 706, 203 Broadway, New York

EARLE E. LIEDERMAN,
Dept. 706, 203 Broadway, N. Y. City.

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write or print plainly.)

Name.....

Address.....

City.....State.....

Digitized by Google

Just Published

The Everyday Engineering Handbooks

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man—the Mechanic and the Radio Experimenter

ILLUSTRATED BY SPECIAL DRAWINGS AND PHOTOGRAPHS

HOME MECHANIC'S WORKSHOP COMPANION



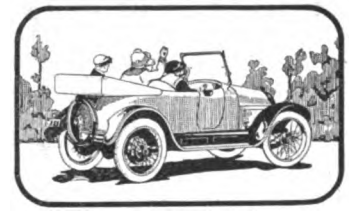
TELLS HOW TO DO MANY USEFUL ELECTRICAL AND MECHANICAL THINGS INCLUDING NUMEROUS SHOP KINKS

By ANDREW JACKSON JR.

①

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

HINTS AND TIPS FOR AUTOMOBILISTS



MONEY SAVING HINTS ON CARE AND OPERATION ALSO LOCATION AND REPAIR OF ROADSIDE TROUBLES

By VICTOR W PAGE

②

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH STREET, NEW YORK

HOW TO MAKE & USE A SMALL CHEMICAL LABORATORY



AN INTRODUCTION TO THE STUDY OF INORGANIC CHEMISTRY WITH DIRECTIONS FOR THE CONSTRUCTION OF A SMALL LABORATORY

By RAYMOND FRANCIS YATES

③

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.

This treatise includes a compilation of useful suggestions that cannot fail to interest the handy man and while it is not intended for mechanical experts or scientists, it will prove to be a veritable store of information for any one who desires to rig up a small shop where odd jobs can be carried on.

The subject matter is divided in five parts as follows:

Chapter 1—The Home Workshop and Its Equipment. Chapter 2—Special Tools and Shop Expedients. Chapter 3—Useful Home Appliances. Chapter 4—How to Do Things Electrical. Chapter 5—Helpful Recipes and Formulae. The illustrations are especially clear and all suggestions are further amplified or made more easy of comprehension by hundreds of thumb nail sketches made by the author.

For the Automobile Owner or Driver

This volume is replete with interesting facts compiled by an expert from a mass of information furnished by the Service Departments of leading automobile makers on operation, upkeep, lubrication, location of troubles and simple repairs of automobile parts. The instructions given are concise and to the point and no information that will help in the everyday operation of automobiles is omitted.

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints and a brief simple exposition of location and remedy of roadside troubles apt to occur under ordinary operating conditions.

To permit of logical presentation, the subject matter is divided into four chapters. Chapter 1 deals with the Control and Operation; Chapter 2, Systematic Inspection and Lubrication; Chapter 3, Power Plant and Auxiliary Groups; Chapter 4, Automobile Care and Maintenance Suggestions.

For the Student Chemist and Experimenter

The treatise covers all of the essentials of elementary chemistry. The law of definite proportions, solutions, crystalloids, colloids, electrolysis, etc., are explained. The second part of the book is devoted to chemical and electro-chemical experiments. Only those experiments that will tend to broaden the readers' knowledge of chemistry in general have been chosen.

The third part of the book describes the construction and fitting out of the home chemical laboratory. Directions for the construction of the many simple pieces of chemical apparatus are given. A chemical balance, ring stand, electric furnace, etc., are described in detail, with working drawings. The manipulation of chemical glassware is also treated.

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.

A SPECIAL OFFER TO READERS OF

ANY ONE OF THE ABOVE VALUABLE BOOKS WILL BE

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOUR

Fill Out the Special Blank on Page 243 of this Issue. Check Off the Title Desired and Mail with Your Remittance to

Digitized by Google

Just Published

Should be in Every Practical Man's Library

All of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest

RADIO BOOKS CONTAIN MANY WIRING DIAGRAMS

SOLDERING & BRAZING



A USEFUL HANDBOOK FOR MECHANICS

By
RAYMOND FRANCIS YATES

④

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work—something that he may heretofore have forgotten.

Hard soldering, for some reason, is not generally known. Hard soldering, however, is very important and must be used in all cases where soft solder does not possess sufficient strength. Hard soldering and solders are thoroughly covered in the book. Nothing has been omitted that will enable the mechanic to apply hard solder successfully.

Brazing and all of its important ramifications are treated in detail. Brazing, like hard soldering, is a process little understood by many mechanics. The book "Soldering and Brazing" is divided in five parts as follows: Part I—Soft Soldering; Part II—Hard Soldering; Part III—Brazing; Part IV—Heating Devices; Part V—Soldering Notes.

RADIO HOOK-UPS



A BOOK OF THE MOST ADVANCED CIRCUITS OF RECEIVERS, AMPLIFIERS AND TRANSMITTERS FOR DAMPED AND UNDAMPED WAVE WORK:

By
M. B. SLEEPER

⑤

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuits for tuning coils, loose couplers, capacity coupling, variometers and other equipment for receiving long and short damped and undamped waves; damped, undamped and modulated wave transmitters using buzzers, spark coils, transformers, arcs and vacuum tubes, telephone transmitters, laboratory oscillators, vacuum tube characteristic measuring circuits, wave-meters, and audibility meters—in short, diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details. Spaces are also provided for notes on the results obtained with each diagram. This arrangement, coupled with the skillful selection of the circuits, makes Radio Hook-ups an essential to every radio experimenter or operator.

DESIGN DATA FOR RADIO TRANSMITTERS & RECEIVERS



SIMPLE METHODS FOR DESIGNING APPARATUS ACCORDING TO ADVANCED AND APPROVED PRACTICE

By
M B SLEEPER

⑥

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH STREET, NEW YORK

For the Radio Engineer and Student

Far from being a collection of formulas, Design Data takes up in proper sequence the problems encountered in planning all types of receiving sets for short, medium, and long wave work, and spark coil, transformer, and vacuum tube transmitters operating on 200 meters.

Where formulas are difficult, tables have been worked out so that values can be found without the use of mathematics. The few formulas given are so simple that any school boy can solve them. The subjects are so arranged that, having decided upon the type of receiver or transmitter to be built, the reader can locate immediately the problems and solutions required.

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION

OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

EVERYDAY ENGINEERING MAGAZINE, 2 W. 45th ST., NEW YORK CITY

Digitized by Google



NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4 H. P., 110 volts, induction, full load start	$24.50
1/2 H. P., 110-220 volts, induction, full load start	$38.50
1/2 H. P., 110-220 volts, repulsion, for compressor	$46.50
1 H. P., 110-220 volts, repulsion, with sliding base	$67.50
2 H. P., 110-220 volts, repulsion, sliding base	$108.50
3 H. P., 110-220 volts, repulsion, sliding base	$124.50
5 H. P., 110-220 volts, repulsion, sliding base	$164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

6 volts, 10 amp.	$16.50
15 volts, 10 amp.	$21.00
40 volts, 6 amp.	$24.50
110 v, 2½ amp.	$24.50
40 volts, 12 amp.	$38.50
110 volts, 5 amp.	$38.50
40 volts, 25 amp.	$58.50
110 volts, 10 amp.	$58.50
Moving Picture Arc Generator	$85.00

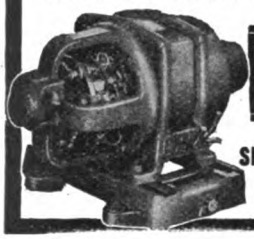
Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 R.P.M., complete with base and pulley.

½ H. P.	$42.50
1 H. P.	$59.50
2 H. P.	$72.50
3 H. P.	$84.50
5 H. P.	$102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt, 24 volts, without switchboard	$40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard	$68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard	$75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard	$85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard	$85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard	$110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard	$125.00

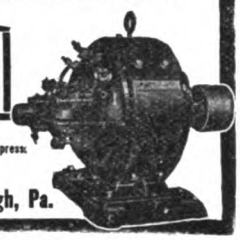
WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL 1/4 H.P. 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $19.75 EACH Reg. Value $22.50



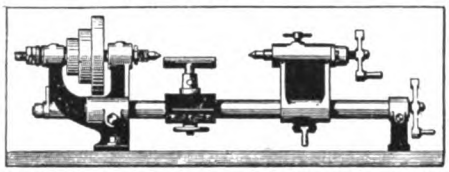
MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

6 INCH BENCH LATHE



ROUGH CASTINGS OR FINISHED MACHINE
Shop Tools and Equipment
DESIGNS FOR MODEL BOATS—Historic and modern—Drawings of famous 110 ft. U. S. Sub-chaser. Send stamp for catalog.
HUHN MFG. CO., 584 Elm St., Arlington, N. J.



THE MIDGET SLIDE RULE will solve any problem in addition, subtraction, multiplication, division and proportion. A Log-Log Scale gives any root or power of any number. Gives Logarithms. Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six decimals. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book 16 pages, 12 illustrations, is sent with each rule. Diameter 4 in. Made in two models: Metal (white coated steel), **$1.00**; White Celluloid **$1.25**. Leather Case **50c** extra. Your money back if you are not satisfied. Send for Catalogue of Slide Rules.

Gilson Slide Rule Co., Niles, Mich.

UmakeM **Airplanes** Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N. Y

USE HB BALL BEARING ELECTRIC MOTORS

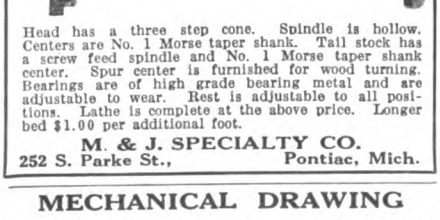
Lower Power Cost—Better Power
HB Ball Bearing Electric Motors save greatly on operating cost. More economical, more dependable, better in every way than gas engine. Trouble proof, built for heavy duty. Ideal power for factory, garage and machine shop.
$20 brings you any HB Motor. Balance on easy terms.



Sizes 1 to 15 h.p. A Size to meet Your Needs.
Service Department gladly advises on your requirements. Get their advice—FREE—simply state what machinery you wish to run and type of current available. Your power system planned for best results at least cost. Pin this ad to your letterhead and mail today for full information. Ask also about HB Battery Chargers, Generators, etc.

HOBART BROTHERS COMPANY
Box EE125 Troy, Ohio
Successful Manufacturers Since 1893

SPEED LATHE $7.00 Complete
Swing 7 inches 24 inch Metal Bed



Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

Protect Good Tools

Keep them safe from knocks, bangs, rust—yet handy and all together. The New Utility Chest illustrated is for garage and home use, for machinists, tool makers, masons, carpenters, repairmen, etc.

UNION TOOL CHESTS



19 Styles and Sizes
Write for Catalog. Prices and name of nearest dealer. Ask about "Satisfaction or Money-Back" Guarantee. If no dealer near you, write for special offer.

UNION TOOL CHEST CO., Inc.
34 Mill Street Rochester, N. Y.

MECHANICAL DRAWING

Successfully taught by mail. Learn to make and read drawings and become a Mechanical Draftsman. Fifty cents each lesson, pay as you go. No other expense. Complete drawing outfit valued at $20.00 free with the Course. One hundred blue-print lessons. Will assist you to secure good paying position when qualified. Send for particulars and sample lessons.

50¢ Per Lesson

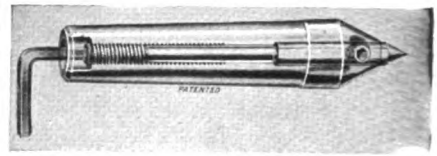
ALBANY INSTITUTE MECHANICAL DRAWING
Desk C, Lock Box 84, Albany, N. Y.

A Lathe Center With Adjustable Point

THE illustration shows the adjustable point lathe center now being marketed by a large manufacturer. The device is very simple consisting of four parts: the body, center point, adjusting screw and locking screw.

The body of the center is made of carbonized steel, but the adjustable center is made of high speed steel containing from eighteen to nineteen point tungsten drawn just enough to relieve the strain of hardening. The diameter of the point is limited to .-0005", but the hole in the center has no limit, thus making all points interchangeable.

Not only does the high speed steel point give from seven to nine times more production per grind than does the ordinary carbon steel point now in general use, but when it does become necessary to grind the new point there is a much shorter angle to be ground, and a much heavier feed can be used while grinding, as the high speed steel will stand much more friction heat without its temper being drawn. This makes it possible to reduce the time of the grinding operation from the usual fifteen or twenty minutes to one to two minutes.



As the point is gradually worn down it is adjusted with the adjusting screw, without the necessity of shifting the tail stock, and when finally worn out, one need only replace the small center point instead of scrapping the entire center as is necessary with the old center.

The new center can be used in either tail stock or spindle of lathe or grinder, and no job is too heavy for it.

D. G. BAIRD.

FROSTING GLASS

A good frosting for glass that imitates ground glass quite well is made up of the following: Sandarac, 18 parts; mastic, 4 parts; benzol, 40 parts, and ether, 200 parts. Clean glass thoroughly before and apply by pouring the mixture on the glass and flowing evenly.

TO PREVENT SCALE IN HARDENING DIES

It is possible to prevent the formation of any scale in the impression of fine jewelers' dies and the like, and retain the finished brilliancy of surface, by applying a mixture of powdered ivory black and sperm oil, mixed to the consistency of paste. It is only necessary to apply a thin coat.

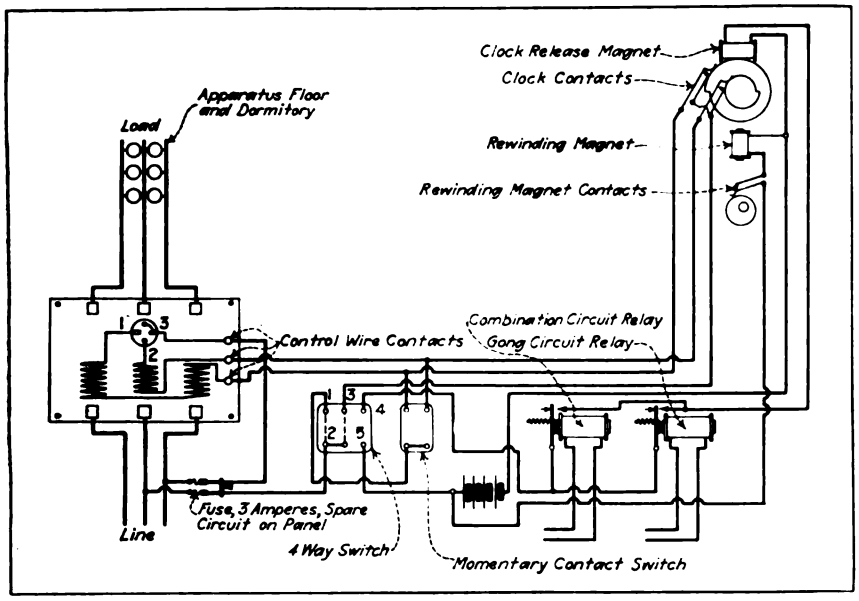
Digitized by Google

Automatic Lighting Mechanism For Fire-Houses

By John F. Rodgers

AN interesting appliance in use in some of the New York City fire-houses increases the celerity with which the men arise and dress with a night alarm and also eliminates the personal equation in an economy of light.

A clockwork mechanism, acting in conjunction with the alarm circuit and energizing the control wires of a Sundh remote control switch, at the first stroke of the alarm throws on the dormitory and apparatus floor lights. After a lapse of time sufficient to allow the men to dress and the apparatus to leave the floor, the switch, by means of the clockwork control, turns out the lights.



The accompanying diagram shows the action of the mechanism and the switch.

(G) is an electro-magnet in series with the gong circuit. (C) is an electro-magnet in series with what is known as the combination circuit, a secondary alarm which rings at the expiration of the gong alarm as a precaution against non-operation or misinterpretation of the gong alarm. Either of these relays, with the first stroke of the alarm, momentarily closes the battery circuit to the release magnet (R) which releases the cams shown just below this magnet. Revolution of these cams causes the outer of the clockwork contacts (P) to close momentarily, the pilot circuit attached to the line at (F), which enters the outer solenoids of the remote control switch through contacts (Y and Z), and, by action of the switch, to close the load circuit. Further revolution of the cams (after a lapse of time required for the men and apparatus to leave the house) causes the inner clockwork contact at (P) to close again, momentarily, the pilot circuit which this time, however, enters the remote control switch through contacts (Y and X) and energizes the central solenoid which trips the switch and throws off the lights.

The switch shown at (M) has two contacts (4 and 5) which, connected, close the battery circuit for operation of the clockwork mechanism. The battery circuit also energizes a magnet (R_1) which, controlled by contacts (R_2), acted upon by an eccentric attached to the spring of the clock, rewinds the mechanism.

The momentary contact switch shown at (O) is used for push-button control of the remote control switch in the event of failure of the clockwork control, by the man on watch at the desk.

The switch shown above the central solenoid of the remote control switch is used to throw the latter in or out of operation. The connections, while in operation, are from (1 to 3) and from (2 to 3), closing all the solenoids and control circuits to the point of the clockwork contacts.

Momentary contact is all that is necessary for the operation of the remote control switch as its action is caused, in either closing or opening, by tripping, and hence there is no necessity for the solenoid to be energized during the entire period of lighting.

Steady Resting a Splined Shaft

This suggestion will be found of value to those mechanics who are called on to do lathe work. It is simple yet useful to know, for it saves time and makes the task of steadying a shaft provided with a key way easier while working on it. The section of the shaft key way where it revolves in the rest is filled with babbitt metal hammered in and scraped to the circumference, and the provision of an unbroken surface permits the shaft to revolve smoothly in the bearings of the steady rest.



Gee! Ain't She A Peach?



—that's what your gang'll say if you win the prize.

We'll tell the names of winners in February. The names and addresses of fellows who won prizes for giving the best uses for the

Auto-Wheel Coaster

AND THE

Auto-Wheel Coaster

Maybe your name will be there. Better watch. Thousands of fellows entered the contest and the judges had a hard time picking the winners. They promised to let us know in time to tell you in February.

More Prizes Coming

Now, if you or any of your gang did not win you have another chance coming. We're going to have a series of contests this year—just the kind of contests you fellows will like.

And say—the prizes you can win will make the other fellows say—"Ain't She a Peach!" Keep your eyes open for these new contests. Send for our Monthly Magazine. You will like it. It is full of contest news—how to get in on Apto-Wheel contests, with suggestions to help you win. Just give the names of three coaster dealers in your town and state which one handles the Auto-Wheel. Then we'll send the Magazine and a FREE FELT PENNANT. Also the story about organizing an Auto-Wheel Club—with FREE CAPS for all members.

Buffalo Sled Co., 159 Schenck Street, N. Tonawanda, N. Y.
In Canada: Preston, Ont.



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-351 Chicago



AMERICAN TECHNICAL SOCIETY
Dept D-351
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

Digitized by Google

Triplane Breaks Altitude Record

ALL altitude records were shattered when Roland Rohlfs ascended to a height of 34,610 feet in his Curtiss Wasp triplane equipped with a K-12 400 horsepower engine. In an unofficial flight he reached a height of 34,200 feet. The latest flight was officially observed and confirmed throughout, and broke all previous records.

This last flight marks the fourth time that Rohlfs has ascended more than 30,000 feet in the same machine since last July, and in each flight he has beaten all competitors, by returning to the same field from which he started. On July 30th he made an official record of 30,700 feet. The highest credited record until this time has been held by Adjutant Casale, of the French army, who ascended 33,136 feet on June 14th.

The entire flight was made in one hour and 53 minutes. At the height of 34,610 feet the temperature was 43 degrees below zero, one degree warmer than it was at the height of 34,200 feet made on a previous flight.

The same pilot and machine broke all world's records for climbing by rising to an altitude of 19,500 feet in 9 minutes and 42.4 seconds. This feat was accomplished at Roosevelt Field, L. I., in his Curtiss Wasp triplane, and is about 2,000 feet per minute.

Airplane Fuel Pumps

IN the pioneer days of aviation, engines were low-powered and flights short and the gasoline system very simple. In the modern commercial plane, fitted with multiple engines required to run several hours without replenishment and perhaps flying across country with but few landings places between, the problem becomes more complex and the fuel supply system must be completely reliable.

Pumps are of many designs, varying from the simple plunger type to vane pumps and gear pumps. These are sometimes driven by a flexible shaft from the engine. Pressure pumps have been almost totally discarded. Pumps which are geared right on to an engine are not always located in the best possible way for the rest of the system. Flexible shafts are one continuous source of worry.

European designers seem to favor a pump with simple vanes, driven by an air turbine. The air-screw and pump impeller are mounted on the same shaft the pump body is, nicely streamlined, located in the slip-stream of the propeller and well below the level of the tank. The over-all efficiency is undoubtedly low, but there is considerable choice of position, reliability and simplicity. Owing to the slip-stream of the propeller furnishing the actuating air current, the pump works perfectly well before the plane is started. Several air-driven pumps have already been devised and it would appear that American designers could give pumps of this kind careful consideration in laying out the airplane fuel systems.

Limit of Air Screw Tip Speed

RATHER divergent views regarding the limiting speeds of aerial propeller tips have been advanced recently by British authorities. Lord Weir, of the Air Ministry, has stated that the speed of sound in air (1050 ft. p. s.) should not be exceeded. Dr. Leonard Bairstow claims that experiments at the Royal Aircraft factory have shown that at about 900 ft. per second the nature of a flow from a propeller suffers a marked and striking change. Up to about that speed the usual strong breeze was felt in rear of the propeller, but at higher speeds the slip stream disappeared, leaving a region of comparative calm behind the screw. On investigating the phenomenon it was discovered that the flow above the critical tip speed was largely centrifugal instead of resembling a jet of somewhat less diameter than the screw. As the speed rose through the critical value there was no sudden variation of power required to drive the screw, but it is obvious that at and above the critical speed the propeller must become very inefficient as an organ of propulsion.

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF 11 SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 7491 431 S. Dearborn St. CHICAGO



Glide "O" Plane

Learn the principles of Aviation by flying our famous Glide "O" Plane, shipped complete ready to assemble and fly with illustrated flying instructions. PRICE 55 Cents POSTPAID IN U.S.A.

Illustrated instructions from which you may carve an accurate propeller complete with a sample propeller blank. 30 Cents POSTPAID IN U.S.A.

Both the above postpaid in U. S. A. 75 Cents. Send for our catalogue D4. It is free.

HEC Aeroplane Co.

345 East 49th St., New York City

WHAT IS $1.50 WORTH ?

In twelve numbers of Everyday Engineering there is the equivalent of:

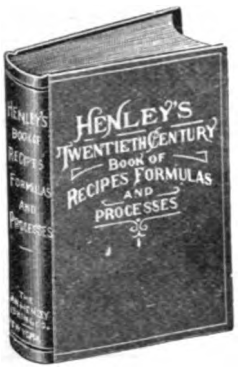
2 BOOKS ON MODEL MAKING, WORTH	$ 6.00
1 BOOK ON AUTOMOBILES, WORTH	3.00
1 BOOK ON AIRPLANES, WORTH	2.00
2 BOOKS ON WIRELESS, WORTH	6.00
3 BOOKS ON GENERAL EXPERIMENTS, WORTH	10.00

A $1.50 subscription to Everyday Engineering is equivalent to $27.00 worth of books

Digitized by Google

The Greatest Book Ever Offered to the Public

Henley's Twentieth Century Book of
RECIPES, FORMULAS AND PROCESSES



10,000 Trade Secrets
Practical Recipes
Chemical Processes
Scientific Formula

HOW TO MAKE EVERYTHING
FOR THE HOME, THE FACTORY AND THE WORKSHOP.

Antiseptics, Waterproofing, Lubricants, Rust Preventatives, Dyes, Filters, Cleaning Preparations, Enameling, Beverages, Inks, Adhesives, Polishes, Disinfectants, Flavorings, Cosmetics, Ceramics, etc., etc.; how to make fly paper; to color flowers artificially; to estimate weight of ice by measurement; to make materials fireproof; to work with metals — aluminum, brass, etc.; to make anything and everything, from A to Z.

THIS IS THE BOOK
every one who seeks PRACTICAL, ACCURATE KNOWLEDGE and guidance in his everyday work MUST HAVE at his command.

It is a money-maker and a money-saver; it appeals to the young as well as to the old. Great business enterprises owe their success to the manufacture or sale of simple inventions or compounds, usually the result of an experiment at home. One woman writes: "I am supporting myself and two small children from the sale of toilet articles I put up by following directions in your book." Profit by the knowledge that has made others successful. GET THIS BOOK TODAY.

Price $4.00

Delivered to any address

Send for our catalogue of practical books including a description of above book.

THE NORMAN W. HENLEY PUBLISHING COMPANY
2 West 45th St., New York, N. Y.

Airplane Design Based on Models

A COMMITTEE of British aviation experts appointed some time ago to consider the value of model experiments in connection with the design of full-sized machines reached a number of interesting conclusions in its report. It advises as follows:

(1) In testing, biplane design model aerofoils must be mounted as biplanes, and for monoplane determinations as monoplanes. The more closely the model wing conforms to that used on the full scale machine, the more reliable the results. Certain differences remain unexplained, so no high accuracy can be obtained in the prediction or verification of performances at low lift values.

(2) Suitable alowance must be made for scale effect on parts where it is known. In the case of struts, wires, etc., this is known to be large, but these parts can be tested under conditons corresponding with those found on the full scale machine.

(3) The resistance of the various parts taken separately may be added together to give the resistance of the complete airplane with good accuracy, provided that such parts, such as the landing gear, which consists of a number of separate small pieces, are tested as a complete unit.

(4) Model tests form an important and valuable guide in aeroplane design. When used for the determination of resistance, they must be used with discrimination and a full realization of the modifications of co-efficient values which may arise owing to interference and scale effect. In prelimnary determinations of the performance of a machine of known type, methods can be employed other than the addition of the resistance of all elementary component parts; every designer has at his disposal the full scale test results of a certain number of types of airplanes, and where a new design conforms to any known type, the most obvious point for starting improvement in design is given by these test results. For suggestion as to how the improvements can be made and their value, the designer is still dependent on model tests. It is of vital importance that the amount of information should be increased, and its use extended by thorough and systematic full scale research.

If you desire to stop by the roadside to change a tire or make other repairs, try to select a place where the car will not obstruct the traffic. Consider two cars passing where you have stopped and place yourself in the position of one of them.

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

— — — — TEAR OUT HERE — — — — —

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6066-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name _____
Present Occupation _____ 7-25-19
Street and No. _____
City _____ State _____

Send for This Book of Model Aeroplanes

Tells how you can build and fly accurate, reduced-scale Models of real Aeroplanes; DE HAVILLAND Battle Plane, NC-4 and others. You can build one easily. Send 10c in stamps NOW and get this 48-page book. Plans for Model Aeroplanes—NC-4, 50c; DE HAVILLAND Battle Plane, Curtiss Military Tractor, Bleriot Monoplane, Nieuport Monoplane, Taube Monoplane, 35c each; Cecil Peoli Champion Racer, 25c. Send for Plans or Book Today.

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Since 1911
Cor. W. Houston & Wooster Sts.
New York



Digitized by Google

Speed of Wood Saws

SAWS for cutting wood are generally designed to run at a certain speed which depends upon the size of the saw, the quality and temper of the material of which it is made and the work to be done. For best results operators should try to maintain this speed as closely as possible. The following figures give the revolutions per minute usually recommended for wood saws of the diameters shown. One column applies to high-grade, well-tempered saws and the other to ordinary steel saws used for sawing cordwood:

Diameter in inches	*High-grade Steel*	*Cordwood Grade*
16	2500	1970
18	2250	1500
20	1950	1300
22	1750	1200
24	1600	1100
26	1500	1000
28	1400	930
30	1300	870
32	1225	820

If the speed is much lower than that given for the kind and size of saw, the saw will not cut clean and more power will be required, while higher speeds than recommended will tend to cause a large amount of vibration and increase the danger of bursting.

Raising Steam by Electricity

AT first thought, the use of electricity for heating boilers to raise steam would seem to be a very inefficient method of generating power, and it would be if the electricity was generated in the usual way by burning coal under boilers, using a steam engine and turbine to drive a dynamo and then taking the current produced to generate steam again. Greater efficiency would be secured by burning coal under the boiler. Where coal is scarce and electricity developed by water power is cheap, then perhaps the electrical heat would be justified. A German engineering journal describes such a boiler. Narrow tubes of insulating material such as porcelain containing water are arranged vertically so as to communicate with the interior of the boiler at the upper and lower ends of the tubes. Current is passed through the water columns enclosed in the tubes. The resistance is relatively high, and accordingly high voltage alternating current is desirable, three phases being used. The current is regulated by moving electrodes in the tubes, which serves to vary the resistance of the water column. The efficiency of the boilers is said to exceed 95 per cent. One heating unit produces about 5 pounds of steam at 90 to 120 pounds pressure. Steam boilers with a capacity of 1,500 kw., with voltages of supply up to 10,000 volts, have so far been designed and used successfully.

Chemists Develop Tar Remover

ONE of the articles developed by the war chemists while experimenting to produce something else was a tar distillate which will dissolve tar as readily as a fire will melt a tallow candle. But it will also ruin varnish if used by itself. A scientific admixture of the distillate with oil and other ingredients, however, renders it harmless so far as the varnish is concerned, but still leaves it death to tar deposits on the automobile.

When applied, it must not be rubbed hard. The heat engendered by friction causes injury to the varnish. The proper application is as follows: With a soft rag, saturated with the liquid, cover the tarred parts. Allow it to remain on them a minute or two; then with a clean rag wipe it off gently, but at the same time get the surface dry—otherwise, it will accumulate dirt. The material is also a very good engine cleaner. May be used effectually inside or outside the engine. It is safer than gasoline because, while inflammable, its vapor is not explosive under ordinary service conditions.

An Easily Fusible Metal

Wood's Metal is the only known alloy that will fuse at 160 degrees F. and it has the lowest melting point of any of the fusible alloys. It consists of the following:

Bismuth	4 parts
Lead	2 parts
Tin	1 part
Cadmium	1 part

This alloy will melt in hot water. Other alloys containing mercury are unsuited for many uses as the mercury is apt to separate under certain conditions. The experimenter can mystify non-scientific friends by casting small objects of this alloy and causing them to disappear by obvious methods.

INDICATING CALIPERS



Here is a finely made tool incorporating features of rule, calipers, indicator and magnifier. Adjustment is provided for wear of parts. Easy movement is effected by ball bearings. A coiled spring draws points together. Tool can be set for desired dimension. It is a one hand tool, leaving other hand free for holding of the work.

Made in two capacities:
2" capacity, graduated in 100ths in.
3" capacity, graduated in 64ths in.
Price $(50

Send for folder or inquire of your dealer.

Indicating Calipers Co.
508 East 19th St., New York

UmakeM Outfit No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

JUST OUT
SELENIUM CELLS
THE
Construction, Care and Use of Selenium Cells with Special Reference to the Fritts Cell
By THOMAS W. BENSON

The lack of definite information relative to the construction of Selenium Cells has led the writer to record the results of some of his experiments and to fully describe the apparatus as developed by him.

CONTENTS OF CHAPTERS

1. **Selenium The Element**
2. **Consideration of Cell Types and their Characteristics; The Bildwell Cell; The Ruhmer Cell; The Mercadier Cell; The Bell and Taintor Cell; The Gripenberg Cell**
3. **Construction of Fritts Selenium Cells**
4. **Testing and Maturing Selenium Cells**
5. **Applications of Selenium Cells**
6. **The Care of Selenium Cells**

73 pages, 15 diagrams and 3 halftone page plates, 7½ x 5¼ inches. Cloth, $1.50.

SPON & CHAMBERLAIN
Publishers of Technical Books
120-122 Liberty Street : : New York

MR. INVENTOR! Let us assist you with that idea that you can't just work out, or let us construct a model of your patent. We develop ideas, and are experts in MODEL and EXPERIMENTAL work. We specialize in designing and building special LABOR SAVING MACHINES. Or perhaps your device is ready for manufacturing. If so, get in touch with us. It would be to our mutual advantages.

ELK MFG. CO., INC.
1926A Broadway, New York

IF YOU USE A. C. MOTORS YOU NEED
THE ELECTRICAL WORKER'S FRIEND
A book of 66 diagrams showing the complete details for connecting and rewinding A.C. Motors. It saves more than its costs. Tells you everything you need to know. $3.50.
H. E. BOSSHART.
P. O. Box 68, Homewood St., Pittsburgh, Pa.

KLEANE-Z-SUSPENSORY
FORM FITTING FOR ALL MEN
LINEN (MESH) $1.50



ALL PRICES SIZES
Balbriggan $1.25
Linen (Mesh) $1.50
Fine Glove Silk $2.00
Heavy Silk (Mesh) $2.50
One Extra Sack
At your dealers or sent postpaid on receipt of price.
A. R. CHISHOLM CO., New York, N. Y.
Suite 597 1328 BROADWAY

Your Prospective Customers
are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.
Send Them Sales Letters
You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"
Ross-Gould Mailing Lists St. Louis

Digitized by Google

Burning Pulverized Coal

THE subject of the burning of pulverized coal and other fuel in boiler fires and the like is exciting great attention in England. The finely powdered fuel is blown into the fire and its combustion is practically instantaneous. Coal with as much as 28% of ash and 6% of sulphur can be used, and has been employed successfully in locomotives. In ordinary hand firing an excess of 100% to 200% of air enters the furnace; with a mechanical stoker it is a little better, only 50% excess entering. With pulverized coal an excess of air of about 20% is standard practice and this can be reduced. Taking the theoretical quantity of carbon dioxide gas, which should be in the chimney gases as 20.77%, this can be reduced to 11% with only 5% loss in efficiency. This reduction, it will be seen, implies an incomplete combustion. 15% of carbon dioxide in the chimney gases is considered good practice. The fuel is so finely pulverized that a single pound is calculated to have a surface area of 26 square feet. The drier the fuel is the better, and it is sometimes artificially dried. It weighs 38 to 45 lbs. to the cubic foot. Of the ash produced 65% is collected as a partly fused slag; the rest goes up the chimney as a fine dust, but seems to do no harm. Excess of air reduces efficiency on account of the fuel wasted in heating the nitrogen of the air.

Welding Torch Cuts Granite

In repairing a drawbridge across the Passaic River, at Newark, N. J., it became necessary to remove a casting and pin from a granite pier. After several unsuccessful attempts to draw the pin, as narrated in Stone, the pin projecting down 3 inches into the masonry, it was found necessary to cut a trench in the hard granite so that the casting might be shifted laterally to one side for removal and replacement by a new and larger center casting. This trench was 4 ft. long, 9 in. wide and 3 in. deep, extending under the old casting. The cutting of the trench would have been an endless task had it not been discovered that an oxyacetylene flame chipped the granite quite readily and could be used under the old casting without damaging the balance of the masonry. The desired channel was thus quickly obtained. The flame was also used for cutting away the abutment back of the fixed span bottom chord to provide expansion clearance. — *Compressed Air Magazine.*

PRINCE ALBERT *the national joy smoke*
Our exclusive patented process cuts out bite and parch.

Earn $35 to $100 a Week
BECOME A PROFESSIONAL PHOTOGRAPHER
Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:
MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free
Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.
N. Y. INSTITUTE of PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.

PHONOGRAPHS $4 UP FROM MANUFACTURER
24 different styles, $4.00 up; $150 style, $40; $100 style, $35; $50 style, $13. Plays Victor, Columbia and Edison Records. Mail Orders Filled Promptly. Send for Catalogue.
DEALERS WHOLESALE.
LUCKY 13 PRODUCTS CO.,
3 East 12th St., New York.

DRAFTING
Inventions and Ideas Developed!
Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE
A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4580

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

SCHNOTER'S SUSPENSORIES
YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit, and low price.
At Drug Stores or sent direct $1.00
Send for booklet of other styles and prices
J. C. SCHNOTER CO.
523 SIXTH AVE. *Dept. E* N. Y. CITY

Don't Wear a Truss
Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.
Mr. C. E. BROOKS
Brooks' Rupture Appliance
Has automatic Air Cushions, Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.
Brooks Appliance Co., 264A State St., Marshall, Mich.

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 904 Bogue Bldg., Indianapolis

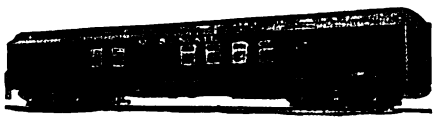
Stop Forgetting — Memory the Basis of All Knowledge
The Key To Success
The secret of business and social success is the ability to remember. I can make your mind an infallible classified index from which you can instantly select thoughts, facts, figures, names, faces. Enables you to concentrate, develop self-control, overcome bashfulness, think on your feet, address an audience. Easy. Simple. The result of 20 years' experience developing memories of thousands.
Prof. Henry Dickson, Principal
Write Today for free booklet "How to Remember" and Copyrighted Memory Test, also how to obtain my FREE book, "How To Speak In Public."
Dickson School of Memory, 1740 Hearst Bldg., Chicago, Ill.

SPECIAL KON-VER-TER SLIDE RULE
The original KON-VER-TER slide rule has over 8,000 graduations and over 1,800 letters and figures, will handle anything in Arithmetic, Algebra, Geometry or Trigonometry. Is 5.4 inches in diameter and in use all over the world, is much simpler to operate than others of similar construction. Eventually you will get the KON-VER-TER—get it now and save money. Plain Utility rules $1.00; Special De Luxe white ivory celluloid $2.50. Leatherette case 50c extra.
J. C. HAMILTON & CO.,
Dept. E, 7 Water St., Boston, U.S.A.

CHEMIST AMAZING DISCOVERY "MOTOROL"
ONE DOLLAR POSTPAID
25 to 40% more miles per gal.
25 to 35% more power.
Agents Wanted. Starts your engine on a cold day instantly.
Eliminates Carbon Deposits.
Less wear and tear on motor.
AUTO PRODUCTS CO.
Dept. 66 468 West 145th St., N. Y.

UmakeM Club
You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 10 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.
W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 8th Ave., N.Y.


Small Investors Wanted
To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.
For full particulars address
Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.



WANTED-Railway Mail Clerks
$1300 First Year
Common Education Sufficient
Sure Pay, Life Job. Pull unnecessary.
COUPON
FRANKLIN INSTITUTE
Dept. L23 Rochester, N. Y.
Sirs: Send me, without charge (1) sample of Fall Railway Mail Clerk Examination questions; (2) schedule showing places of all U. S. Government coming examinations; (3) list of other government jobs open to men and women and (4) free book describing them.
Name.....
Address.....

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

AGENTS—Something different! Our Bradium (Luminous) Crucifix actually Shines in the Dark. Startling! Mysterious! Wonderful enthusiasm follows every demonstration. 150% profit on every sale. Sole manufacturers. The Pioneer Corporation, 1365 W. 63rd Street, Chicago.

AGENTS. Signs for store and offices. Entirely new. $50-week easily made. Chicago Sign System 1-326 River St., Chicago.

MAKE $30 NEXT SATURDAY. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address PERRIN COMPANY, 1042 Hayward Bldg., Detroit, Mich.

WE WANT YOU TO BE OUR LOCAL REPRESENTATIVE. Devote your spare time to taking subscriptions for Everyday Engineering Magazine. There is at the present time a great demand for this magazine and among your friends you can get many subscriptions. Good pay. Write for particulars. Address EVERYDAY ENGINEERING MAGAZINE, 2 West 45th Street, New York.

Auctioneers

AUCTIONEERS. Make big money. Free Catalogue. Carpenter's Auction School, Kansas City.

Automobile Accessories

MORE Power, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

AUTOMOBILE REPAIRING MADE EASY—The most needed and useful book on Automobiles ever written. Only book of its kind. Covers every phase of Automobile repairing practice. 1060 pages. 1000 engravings. Price $3.50 postpaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, B402, Muscatine, Iowa.

Automobile Schools

HAVE YOU A TRADE?—Why not learn the Automobile Business—actual practice under expert instructors qualifies you in a few weeks' time to repair or drive any make of car, truck or tractor. There are always plenty of good positions open for trained men. Write today for particulars to Buffalo Auto School, Dept. 84, Buffalo, N. Y.

Aviation

BUILD YOUR OWN AEROPLANE; materials on installments, in the rough or cut to fit ready to assemble. Also machines completed. J. Angeles, Centralia, Wash.

WANT TO SELL small, uncompleted airplane, with motor, or will exchange for motorcycle. BRUBAKER, 522 East 78th St., New York.

Blueprints

MODEL ELECTRIC MOTOR Blue Prints 25c. Complete working outfit $1.75. A. F. Cassel, 52 West 130th St., New York City.

Business Opportunities

MONEY SAVED—All kinds used correspondence courses sold. (Also courses bought.) Write Lee Mountain, Pisgah, Ala.

Chemicals

MICROSCOPES. Balances, Experimental Laboratories. Buy through our easy Payment Plan. No red tape. Write for Booklet 24-E. Chemical and apparatus supplied for all Chemistry articles appearing in Everyday Engineering. Perform their experiments with our equipment. Lions Scientific Institute, Bausman Street, Mt. Oliver, Pittsburgh, Penna.

EXPERIMENTERS.—This Ad pays for itself because Everyday Engineering Readers are our regular customers. Our chemicals, apparatus, and supplies outfit their laboratories. Why not yours? Ask for free pricelist and free service card. Lions Scientific Institute, Mt. Oliver, Pittsburgh, Pa.

Electrical

100 INDUCTION MOTOR winding diagrams 1, 2, 3, phase star delta. 2 to 12 poles inclusive. Postpaid $5.00. E. Glass, 2108 South Broad Street, Philadelphia, Pennsylvania.

Fish

GOLD FISH. Imported Japanese, Chinese and American fish aquarium plants. We manufacture beautiful home aquariums. Descriptive circular free. Pioneer Goldfish Hatcheries, Racine, Wisconsin.

Ford Owners

300-PAGE book on the Ford car for every Ford owner, dealer and repairman. Deals fully with construction, operation and repair. 100 engravings. Best and most complete Ford book published. Price, $1.00 postpaid. Also Ford Engine Chart. 25x38 in. Location of engine trouble made easy. Price, 25 cents postpaid. The Norman W. Henley Publishing Co., 2 West 45th St., New York.

Formulas

370 FORMULAS. 10c. Fitzgerald, 15 West 65th St., New York.

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

MANUFACTURING PROCESSES. Formulas, Technical Information. Interesting booklet free. Consulting Chemist, Little Falls, N. J.

For Sale

100 6¾ ENVELOPES PRINTED to your order (2) colors, 75c prepaid. Write for Samples. Lincoln Novelty Co., Rochester, N. Y.

GENUINE INDIAN BASKETS—60 Styles. Catalogue. GILHAM, Highland Springs, California.

SELLING OUT parts for valves, water gauges, steam gauges, taps, dies, reamers and mills. An opportunity for model makers. Write for prices. ATTKEN, 1714 Brown St., Philadelphia.

Gummed Labels

FREE CATALOGUE containing ideas in package labels suitable for your business. Stock labels a specialty Royal Label Co., 29 S. Seventh, Philadelphia.

Help Wanted

WRITE for newspapers and magazines. Big Pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

MODEL MAKERS—Splendid opportunity in marine model shop for several young men who have decided taste and inclination in this line of work in both wood and metal. Write fully stating age, experience, where had, and wages expected. Address Model Maker, Everyday Engineering Magazine, 2 West 45th Street, New York.

U. S. GOVERNMENT wants hundreds railway mail clerks. Beginners salary $1200 year. Men-women, 18 up. List positions free. Write today. Franklin Institute, Dept. O-99, Rochester, N. Y.

Inventors

INVENTORS. In all matters concerning Patents, The National Institute of Inventors, 118 Fulton St., New York City, a co-operative society of 2500 will help you protect, develop and market your inventions. Annual dues $10.00. Booklet on request.

INVENTORS—We do experimental, Model, Tool, Die and Jig work. Light manufacturing. Miller & O'Brien Mfg. Co., Saint Paul, Minn.

INVENTOR'S MANUAL, HOW TO MAKE A PATENT PAY is a work of special interest to inventors in perfecting their inventions, taking out their patents, and disposing of them. It is not in any sense a Patent Solicitor's circular nor a Patent Broker's advertisement. No advertisements of any description appear in the work. It is a book containing a quarter of a century's experience of a successful inventor, together with notes based upon the experiences of many other inventors. 120 pages. Price $1.25 postpaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

TWO VOLUMES on MECHANICAL MOVEMENTS by G. D. Hiscox are works every inventor should have for it is illustrated in these volumes. If it hasn't been reference. If the thing you want has been invented, invented, then you'll find in it the nearest things to what you want, some movement or device that will apply in your case, perhaps; or which will give you a key from which to work. No books ever published are of more real value to the inventor, draftsman or practical mechanic than this set of books. Price per volume each $3.00 prepaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS; $110.00 a month to start and expenses; travel if desired; unlimited advancement. No age limit. Three months home study Situation arranged. Prepare for permanent position Write for booklet CM-56. STANDARD BUSINESS TRAINING INSTITUTE, Buffalo, N. Y.

FIREMEN, BRAKEMEN, BAGGAGEMEN, $140-$200. Colored Porters, by railroads everywhere. Experience unnecessary. 898 Railway Bureau, East St. Louis, Ill.

Miscellaneous

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

SPORTSMEN.—Trained beagles, rabbit, fox, coon, skunk, squirrel, and opossum dogs, bird dogs, pet and farm dogs, swine, rabbits, pigeons, pheasants, goats.—100 Varieties blooded stock. Circulars 10c. VIOLET HILL KENNELS, YORK, PA.

Model Supplies

SPECIAL MODELS DESIGNED. Also many standard designs. Write, telling us what you want. F. E. Harris, Central Y. M. C. A., Columbus, Ohio.

BOYS build your own Electric Motor. Complete outfit $1.75. Blue Prints 25c. A. F. Cassel, 52 West 130th St., New York City.

Motion Picture Plays & Supplies

$25-$00 paid anyone for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 550 St. Louis, Mo.

Patents

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS—Herbert Jenner, patent attorney and mechanical expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" FREE. Franklin H. Hough, 510 Loan & Trust Building, Washington, D. C.

PATENTS. Prompt, personal efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years actual experience, full information upon request. B. P. Fishburne, 322 McGill Building, Washington, D. C.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., patent attorneys, 641 Woolworth Building, New York. 625 F Street, Washington. Tower Building, Chicago.

INVENTIONS PATENTED; Trade-Marks Registered; Labels, Prints, Publications Copyrighted; prompt service; reasonable fees; plain advice; request detailed information before placing your business. Jaynes & Jaynes, 804 Kellogg, Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers. Washington, D. C.

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

PATENT ATTORNEY. Consulting Engineer. High class patent service in all its branches. Write for particulars. M. H. Loughridge, 1457 Broadway, New York.

Photography

DO YOU TAKE PICTURES? Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 466 Pope Building, Boston, Mass.

Printing

FIRST CLASS JOB PRINTING. Satisfactory work assured at reasonable prices. All orders receive prompt attention. Price list upon request. Mansler Bros., 270 Sanford, Rochester, N. Y.

Purchasing

LET ME DO YOUR BUYING. I will quote you best price and delivery on anything. Purchasing Agent, W. G. B., 1337 St. Marks Ave., Brooklyn, N. Y.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

STAMPS SENT ON APPROVAL at 70% discount. References required. J. Emory Renoll, Dept. W, Hanover, Pa.

Tricks

1,000 STAGE TRICKS with 500 illustrations. Catalogue 15c. Small Catalogue Free. Hornmann Magic Co., Station S, 304 West 34th St., New York.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¼" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotoy Electric, Charlotte, N. C.

WELDING APPARATUS for all purposes. All cash not required. Payments monthly. Also a limited number of plants left to fill orders for rental plan. All equipment highest grade. Guaranteed for one year. Write or wire today. E. E. Bermo Co., Omaha, Neb., U. S. A.

WELDING INSTRUCTIONS written in plain language and illustrated. Post paid, fifty cents. A. J. P. Bertschy, Cor. 20th and Harney, Omaha, Neb.

Digitized by Google

CONTENTS

Vol. 8 FEBRUARY, 1920 No. 5

OPERATING PRINCIPLES OF ROTARY ENGINES... 261
By Victor W. Pagé

A MODEL STEAM ENGINE..... 266
By Oliver Savage

GRINDING CONVEX LENSES..... 268
By Victor H. Todd

A MODEL TRACTOR..... 269
By Edward F. McCabe

MODEL LOCOMOTIVE DESIGN AND CONSTRUCTION 270
By Henry Greenley

FUSELAGE DESIGN TO REDUCE RESISTANCE..... 274

LARGE MONOPLANES PRACTICAL..... 275

FITTING AND ADJUSTING CONNECTING ROD BEARINGS—PART III..... 276

VAPORIZING LOW-GRADE FUEL..... 279

THE PROPER USE OF LATHE TOOLS..... 280
By George Shipston

BUILDING A SMALL CRANK SHAPER..... 282
By Joseph Dante, Jr.

FORD-MOTORED AIRPLANES PROVE PRACTICAL.. 286
By E. H. Holterman

ELECTRICAL PROGRESS DIGEST..... 288

AN ELECTRICALLY EQUIPPED LIGHTER..... 289

PREPARATION AND USE OF PERMANGANATE SOLUTIONS..... 290
By Albert T. Fellows

AN EXPERIMENT IN PHYSICAL CHEMISTRY.... 292

READERS' WORKSHOPS PAGE..... 293

BUILDING A TWO-PASSENGER SEAPLANE—PART VI..... 294

THE EVERYDAY MOTORIST..... 297

SUPERCHARGERS AND SUPERCHARGING AVIATION ENGINES..... 299
By Major E. A. Hallett, U. S. A.

A WAVEMETER FOR TUNING TRANSMITTERS... 302

SIMPLE EXPERIMENTS IN SCIENCE FOR BEGINNERS..... 303

EVERYDAY SCIENCE NOTES..... 304
By Prof. T. O'Conor Sloane

A 34-INCH SPREAD MONOPLANE MODEL..... 307
By H. C. Ellis

THE AMERICAN SOCIETY OF EXPERIMENTAL ENGINEERS..... 308

THE CONSTRUCTION OF A RADIO-FREQUENCY TRANSFORMER..... 310

THE RADIO DEPARTMENT..... 313

SOME DETAILS OF A NEW CONDENSER..... 314

EFFECTIVE CAPACITY TABLE..... 315

AN INTERESTING AUDION CONTROL BOX..... 316

MEASURING THE NATURAL WAVELENGTH OF AN ANTENNA..... 317
By H. W. Houk

THE MANUFACTURE OF ARTIFICIAL SILK FROM COTTON WASTE AND WOOD CELLULOSE..... 320
By Werner A. Schildknecht, A. S. E. E.

AN ENGINEER IN MODELDOM..... 345
By Dwight S. Simpson

ADJUSTING BRACING WIRES SCIENTIFICALLY... 350

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street **New York City**

Editor RAYMOND F. YATES
Managing Editor VICTOR W. PAGÉ
Radio Editor M. B. SLEEPER

Contributing Editor
PROF. T. O'CONOR SLOANE

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Office
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, INC.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $1.50 a year in the United States and possessions. Canada, $1.75; Foreign, $2.00 a year.

Copyright, 1920, by Everyday Mechancis Co., Inc.

Have You a Workshop?

THE chap with a little workshop in the cellar, attic, shed or garage has a companion whose company he can always enjoy. It is a place where he can go to relax after a day's work; a place where quiet moments can be passed making things.

EVERY normal man has the creative instinct in some form. To those mechanically inclined, the little workshop is a place provided with the very instruments of creation—tools. A screw-driver, a plane, a hammer or lathe is more than a mere convenient device for this or that operation. Tools provide man with the means for satisfying his desire to build, to create. The man working diligently in his shop over a model boat or a new engine at 2 o'clock in the morning is not to be considered eccentric. He merely has a strong desire to produce something, and incidentally he loves to use tools because they help him to satisfy this desire. The writer is acquainted with men who love tools in the strictest sense of the word.

IT makes no difference whether a shop contains ten thousand or ten dollars' worth of tools. It is a shop just the same, and its owner will enjoy it regardless of its value. Probably the man who has just a few tools enjoys his shop more than the man who has every conceivable device to help him in his work. The chap with a few tools must use ingenuity; he must display resourcefulness to accomplish various difficult operations, and this he enjoys. True, his shop's capacity for work is not great, but he obtains just as much pleasure as the fellow with a complete outfit.

THOSE who do not know the amount of good, wholesome pleasure that can be derived from a workshop should equip one. It is a place where one can go and forget worries and business. When one enters his little shop he enters a new realm. The very atmosphere is warm and hospitable, and every tool on the bench seems anxious to be used. Hours slip by rapidly. There is always something to do, something to make.

THE man without a shop is a man who is unable to enjoy the hospitality of an unfailing friend and companion.

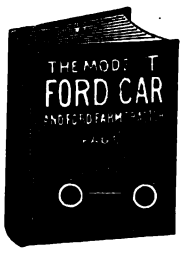
RAYMOND FRANCIS YATES,
Editor.

Digitized by Google

EVERY PRACTICAL MAN'S LIBRARY SHOULD CONTAIN THE FOLLOWING BOOKS

The Modern Gasoline Automobile, Its Design, Construction, Operation.

By Victor W. Pagé, M.S.A.E. This is the most complete, practical and up-to-date treatise on gasoline automobiles and their component parts ever published. In the new revised and enlarged 1920 edition, all phases of automobile construction, operation and maintenance are fully and completely described and in language anyone can understand. 1,000 pages. 1,000 illustrations. **Price, $4.00**



The Model T Ford Car, Its Construction, Operation and Repair, Including the Fordson Farm Tractor. The F. A. Starting and Lighting System and the Worm Drive 1-Ton Truck.

By Victor W. Pagé. This is the most complete and practical instruction book ever published on the Ford car and the Fordson Tractor. Illustrated by specially made drawings and photographs. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and operating principle made clear to everyone. 425 pages, 150 illustrations. **Price, $1.50**

How to Run an Automobile.

By Victor W. Pagé. This treatise gives concise instructions for starting and running all makes of gasoline automobiles, how to care for them, and give distinctive features of control. Describes every step for shifting gears, controlling engines. 178 pages. 72 illustrations. **Price, $1.25**

Automobile Welding with the Oxy-Acetylene Flame.

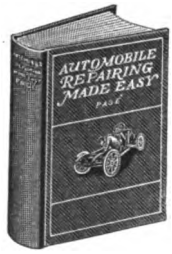
By M. Keith Dunham. Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understanable by everyone. 167 pages, fully illustrated. **Price, $1.50**

Abrasives and Abrasive Wheels.

By Fred B. Jacobs. A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantage in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering. 340 pages, 200 illustrations. This is an indispensable book for every machinist. **Price, $3.00**

Automobile Repairing Made Easy.

By Victor W. Pagé. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism. Written in a thorough but non-technical manner. This book also contains Special Instructions on Electric Starting, Lighting and Ignition Systems, Tire Repairing and Rebuilding. Autogenous Welding, Brazing and Soldering, Heat Treatment of Steel, Latest Timing Practice, Eight and Twelve-Cylinder Motors, etc., etc. You will never "Get Stuck" on a Job if you own this book. 1,000 specially made engravings on 500 plates. 1,056 pages (5½x8). 11 folding plates. **Price, $4.00**



Machine Shop Arithmetic.

By Colvin-Cheney. Most popular book for shop men. Shows how all shop problems are worked out and "why." Includes change gears for cutting any threads; drills, taps, shrink and force fits; metric system of measurements and threads. Used by all classes of mechanics and for instruction in Y. M. C. A. and other schools. Seventh edition. 131 pages. **Price 60c**

Steel: Its Selection, Annealing, Hardening and Tempering.

By E. R. Markham. This work was formerly known as "The American Steel Worker," but on the publication of the new, revised edition, the publishers deemed it advisable to change its title to a more suitable one. This is the standard work on hardening, tempering, and annealing steel of all kinds. This book tells how to select, and how to work, temper, harden, and anneal steel for everything on earth. It is the standard book on selecting, hardening, and tempering all grades of steel. 400 pages. Very fully illustrated. Fourth edition. **Price, $3.00**

Saw Filing and Management of Saws.

By Robert Grimshaw. A practical hand book on filing, gumming, swaging, hammering and the brazing of band saws, the speed, work, and power to run circular saws, etc. A handy book for those who have charge of saws, or for those mechanics who do their own filing, as it deals with the proper shape and pitches of saw teeth of all kinds and gives many useful hints and rules for gumming, setting, and filing, and is a practical aid to those who use saws for any purpose. Third edition, revised and enlarged. Illustrated. **Price, $1.25**

Brazing and Soldering.

By James F. Hobart. The only book that shows you just how to handle any job of brazing or soldering that comes along; it tells you what mixture to use, how to make a furnace if you need one. Full of valuable kinks. The fifth edition of this book has just been published, and to it much new matter and a large number of tested formulas for all kinds of solders and fluxes have been added. **Price, 35c**

Drafting of Cams.

By Louis Rouillion. The laying out of cams is a serious problem unless you know how to go at it right. This puts you on the right road for practically any kind of cam you are likely to run up against. Third edition. **Price, 35c**

House Wiring.

By Thomas W. Poppe. Describing and illustrating up-to-date methods of installing electric light wiring. Intended for the electrician, helper and apprentice. Contains just the information needed for successful wiring of a building. 125 pages, fully illustrated, flexible cloth. **Price, 75c**

Electric Wiring, Diagrams and Switchboards.

By Newton Harrison, with additions by Thomas Poppe. This is the only complete work issued showing and telling you what you should know about direct and alternating current wiring. It is a ready reference. The work is free from advanced technicalities and mathematics, arithmetic being used throughout. It is in every respect a handy, well-written, instructive, comprehensive volume on wiring for the wire-man, foreman, contractor or electrician. Second revised edition. 303 pages, 130 illustrations. Cloth. **Price, $2.00**

High Frequency Apparatus, Its Construction and Practical Application.

By Thomas Stanley Curtis. The most comprehensive and thorough work on this interesting subject ever produced. The book is essentially practical in its treatment and it constitutes an accurate record of the researches of its author over a period of several years, during which time dozens of coils were built and experimented with. 248 pages. Fully illustrated. **Price, $2.50**

The Lathe—Its Design, Construction and Operation, With Practical Examples of Lathe Work.

By Oscar E. Perrigo. A new revised edition, and the only complete American work on the subject, written by a man who knows not only how work ought to be done, but who also knows how to do it, and how to convey this knowledge to others. It is strictly up-to-date in its descriptions and illustrations. A number of difficult machining operations are described at length and illustrated. The new edition has nearly 500 pages and 350 illustrations. **Price, $3.00**

Henley's Twentieth Century Book of Recipes, Formulas and Processes.

Edited by Gardner D. Hiscox. The most valuable techno-chemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work. New edition. Cloth. **Price, $4.00**

Starting, Lighting, and Ignition Systems.

By Victor W. Pagé. A practical treatise on modern starting and ignition system practice. This practical volume has been written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. It can be understood by anyone even without electrical knowledge. Nearly 500 pages. 297 specially made engravings. New Edition. **Price, $2.50**



☞ Any of these books sent prepaid on receipt of price. FREE—Our new 1920 Catalog of Practical Books sent free on request

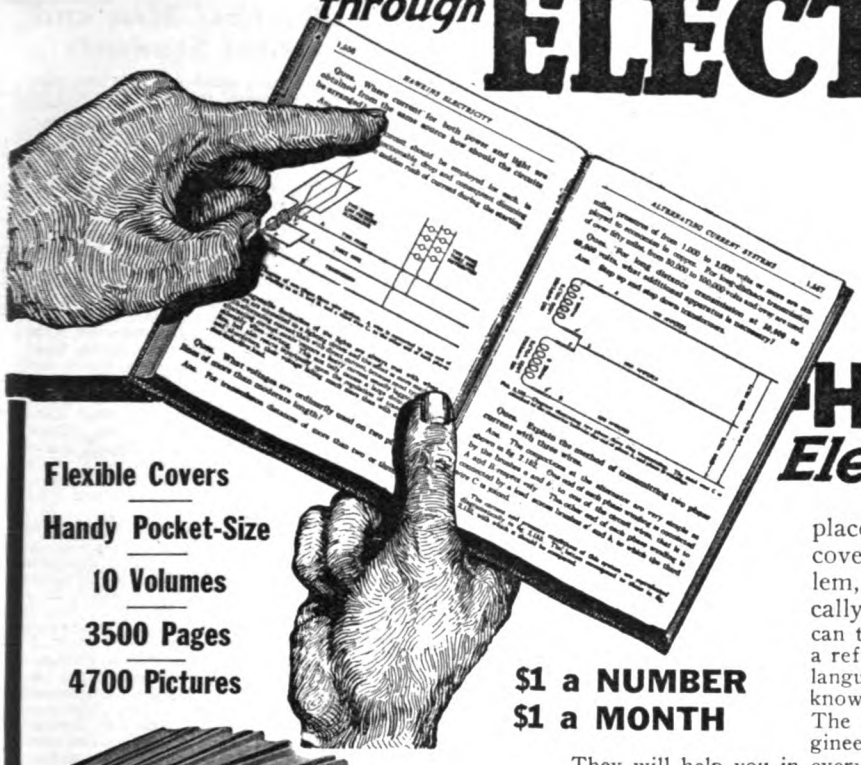
THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. **2 West 45th Street, New York**

Digitized by Google

Get Bigger Pay through ELECTRICITY

by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.



Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

HAWKINS Electrical Guides

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

SEND NO MONEY - USE THE COUPON

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Employed by .....

Residence .....

Reference ..... Feb.

Digitized by Google

Learn Mechanical Drafting

Earn $35 to $100 A Week

"Get into the profession of big pay and Rapid Advancement with the help of the school that has started hundreds on the Road to Success. I am ready to help you." Roy C. Claflin, President Columbia School of Drafting.



Learn at Home in Spare Time

You don't have to stop work or leave home in order to become a trained Draftsman. Through our practical Home Study Training we teach you in your own home, and enable you to qualify as a practical Draftsman.

No Previous Training Required

Owing to the comprehensive nature of our course, you need no previous training in the subject. Though you have never done any kind of drawing before, you can become a thorough Draftsman by following our instructions.

Can Learn in Short Time by Our Methods

The reason for this is that we eliminate unnecessary theoretical work and concentrate upon the PRACTICAL problems such as confront the professional Draftsman. We do not require you to spend months of your time on "preliminary" work, but start you on REAL DRAFTING at once. That is one reason why our students "make good" so readily.

Our Graduates Get to the Top

The universal success of our graduates as Professional Draftsmen, many of whom have advanced rapidly to positions of Chief Draftsmen, is evidence of the REAL VALUE of the training given by the COLUMBIA SCHOOL OF DRAFTING. Large numbers of our students have secured excellent positions even before completing their courses. We gladly cooperate with our students and graduates in securing desirable positions, which has been easy for us owing to the many demands upon us to supply our "product" for these positions.

Draftsmen Get $35 to $100 a Week

Our graduates have shown their ability to reach high salaries RAPIDLY, owing to their practical training. They secure excellent salaries AT THE START, as high as $2.000 a year. The usual pay of Draftsmen is $35 to $100 a week.

The Demand is Greater than the Supply

The demand for properly trained Draftsmen has always been greater than the supply, but this is more so today than ever before, owing to greatly increased construction and mechanical development. The Draftsman is an essential connecting link in all engineering work. This great demand is indicated by the long lists of want ads for Draftsmen in the daily papers, especially those of industrial centers.

Specialists in Mechanical Drafting

The COLUMBIA SCHOOL OF DRAFTING not only trains Draftsmen by mail but also maintains a large local institution of the highest standing. For many years it has been the leader in SPECIALIZING on the teaching of DRAFTING. This is an obvious advantage over teaching Drafting only as a side issue.

Drawing Outfit Furnished

We supply all our students with a drafting outfit for use throughout the course. There is no extra charge for this, and it becomes your personal property when the course has been paid for in full.

Book of Particulars Sent Free

If you are interested in becoming a practical Draftsman through the thorough training of the COLUMBIA SCHOOL OF DRAFTING, whereby you can enter a Profession in which your services will always be in demand, you are invited to write us for our free book of particulars, which describes our school and methods.

COLUMBIA SCHOOL OF DRAFTING
Dept. 1082—14th and T Sts.
Washington, D. C.

For your convenience you can fill out and

Mail This Coupon To-day

Columbia School of Drafting,
Dept. 1082, 14th & T Sts., N.W.,
Washington, D. C.

Without obligation to me, please send me full particulars of your practical home study training in Drafting.

Name .....

Address .....

City..... State.....

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.
Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop then.

PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs.

Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School
YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 8 FEBRUARY, 1920 NUMBER 5

Operating Principles of Rotary Engines

A Non-technical Description of the Gnome and Le Rhone Revolving Cylinder, Fixed Crankshaft Aviation Engines Detailing Principles of Operation and Features of Construction

By Victor W. Pagé, M. S. A. E.

THOUSANDS of rotary engines were used by the Allies during the past emergency on scout planes employed in active service both for operations against the enemy and for training pilots at the various aviation schools in this country and Europe. Some of the most successful airplanes devised have used rotary cylinder-fixed crank engines for power, and this interesting type has much to commend it for airplane use. The engines are easily installed and the design makes for a short, easily manoeuvered fuselage and a compact placing of power plant, controls and pilot that is so essential in the scout plane.

Rotary Engines Easy to Maintain

The revolving cylinder engine is a very easy type to overhaul and keep in condition because it is simple and compact in construction and practically all bearings are of the anti-friction type. These bearings do not require refitting every time the engine is overhauled, as is necessary with the plain bearing fixed cylinder, revolving crankshaft engines. Rotary engines are easily dismantled when repairs are necessary. The Le Rhone type has been found to be more enduring than the Gnome in the writer's experience, the former giving an average useful service of 75 flight hours between overhaulings, the latter seldom running more than 50 hours. It requires about 60 man-hours, or two men working 30 hours to overhaul a rotary engine if new rings must be fitted, all parts thoroughly cleaned, carbon removed and valves ground and have it ready for the test stand. With the conventional eight or twelve cylinder V-type it requires about twice as much time to do any kind of a job of overhauling, especially if crankshaft and connecting rod bearings must be fitted. As for ease of replacement, a crew of three men has taken a rotary engine out of fuselage and replaced it in eight minutes, a feat impossible of duplication with any conventional water cooled V-type or cylinders-in-line form. The fixed cylinder engines have a longer useful life, however, and it is not unusual to get 100 hours' flying time before cleaning is necessary. Some Curtiss OX5 engines have been run 120 flight hours without cleaning and Liberty engines have been operated for even longer periods without repairs being necessary.

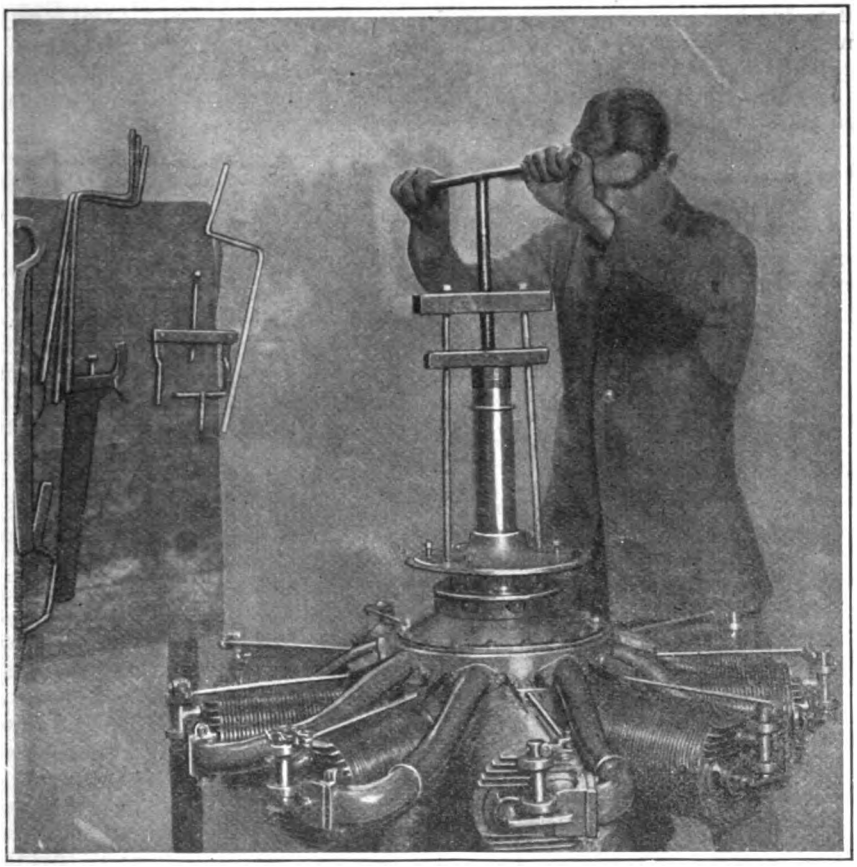


Fig. 1. American soldier-mechanic overhauling Le Rhone rotary motor. Special puller shown was developed for removing engine supporting plates

Design Permits Light Construction

Rotary engines are generally associated with the idea of light construction and it is rather an interesting point that the reason why rotary engines are popularly supposed to be lighter than the others is because they form their own fly-wheel, yet on aeroplanes engines are rarely fitted with a fly-wheel at all. As a matter of fact these engines are not light merely be-

Digitized by Google

cause they are rotary motors, but are rotary motors because that design has been adopted as that most conducive to lightness and is most suited to an engine working in this way. The cylinders of a Gnome could be fixed and crankshaft revolve without increasing the weight to any extent if the engine operated on a more conventional cycle. There are two prime factors governing the lightness of an engine, one being the initial design and the other the quality of the materials employed. The consideration of reducing weight by cutting away metal is a subsidiary method that ought not to play a part in standard practice, however useful it may be in special cases. In most rotary engines the lightness is entirely due to the initial design and to the materials employed in manufacture. Thus, in the first case the engine is a radial engine, and has its seven or nine cylinders spaced equally around a crank-chamber that is no wider, or rather, longer, than would be required for any one of the cylinders.

This shortening of the crank-chamber not only effects a considerable saving of weight on its own account, but there is a corresponding saving in the shafts and other members, the dimensions of which are governed by the size of the crank-chamber. With regards to materials, nothing but high-grade steel is used throughout, and most of the metal is forged chrome nickel steel. The steady running of these engines is largely due to the fact that there are literally no reciprocating parts in the absolute sense, the apparent reciprocation between the pistons and cylinders being solely a relative reciprocation, since both travel in circular paths, that of the pistons, however, being eccentric by one-half of the stroke length to that of the cylinder.

While the rotary engine has many advantages, on the other hand, the head resistance offered by a motor of this type is considerable; there is a large waste of lubricating oil, due to the centrifugal force which tends to throw the oil away from the cylinders; the gyroscopic effect of the rotary motor is said to be detrimental to the best working of the single engine aeroplane if of short span, and, moveover, it requires about 7 per cent of the total power developed by the motor to drive the revolving cylinders around the shaft and overcome the air resistance. Of necessity, the compression of this type of motor, which is always air cooled, is rather low, and an additional disadvantage manifests itself in the fact that there is as yet no satisfactory way of entirely muffling the rotary type of motor.

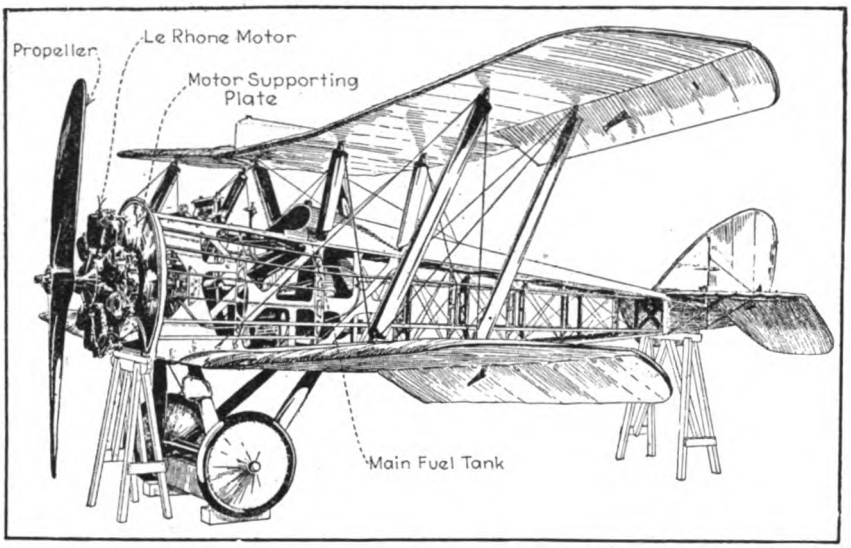


Fig. 2. View of DH-5 airplane, showing how easily rotary motor is installed

Rotary Cylinder Engine of American Origin

The modern Gnome engine has been widely copied in various European countries, but the form on which its design is based was originated in America, the early Adams-Farwell engine being the pioneer form. It has been made in three, five and nine-cylinder types and forms of double these numbers. The simple or one-crank engines have an odd number of cylinders in order to secure evenly spaced explosions. In the seven-cylinder the impulses come 102.8° apart. In the nine-cylinder form the power strokes are spaced 80° apart. The fourteen-cylinder engine is virtually two seven-cylinder types mounted together, the cranks being opposed just the same as in a double cylinder horizontal motor, the explosions coming 51.4° apart, while in the eighteen-cylinder model the power impulses come every 40° cylinder travel. Other rotary motors have been devised, such as the Le Rhone and the Clerget in France and copies of these types in other countries. The speed of a rotary cylinder engine is limited to a greater degree than any other form, and it is not safe to run them over 1200 r.p.m. owing to stresses produced by centrifugal force at higher speeds. The writer has seen an engine under test "throw a cylinder" when run at 1500 r.p.m. for trial purposes.

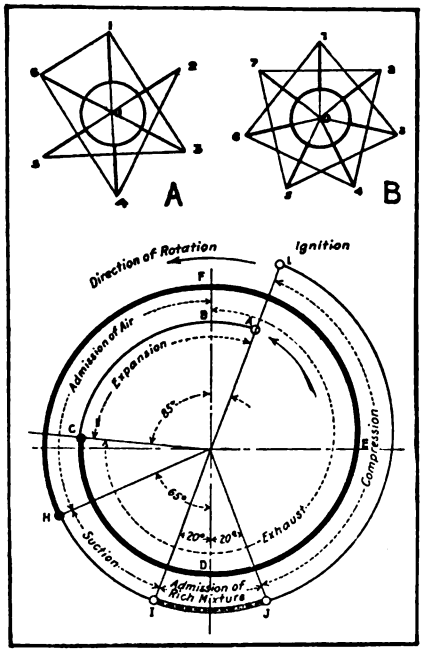


Fig. 3. Diagrams at A and B show why rotary cylinder engines operating on single crank should have odd number of cylinders. Gnome Monosoupape timing diagram shown below

Why an Odd Number of Cylinders Is Used

Many people doubtless wonder why single crank rotary engines are usually provided with an odd number of cylinders in perference to an even number. It is a matter of even torque, as can easily be understood from the accompanying diagram. Fig. 3A represents a six-cylinder rotary engine, the radial lines indicating the cylinders. It is possible to fire the charges in two ways if the engine is a four-cycle type, firstly in rotation, 1, 2, 3, 4, 5, 6, thus having six impulses in one revolution and none in the next; or alternately, 1, 3, 5, 2, 4, 6, in which case the engine will have turned through an equal number of degrees between impulses 1 and 3, and 3 and 5, but a greater number between 5 and 2, even again between 2 and 4, 4 and 6, and a less number between 6 and 1, as will be clearly seen by reference to the diagram. Referring to Fig. 3B, which represents a seven-cylinder engine, if the cylinders fire alternately it is obvious that the engine turns through an equal number of degrees between each impulse, thus, 1, 3, 5, 7, 2, 4, 6, 1, 3, etc. Thus, supposing the engine to be revolving, the explosion takes place as each alternate cylinder passes, for instance, the point 1 on the diagram, and the ignition is actually operated in this way by a single contact brush that ditsributes the current to contact segments on the distributor plate.

Digitized by Google

Rotary Engines Easily Installed

When rotary engines are installed, simple steel stampings or "spiders" are attached to the fuselage to hold the fixed crankshaft. Inasmuch as the motor being dispensed with on account of the trouble caused by that member on earliest engines. The construction of this latest type follows the lines established in the earlier designs to some extent and it differs only in the method of charging. The very rich mixture of gas and air is forced into the crank-case through the crankshaft, and enters the cylinder when the piston is at its lowest position, through the half-round openings in the guiding flange and the small holes or ports machined in the cylinder and clearly shown at Fig. 5. The returning piston covers the port, and the gas is compressed and fired in the usual way. The exhaust is through a large single valve in the cylinder head, which gives rise to the name "monosoupape," or single-valve motor, and this valve also remains open a portion of the intake stroke to admit air into the cylinder and dilute the rich gas forced in from the carnk-case interior. Aviators who have used the early form of Gnome say that the inlet valve in the piston type was prone to catch on fire if any valve defect materialized, but the "monosoupape" pattern is said to be nearly free of this danger. The bore of the 100-horsepower nine-cylinder engine is 110 mm., the piston stroke 150 mm. Extremely careful machine work and fitting is necessary. In many parts tolerances of less than .0004" (four ten-thousandths of an inch) are all that are allowed. This is about one-sixth the thickness of the average human hair, and in other parts the size must be absolutely standard, no appreciable variation being allowable.

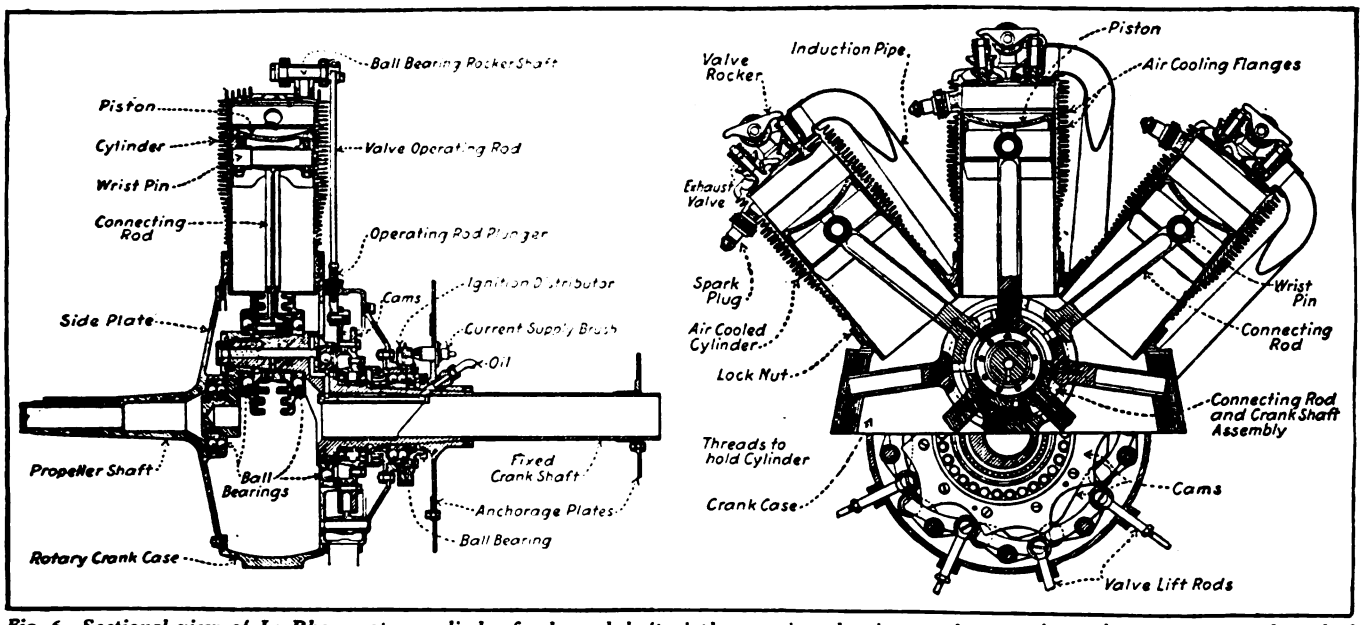


Fig. 6. Sectional view of Le Rhone rotary cylinder fixed crankshaft airplane engine, showing novel connecting rod arrangement and method of valve actuation

projects clear of the fuselage proper there is plenty of room back of the front spider plate to install the auxiliary parts, such as the oil pump, air pump and ignition magneto, and also the fuel and oil containers. The diagram given at Fig. 4 shows how a Gnome "monosoupape" engine is installed on the anchorage plates, and it also outlines clearly the piping necessary to convey the oil and fuel and also the air-piping needed to put pressure on both fuel and oil tanks to insure positive supply of these liquids, which may be carried in tanks placed lower than the motor in some installations. The view of the DH5 biplane single-seater scout with rotary motor installed but motor cowling removed shows how simple this installation is, the engine in this case being a 110 h.p. Le Rhone.

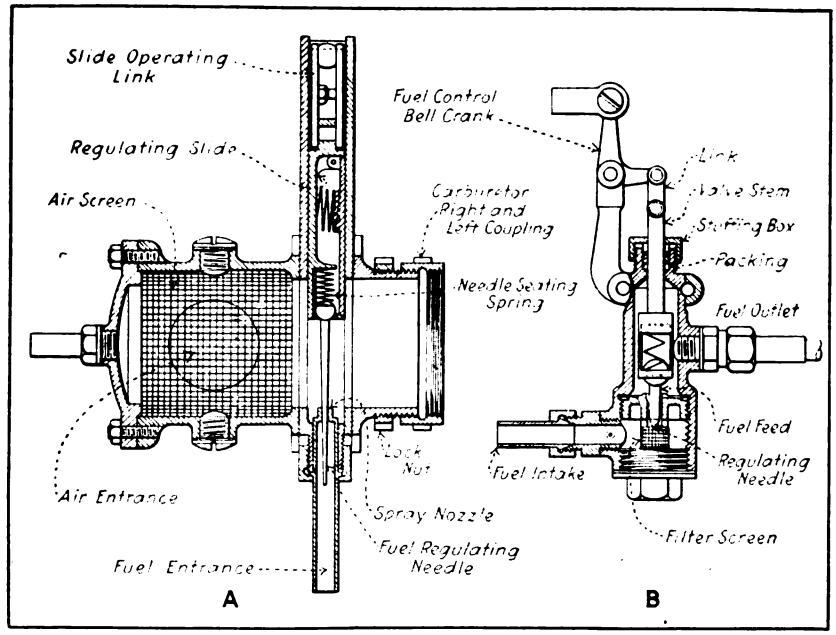


Fig. 7. The Le Rhone carburetor at A and Fuel supply regulating device at B

Gnome "Monosoupape" Type

The latest type of Gnome engine is known as the "monosoupape" type, because but one valve is used in the cylinder head, the inlet valve in the piston

A still later development of the "monosoupape" is a 150-horsepower type with a special form of clack valve that has no valve spring. In other details, with the exception of the connecting rod arrangement, which is similar to that of the Le Rhone motor, it resembles the smaller model.

Gnome "Monosoupape" Valve Timing

In the present design of the Gnome motor, a cycle of operations somewhat

Digitized by Google

different from that employed in the ordinary four-cycle engine is made use of. This cycle does away with the need for the usual inlet valve and makes the engine operatable with only a single valve, hence the name "monosoupape," or "single-valve." The cycle is as follows: A charge being compressed in the outer end of the cylinder, combustion chamber, it is ignited by a spark produced by the spark plug located in the side of this chamber, and the burning charge expands as the piston moves down in the cylinder while the latter revolves around the crankshaft. When the piston is about half way down on the power stroke, the exhaust valve, which is located in the center of the cylinder head, is mechanically opened, and during the following upstroke of the piston and burned gases are expelled from the cylinder through the exhaust valve directly into the atmosphere.

Instead of closing at the end of the exhaust stroke, or a few degrees thereafter, the exhaust valve is held open for about two-thirds of the following inlet stroke of the piston, with the result that fresh air is drawn through the exhaust valve into the cylinder. When the cylinder is still 65° from the end of the inlet half-revolution, the exhaust valve closes. As no more air can get into the cylinder, and as the piston continues to move inwardly, it is obvious that a partial vacuum is formed.

When the cylinder approaches with 20° of the end of the inlet half-revolution a series of small inlet ports all around the circumference of the cylinder wall is uncovered by the top edge of the piston, whereby the combustion chamber is placed in communication with the crank chamber. As the pressure in the crank chamber is substantially atmospheric, and that in the combustion chamber is below atmospheric, there results a suction effect which causes the air from the crank chamber to flow into the combustion chamber. The air in the crank chamber is heavily charged with gasoline vapor, which is due to the fact that a spray nozzle connected with the gasoline supply tank is located inside the chamber. The proportion of gasoline vapor in the air in the crank chamber is several times as great as the ordinary combustible mixture drawn from a carburetor into the

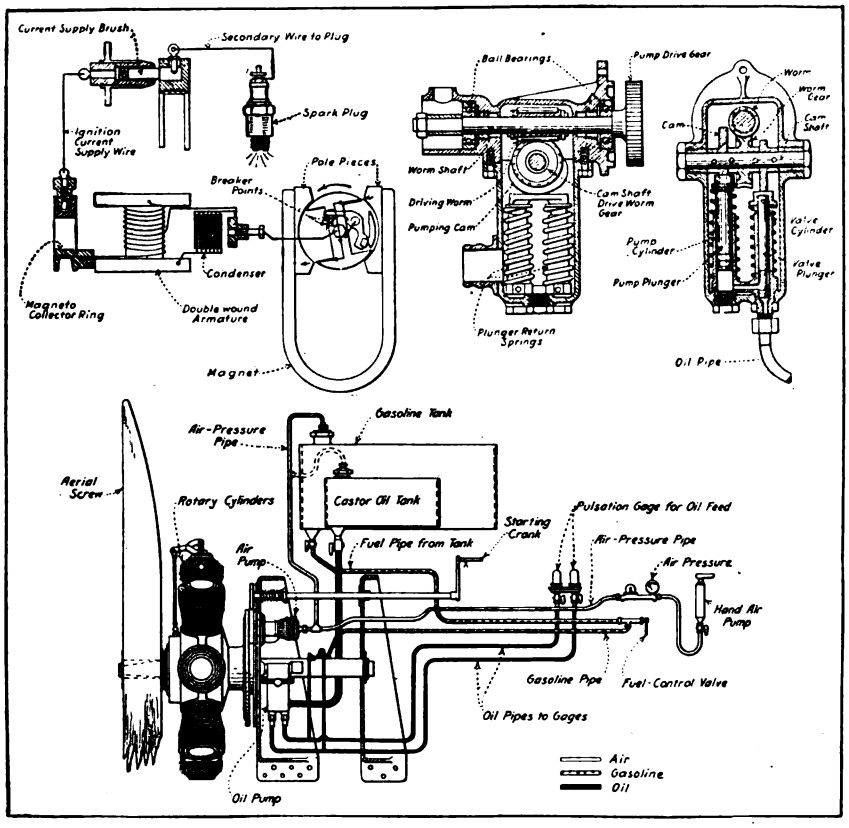


Fig. 4. Diagrams explaining action of Gnome ignition system, oil pump and showing complete power plant installation

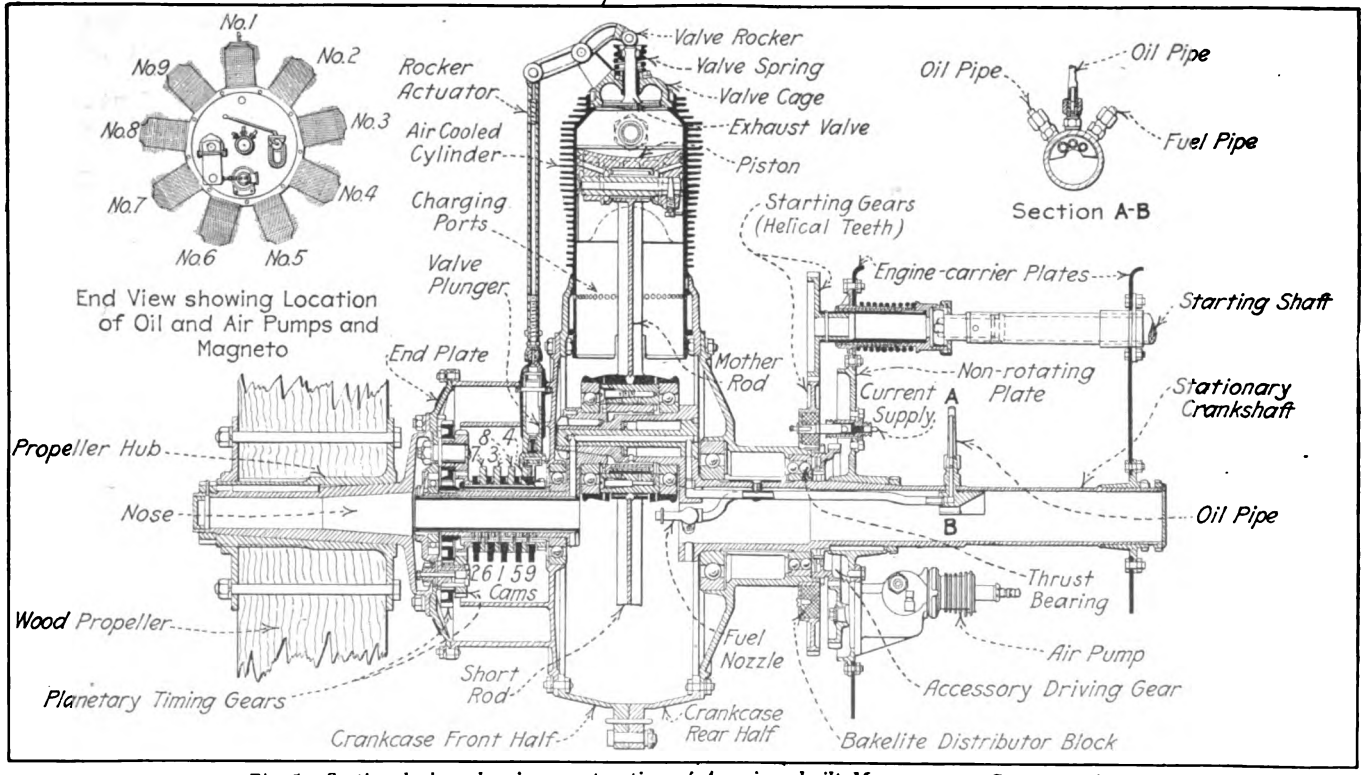


Fig. 5. Sectional view showing construction of American built Monosoupape Gnome engine

Digitized by Google

cylinder. This extra-rich mixture is diluted in the combustion chamber with the air which entered it through the exhaust valve during the first part of the inlet stroke, thus forming a mixture of the proper proportion for complete combustion.

The inlet ports in the cylinder wall remain open until 20° of the compression half-revolution has been completed, and from that moment to near the end of the compression stroke the dead center on the second revolution. Then for 45° of travel the charge within the cylinder is expanded, whereupon the inlet ports are uncovered and remain open for 40° of cylinder travel, 20° on each side of the inward dead center position.

Gnome Fuel System, Ignition and Lubrication

Gasoline is fed to the engine by means of air pressure at five pounds per square inch, which is produced by the air pump on the engine clearly shown at Fig. 4. A pressure gauge convenient to the operator indicates this pressure, and a valve enables the operator to control it. No carburetor is used. The gasoline flows from the tank through a shut-off valve near the operator and through a tube leading through the hollow crankshaft to a spray nozzle located in the crankcase. There is no throttle valve, and as each cylinder always receives the same amount of air as long as the atmospheric pressure is the same, the output cannot be varied by reducing the fuel supply, except within narrow limits. A fuel capacity of 30 to 40 gallons is usually provided. The fuel consumption is at the rate of 12 U. S. gallons per hour.

The high-tension magnetos, with double cam or two break per revolution interrupter, is located on the thrust plate in an inverted position, and is driven at such a speed as to produce nine sparks for every two revolutions; that is, at 2¼ times engine speed. There is no distributor on the magneto. The high-tension collector brush of the magneto is connected to a distributor brush holder carried in the bearer plate of the engine. The brush in this brush holder is pressed against a distributor ring of insulating material molded in position in the web of a gear wheel keyed to the thrust plate, which gear serves also for starting the engine by hand. Molded in this ring of insulating material are nine brass contact sectors, connecting with contact screws at the back of the gear, from which bare wires connect to the spark-plugs. The distributor revolves at engine speed, instead of at half engine speed, as on ordinary engines, and the distributor brush is brought into electrical connection with each spark-plug every time the piston in the cylinder in which this spark-plug is located approaches the outer dead center. However, on the exhaust stroke no spark is being generated in the magneto, hence none is produced at the spark plug.

Ordinarily the engine is started by swinging the propeller, but for emergency purposes, as in seaplanes or for a quick "get away," if a landing is made where it is not possible to start the motor by turning the propeller, a hand starting crank is sometimes provided. This is supported in bearings

(*Continued on page* 310)

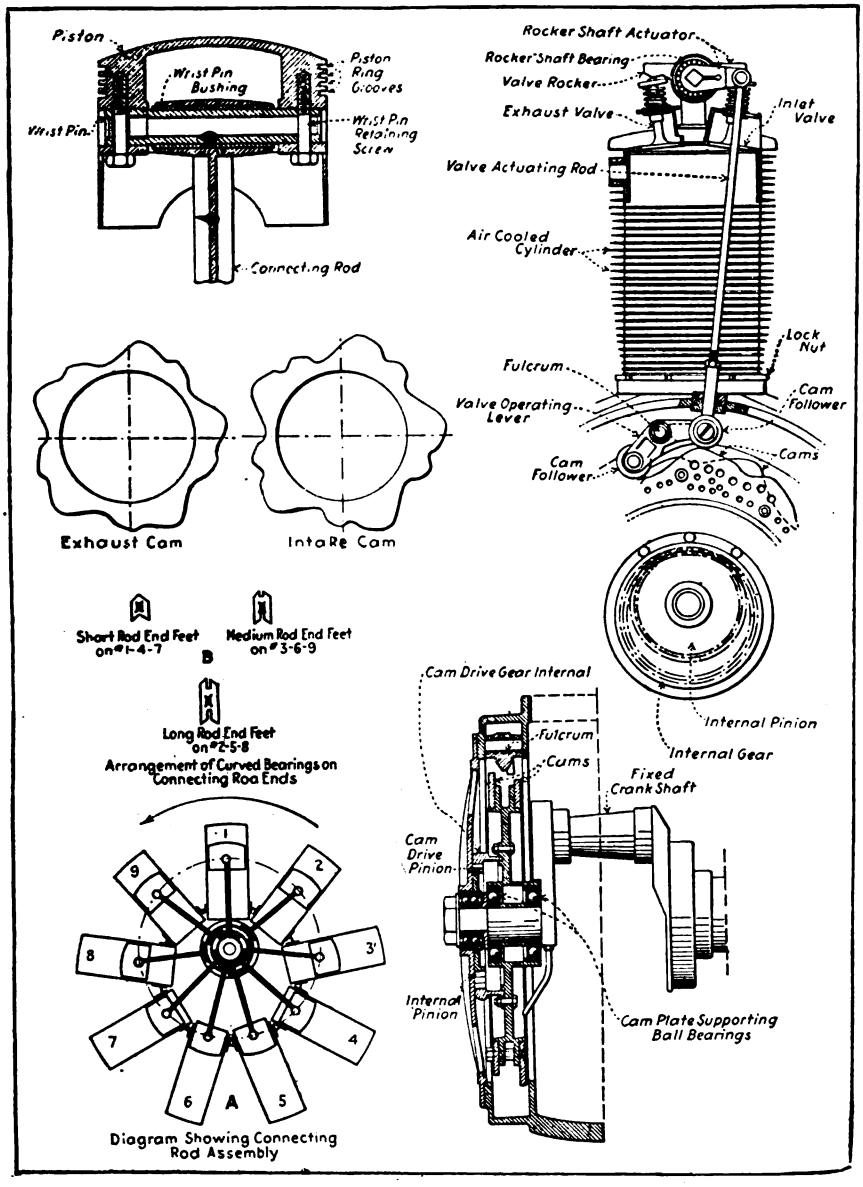


Fig. 8. Interesting mechanical details of the Le Rhone rotary cylinder motor

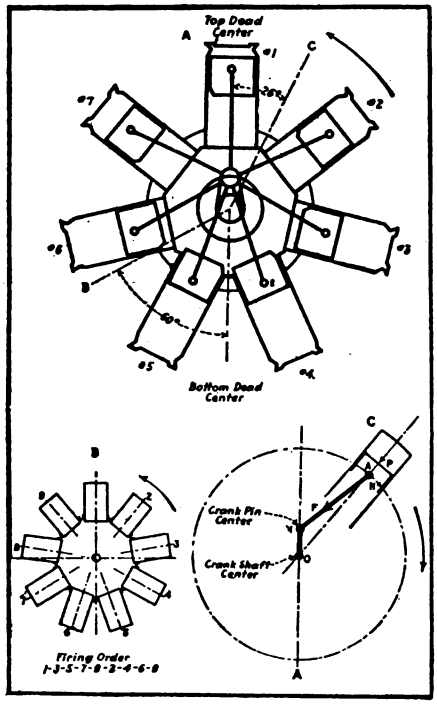


Fig. 9. Explaining Le Rhone motor action

gases are compressed in the cylinder. Near the end of the stroke ignition takes place and this completes the cycle.

The exact timing of the different phases of the cycle is shown in the diagram at the bottom of Fig. 3. It will be seen that ignition occurs substantially 20° ahead of the outer dead center, and expansion of the burning gases continues until 85° past the outer dead center, when the piston is a little past half-stroke. Then the exhaust valve opens and remains open for somewhat more than a complete revoultion of the cylinders, or, to be exact, for 390° of cylinder travel, until 115° past the top

Digitized by Google

A Model Steam Engine

Constructional Data for a Model With a Simple Walchert Valve Gear

By Oliver Savage

MODEL makers who have a desire to produce a workable steam engine, should not hesitate to set about the task of building one merely because they do not have the facilities for making castings or patterns. Very workable and practical little engines can be produced by using a few extremely simple castings and different odds and ends found about the workshop. It is true that perfect engines cannot be built by the use of such materials but working models can be made that will operate just as successfully as models that require a number of castings in their make-up. When engines are built with spare parts, the builder must use his own ingenuity in perfecting the design so that most of the available materials on hand can be used in the construction.

The little engine constructed by the writer evolves the use of only five castings and these are produced with very simple patterns that can be made by any experimental engineer no matter how inexperienced he may be in the art of pattern making. The patterns can be taken to the local foundry and the castings obtained for about one dollar. The castings should be made with hard brass.

The cylinder of the engine should be cast with a three-quarter hole and it will, of course, be necessary to employ a core box for this purpose. When the rough casting of the cylinder is received from the foundry, it is chucked in the lathe and the hole bored out to a diameter of one inch. After this is done, each end of the cylinder is faced off square. The flat portion of the cylinder upon which the steam chest rests must be filed square and finished as smoothly as possible, as much depends upon this particular operation. This operation can also be accomplished very nicely by the use of a small lapp grinder or disc grinder that can be mounted in the live spindle of the lathe. The flat surface should be tested for accuracy by the use of a machinist's square. By this the writer means that it should be squared up with the cylinder ends.

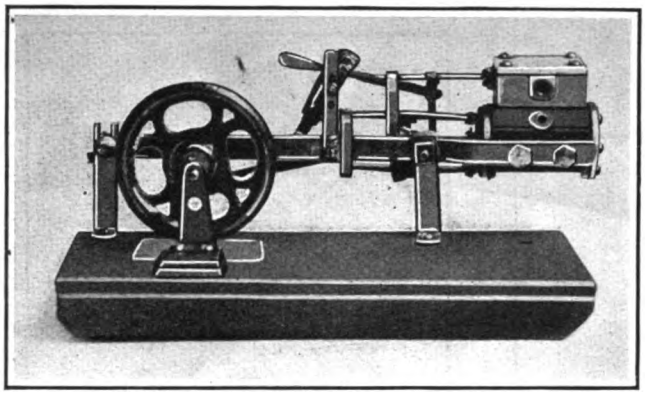
Few model makers or experimental engineers realize what neat and workable model steam engines can be made in a few hours' time and by the use of simple materials and tools. The little engine pictured on this page and described in the text is an example of the work that can be accomplished by the use of odd materials and a few simple castings of brass, the patterns for which can be made by every mechanic worthy of the name.—EDITOR.

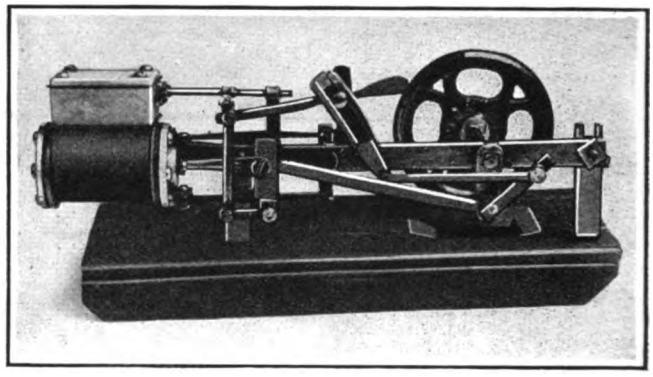
The cylinder heads are now faced off carefully in the lathe and divided with a protractor into six equal parts. After being punched, these members are drilled with a ⅛-in. drill. When these holes have been drilled the cylinder heads can be used as a jig to drill the corresponding holes in the cylinder ends. The holes in the cylinder ends, however, should only be marked out by the aid of the cylinder ends. The holes should be drilled with a No. 36 drill. When this is done the holes in the cylinder are tapped out with a 6-32 tap to receive the small cap screws which hold the heads to the cylinder ends.

Now the holes in the top of the cylinder are laid out and a ⅛-in. drill run down about a quarter of an inch. Another drill is then run in from each end to meet. Care should be taken in this operation to see that the holes do not break through into the exhaust port, as this would render the cylinder useless. The exhaust port is drilled out by drilling about half way in with a ¼-in. drill. This hole is then tapped with a ¼-28 tap to receive the exhaust pipe which is held in this manner to avoid the use of solder. The hole for the exhaust port is continued beyond the one-quarter inch with a ⅛ inch drill One-quarter-inch copper tubing is used as the exhaust pipe.

By referring to the drawing it will be seen that the cylinder is provided with two projections. These are used in fastening the cylinder to the engine frame and they should be drilled out and tapped with a ¼-28 tap.

The engine valve is smoothed the same way as the top of the cylinder. The holes are then laid out on the steam chest cover and drilled and tapped to receive the cap screws. Where the valve rod enters the steam chest, a hole is made with a ⅛-in. drill one-half way through. The hole is then continued with a ¼-inch drill. In this way a place is made for the packing which obviates the necessity of making a union, which always requires a lot of time and patience. Very small unions are also impractical unless they are made with the greatest precision.





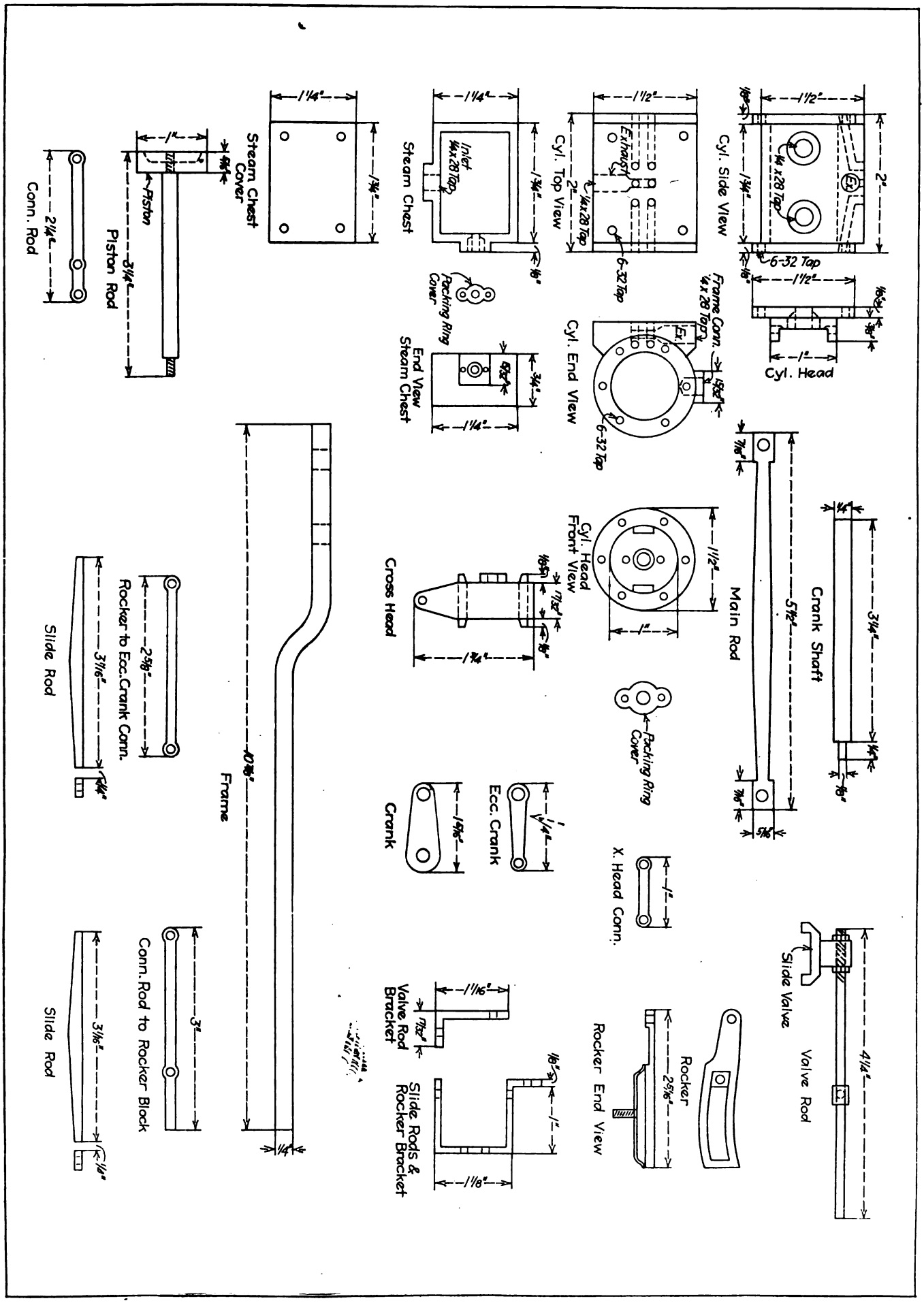
Two views of the little steam engine described in this article. A careful study of the photographs will do much to assist the builder in the construction of the engine

The cylinder head is drilled in the same manner as the steam chest. In the case of the cylinder head a 5/16-in. drill is used, first to drill the hole half way and this is followed with a 3/16-in. drill. A little packing plate is then cut to shape from thin sheet brass and placed over the hole in the cylinder end to hold the packing in place. The same thing is done with the hole in the steam chest through which the valve rod passes. The shape of these little pieces can be seen by referring to the drawing on the opposite page.

The valve rod is threaded on one end to fasten the valve to it. The stroke of the valve is regulated by means of two screws which are shown in place on the

(*Continued on page* 342)

Digitized by Google



Digitized by Google

Grinding Convex Lenses

By Victor H. Todd

TO the average person, and to many mechanics accustomed to working in metal, the process of shaping and polishing a glass lens may seem quite beyond the powers of those who have not had some experience. As a matter of fact, the making of a lens is a simple process, and is done easily on an ordinary turning lathe and does not require more skill than is required for turning out a perfect metal article. The greatest asset required is patience and time, especially on the final polishing. Of course, special glasses with bifocal curved surfaces and the like are really the subject of the professional optician, but lenses such as those used for magnifying glasses are easily produced.

Assuming that a fairly high grade speed lathe is available, it is first necessary to make a few tools, which are easily produced by the ordinary mechanic; a gauge, a gouge and a polishing fixture.

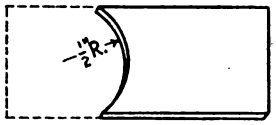


Fig.1
Brass Gauge for testing the Convex surface of lens

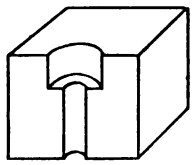


Fig.4
Cross-section of mould

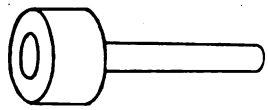


Fig.5
Polishing Fixture Casted from Fig.4

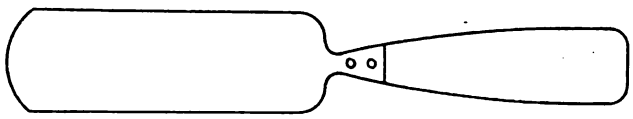


Fig.2
Gouging Chisel, Front View.

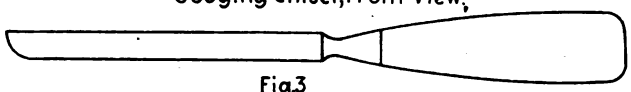


Fig.3
Gouging Chisel, Side View.

First determine the length of the desired lens; whether it is to be plano-convex (that is, flat on one side and convex on the other) or double-convex (convex on both sides) and the diameter.

Suppose we wish to make a plano-convex lens, with one inch focal length, which will magnify 10 diameters. Take a pair of dividers and set for ½ the focal length (½ in. in this case) and upon a thin sheet of brass strike a quarter or third of a circle. It may be advantageous to make a centre punch prick mark in the brass first, to get a true arc without the dividers slipping. If a double convex lens is desired, it would be necessary to set the dividers equal to the focal length and not one-half as in this case.

Now, with shears or narrow cold-chisel carefully cut the inner part of the circular segment out, and finish with a round fine file, exactly to the mark. Of course, if a cutter or other tool is available, or if proper appliances are had for cutting a circle in the lathe, it will undoubtedly make a truer and neater job. In any case, the finished gauge should look like Fig. 1 and the curved part should be part of a perfect circle.

The next tool, the gouge, is not used directly in making the lens, but is used in making the polishing fixture. It may be made of an old flat file, or a chisel, or even a wide saw blade.

The end should be carefully ground to a convex shape so that it exactly fits the concave gauge, and must be so exact that when the two are held together, toward the light, no light can be seen between them. It may be ground roughly on a coarse emery wheel and finished accurately on a finer one and at last by an oilstone. The cutting edge should not be flat like a chisel, but should be not less than 60 degrees, with the heel rounded off. The finished gouge should appear like Fig. 2 on a front view and an edge view like Fig. 3.

In order to make the polishing fixture, it is first necessary to make a wooden mould. Take a block of hardwood, about a 2-inch cube, plane one side smooth and with a sharp bit bore a hole, 1 inch in diameter, one-half inch deep, in the planed side. Then take a smaller bit and make the hole through the block. This last hole should be of a size most conveniently held in the lathe chuck. These two holes, of course, must be quite perpendicular, and if possible should be done in the lathe. A cross section of this wooden mould is shown in Fig. 4.

Next, melt some block tin or solder in a ladle, and, holding the block firmly on some firm smooth surface, pour it into the mould. On removing the casting it should present the appearance of Fig. 5. If the lathe is large enough to chuck the big end, the smaller part may be carefully trued up, so that it may be removed while shaping the lens, but we will assume it is not, so the first thing to do is to shape the lens, and then complete the polishing fixture, as will be described later.

Select a good piece of crown glass, as near as possible to the size of the lens, and cement it to a wooden center as follows: Turn a piece of wood similar to Fig. 5, except turn the front side perfectly plane, so it runs true. Now get some hard shellac (sometimes called stick shellac) and heating it in a fire, or flame, smear the end of the stick, smoothly and evenly, but very thin. Hold the glass cautiously in or near the flame until it is hot enough to make the shellac melt and stick. Smear the glass smoothly and thinly. Then, holding both the stick and glass in the flame quite close together until the shellac starts to run, press them firmly together, centering the glass as near as possible. When cold, if this cementing has been done properly, the glass will break before it will loosen from the stick.

Remove the slide rest and tail stock end chuck the stick with the glass on the end. It must be held very tightly so as not to work loose during the grinding process. Take a small emery wheel or piece of emery wheel and, setting the lathe in motion, hold the emery against the glass, first working it into a round shape and then grinding off the edges, gradually forming it into a convex shape. During the grinding the glass should be wet frequently. This can be readily done by using a sponge soaked in water and held in the left hand while the emery is held in the right hand for grinding.

The glass must not get hot enough to melt or loosen the shellac. After it has been worked into a smooth convex surface, stop the lathe and apply the brass gauge. This will immediately show where it must be ground in order to produce the right curvature. The gauge test must be made quite frequently when nearing the proper shape. Finally, it must fit the gauge so that when held up to the light no light can be seen between the gauge and glass.

When this is reached, go over it with fine emery paper to remove all scratches left by the coarser emery, being very careful not to distort the shape. Follow this with a piece of very fine whetstone until it is smooth, free from coarse scratches and still gauges up accurately. This leaves the surface ready for polishing.

Grinding a lens of this size need not

Digitized by Google

take very long unless a very thick piece of glass is used. It should not take over an hour or so. The hand very quickly acquires the knack of moving the stone around so as to give a smooth convex surface.

Remove the stick and glass and insert the moulded polishing tool in the chuck. Set the side rest squarely in front and proceed to turn the metal out of the center, using the gouge previously made.

Turn until there is a smooth concavity in the end, a little larger than the proposed lens, then dip a piece of slightly moistened flannel cloth into "putty powder" (tin oxide) and polish this concavity, being very careful not to polish it out of shape. This must also fit the gauge perfectly.

Now tie a piece of thin doeskin or other firm and thin woolen cloth over the concavity, fastening it around the sides with a piece of string. Slightly moisten the cloth and put a small quantity of putty powder over it. Start it revolving and press the glass (still held on the end of the stick) into the concavity, which it will fit perfectly. Keep up the application of moisture and powder frequently. Do not let the glass get hot enough to melt the shellac. Do not hold the glass in only one position, but rock it around in every position, taking care that it fits in accurately in any position in the polisher. If the cloth gets worn through, replace it with new. When the polishing has proceeded so far that the surface appears brilliant, and no scratches appear visible to the naked eye, the dampening and application of powder should be stopped, and polishing continued with what powder remains worked into the cloth, or, if desired, a finer polishing powder may be substituted. The polishing should not take long if the glass was finished carefully with a very fine stone as directed. It should be continued until a magnifying glass with a magnifying power of 10 diameters will not reveal the least scratch or roughness.

The lens may now be heated enough to melt the cement and removed. A little alcohol will remove all traces of shellac. If properly made, the lens will now give a clear, bright view of any object, and upon turning the glass in various positions no distortion will be noted.

It must be remembered that practice makes perfect and that this work requires a great deal of patience, as it is very tedious and the whole work may be spoiled in a few seconds by a little hurrying or impatience.

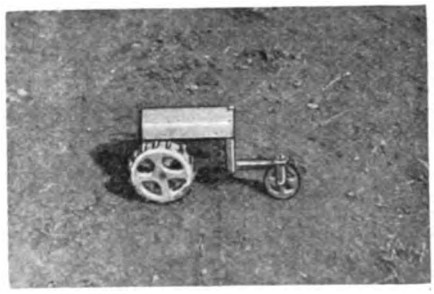
The average experimenter seems to have inherited fear of working with glass. If the directions outlined are followed, all will be well.

A Model Tractor

By Edward F. McCabe

THE making of a farm tractor may be something new in the line of models, yet there is no reason why any amateur handy with the scroll saw (which is used considerably in making the wheels) could not make this machine in a few hours.

A piece of hard wood 6 x ¼ x ⅜ in. is used in making the frame on which the clock-work, radiator and gears to the rear wheels are mounted. The clock-work from any clock will do, but try to get a clock as small as possible.



It need have no alarm, as this is not used.

The rear wheels, which are 2¾ in. in diameter, are cut from ⅜ in. hard wood, two pieces making one complete wheel. After sawing out the size of the wheel, the spokes must be cut out with a scroll saw, each piece having four spokes. Place the two pieces together so that the spokes in the first piece are just between those of the second and then glue. The small pieces of wood are glued in place. The front wheel is made of but one piece. Tin furnished the support from the frame to the front wheel.

The largest gear in the clock, which is connected with the spring, is used to drive the rear wheels, all other cogs being left in place except the balance wheel. Directly to the large gear is connected a small gear which can be taken from some other clock. This is soldered to the rear axle and fitted in the tin bearing, which is clearly shown in illustration No. 4.

The radiator is a ⅜ in. piece of hard wood with tin fastened to its center with small brads. The hood is simply a strip of tin 4¼ ins. long and 3¼ ins. wide, bent to the proper shape.

To stop and start the motor a wire is fastened as shown, so that when it is turned to the left it comes in contact with a small cog and brings it to a stop. To wind, a long key is necessary, as it must reach through the left wheel. This model will give much enjoyment and is able to pull small wagons three times its size.

The tractor can be improved by arranging a small steering wheel upon it together with a seat for the operator. The seat should be located at the back and the steering should be equipped with a long axle which will reach the front wheel.

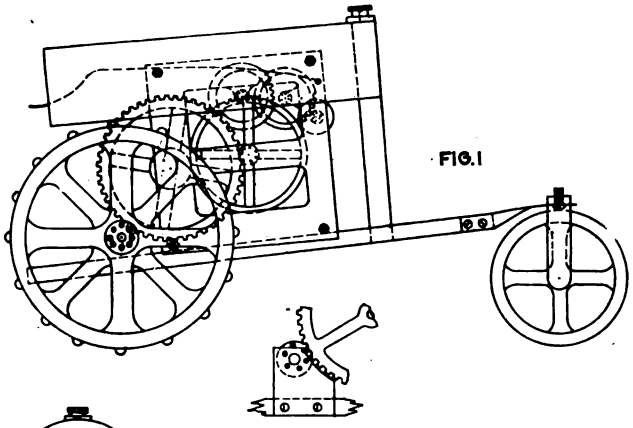


FIG. 1

FIG. 4

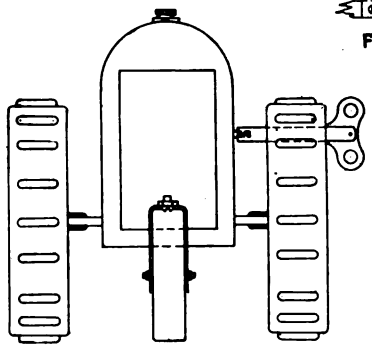


FIG. 2

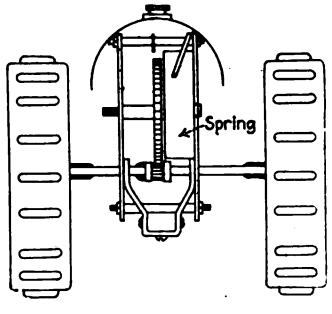


FIG. 3

Digitized by Google

Model Locomotive Design and Construction

By Henry Greenly, M. E.
Associate Member Institute Locomotive Engineers, England

IN the "old country" the standardization of model locomotive parts by the writer has been attended with a considerable degree of success and, as a result, many amateur model makers are now building satisfactory working models of their own general design where before they were limited to given types or held up by the fact that the supply of castings and accessories of interchangeable design was non-existent. Of course, the war has retarded progress in this work, but lost time is now being made up.

For the past twenty years the writer has been designing models of locomotives of all sizes as well as model rolling stock and railroad equipment. These models have comprised the toy engines and accessories for gauges 1¼ in., 1¾ in., and 2 ins., actuated by clockwork, steam and electricity such as were manufactured for the world's supply by the Germans in the Nuremberg district of Bavaria and, through all the intermediate gauges, model locomotives weighing anything from 5,000 to 6,500 lbs. capable of hauling 50 or 60 passengers, for 15 in. gauge public park and private garden railways. In numbers these models total some hundreds of different designs and naturally the result of this experience and from the data obtained from the many schemes tried out it has been possible to arrive at some measure of finality in the details of construction and to put forward a system of standardization.



Mr. Henry Greenly

In this series of articles, Mr. Henry Greenly, who was introduced to our readers in the August number of "Everyday," will cover the standardization of model American locomotive parts. Mr. Greenly is consulting and designing engineer for a large English model manufacturer and his work can be relied upon as authoritative. The drawings are the work of Mr. Greenly.—EDITOR.

The accompanying table will give the reader a little idea of the attributes of the various sizes which have had a vogue in the past. Several of them are so nearly alike—due to the parallel but in-co-ordinated efforts of British and German manufacturers, also amateur builders in pre-war days—that at this juncture the writer considers it wise to drop several of them. This advice has already been accepted and, in the small sizes especially, British model makers seem quite satisfied with the following:

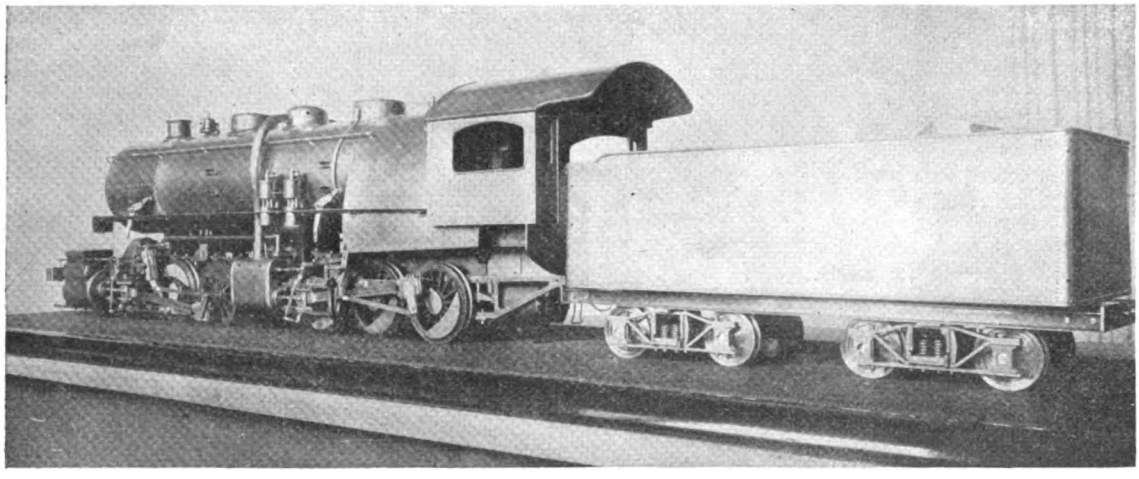
Toy Gauges—No. 0 (1¼ ins.) or 327 m. gauge; 77 m. scale. No. 1 (1¾ ins.) or 457 m. gauge; 107 m. scale.

"Engineer Made" Models—2½ ins. Nominally half inch scale, actually 17/32 in. to 1 foot. Gauge 4¾ ins. Scale 1 in. to the foot.

Passenger Carrying Locomotives—7¼ in. gauge and 15 in. gauge as already tabulated.

It is not intended in these articles to preach anything in the nature of standard locomotives. If, in America, the personal interest in the various types and design of locomotives approaches anything like the dimensions it does in Great Britain, then such a doctrine would soon prove impossible. Amateurs in the latter country have their particular "fancies." At the end of the last century the old Great Northern "single wheeler" with its 8 ft. driving wheel was the most popular engine, while the old Brunel broad gauge engines of the Great Western line had their devotees. The interest now is divided between the G.N.R. "Atlantic," a type of locomotive imported from the States and the Great Central Railway Company's 4-6-0 inside connected engine "Sir Sam Fay," a class which embodies most of the traditions of British locomotive practice. The writer's particular favorites in U. S. A. engines are those of the more recent machines built for the Pennsylvania Railroad, this preference being due to their excellent external proportions and to the scientific manner of their design.

Standard Cylinders for 2½ in. gauge models. With our Editor's permission it is the writer's intention to deal with "Character details" of various U. S. locomotives from a model maker's point of view and for the moment to give some attention to the design of what may be considered as the "heart of a working model," the cylinder—in the most popular and most suitable gauge of model locomotive for amateur building, viz., 2½ ins. Before doing so, readers may be referred to the diagrams, Figs. 1, 2 and 3, which give the leading dimensions in inches of a model 2½ ins. gauge, Atlantic 4-4-2 type engine. This locomotive can be fired with charcoal or alcohol (methylated spirit). It is also eminently suitable for amateur construction and for an outdoor model



A model American locomotive built by an English model enthusiast. The loco. is a Baltimore and Ohio "Mallet," articulated. It was constructed by Rene Bull

Digitized by Google

railroad. The proportions, if adhered to more or less exactly, are bound to provide a successful model, given reasonably accurate workmanship with special attention to the cylinder details and to the steam tightness of the boiler.

The cylinder of a model locomotive must be made smaller than the scale equivalent. As working pressures cannot, from a practical point of view, be reduced to scale, in a 2½ in. gauge model which is roughly 1/24th full size, it would prove impossible to reduce 200 lbs. square inch to 1/24 of 200, owing to the increase in the proportion of condensation losses as an engine is reduced in size, a working pressure of from 50 to 60 lbs. is usually employed. The size of the cylinder and working pressure could be calculated from the point of view of tractive effort and adhesion weight, but such factors are governed by other considerations such as the reduction of working pressure due to the withdrawing of the steam. Readers will therefore welcome a simple rule based on actual model experience. With a normal boiler the size of the cylinder may be determined by the following formula:

Bore of cylinder in inches = 1.5 S —.125 where S is the scale of the model in inches to the foot.

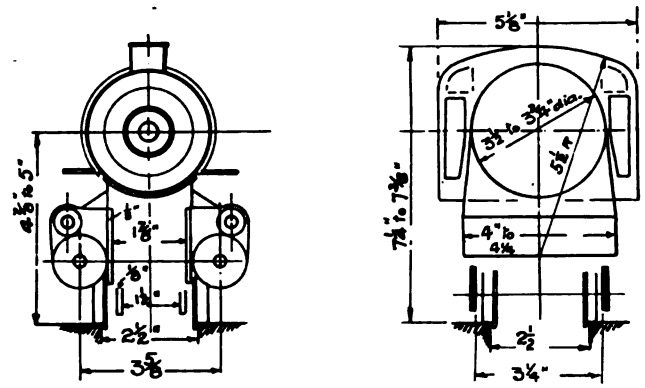


FIG.2

FIG. 3

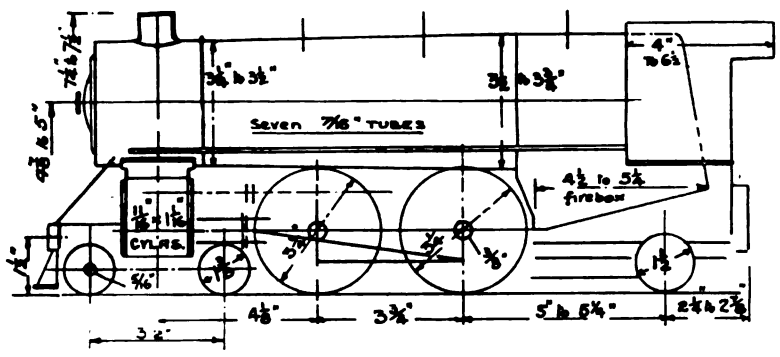


FIG.1

Fig. 1. Elevation giving leading standardised dimensions of a half-inch scale 2½ in. gauge loco., Atlantic tyype. Fig. 2. Front view showing frame width at cylinders. Fig. 3. Rear end giving cab and firebox dimensions.

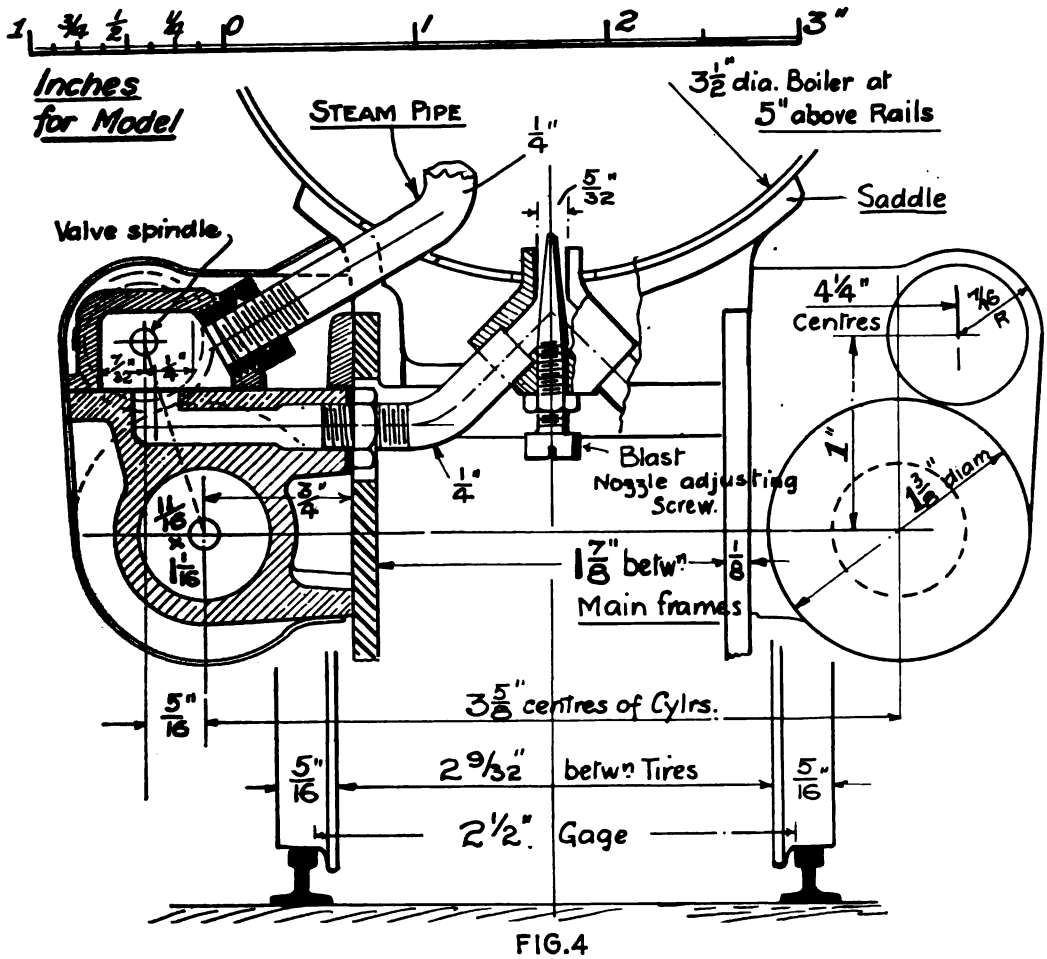


FIG.4

Standard "half-inch" scale locomotive cylinder (modern piston valve type) cross-section and end view

For a 2½ in. gauge engine the scale may be taken as 17/32 in. or .531 in. and the result of the application of the formula gives .666 in., which is practically 11/16 in. The stroke of a model cylinder must as a rule, for spectacular reasons, be somewhere near the scale equivalent and therefore requires no special calculation. Should any model locomotive engineer wish to consider the size of the cylinder from the tractive effort point of view, he may take it that the steam pressure will be reduced at the cylinder to something like half of its nominal pressure, as he reads it at the boiler pressure gauge and that a tractive effort, on paper, of at least one-third of the adhesive weight may be provided for in a small model without risk of excessive slipping.

In making a model of any existing prototype, the dimensions and weight of which is known, the 2½ in gauge

Digitized by Google

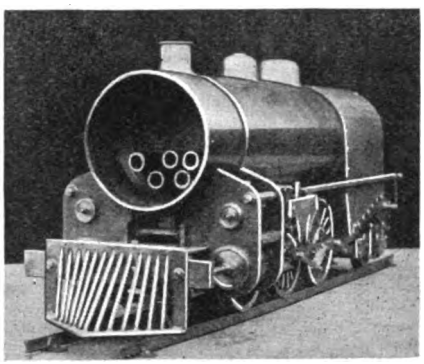
model will weigh at least .165 lbs. for every ton (American, 2,000 lb. ton) of the original. A model varies roughly as the cube of the scale and the reciprocal of the above coefficient used in model work for 2½ in. gauge is

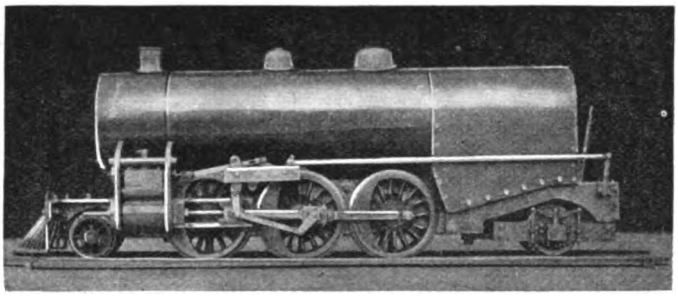
1 lb. of model = 6.06 American tons of prototype.

In figuring out the adhesive weight it should be noted that it is best practice in arranging the spring gear of a working model to crowd on to the driving and coupled wheels a little more weight than the equivalent at the expense of that carried by bogie and pony trucks.

So much for what may be termed theoretical considerations. The cylinder of an American engine are usually outside the frames with the valves above the pistons. In most modern prototypes piston valves are employed, but in model practice such as not satisfactory under 1½ in. or 1¾ in. in diameter and therefore, for 2½ in. gauge engines may be entirely ruled out.

To preserve the external features of a piston valve cylinder a design similar to that shown in the accompanying full size drawings, Figs. 4 to 8, has been employed by the writer with success. The cylinder and steam chest is cast separately, gunmetal being usually employed. The end faces





Semi-finished American type model locomotive

are machined true after the two parts have been fitted together, preferably from the bore of the cylinder, the casting being mounted on a mandrel for this purpose. The cylinder and steam chest are finished off to the correct profile by a lagging or cleaning strip of planished metal—blue or Russian iron, for example, looks very well. The valve is of the time honored "D" type and to provide for Walschaerts' or other type of radial valve gear the valve spindle is offset to the extent shown on the cross sectional drawings (see Figs. 4, 7 and 8).

The castings are arranged so that they may be moulded from metal patterns without coreboxes, the writer having found that for cylinders under ¾ in. bore no advantage accrues from the use of cores for cylinder bores. It is easier and cheaper in the long run, even for quantity production to rough drill the cylinders at the outset, and to complete all further machining operations from the bore.

All the steam passages are formed by drilling, the ports at the valve face being either chipped by hand or end-milled to the rectangular shape indicated in the plan view (Fig. 7). The steam passage should be two adjacent 3/32 in. holes, the

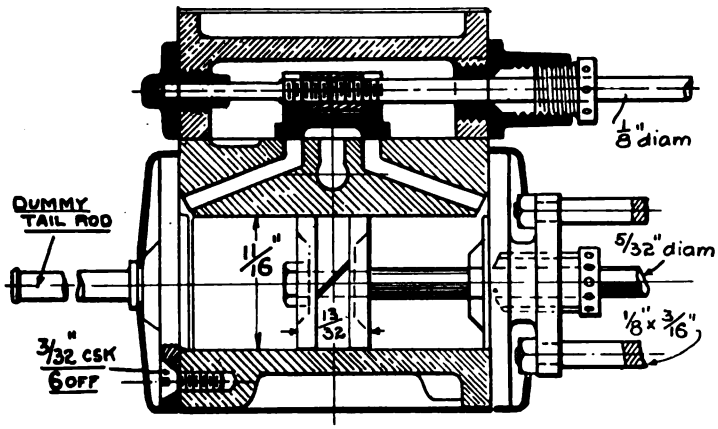


FIG. 5

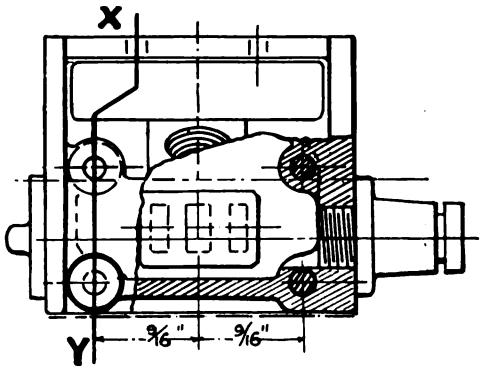


FIG. 7

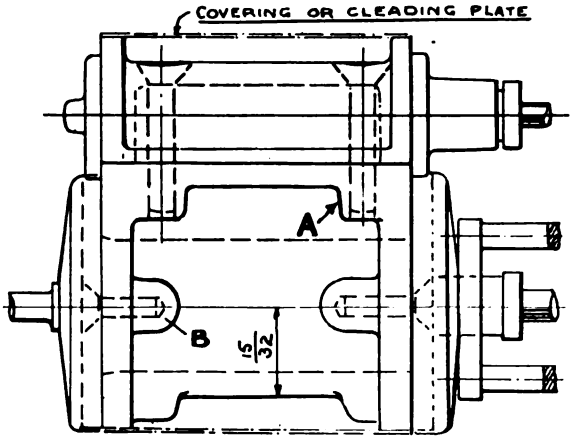


FIG. 6

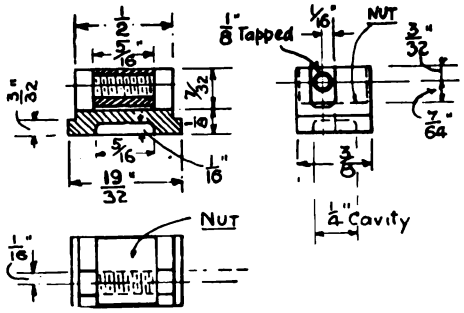


FIG. 9

Fig. 5. Longitudinal section of standard cylinders. Fig. 6. Elevation of standard cylinders. Fig. 7. Plan of steam chest. Fig. 9. Detail of slide valve and nut

Digitized by Google

exhaust being a tapping hole for ¼ in. copper pipe. The steam chest is held down to the cylinder castings by four ⅛ in. countersunk screws as shown in Figs. 6, 7 and 8, bosses being provided for these fastenings in the walls of the steam chest casting as indicated in the plan view, Fig. 7, and in cylinder casting as shown at A, Fig. 6.

The valve spindle is supported at both ends. This arrangement being more or less essential where a radial valve gear is employed and where the spindle is not provided with an outer guide. Both the packed and the

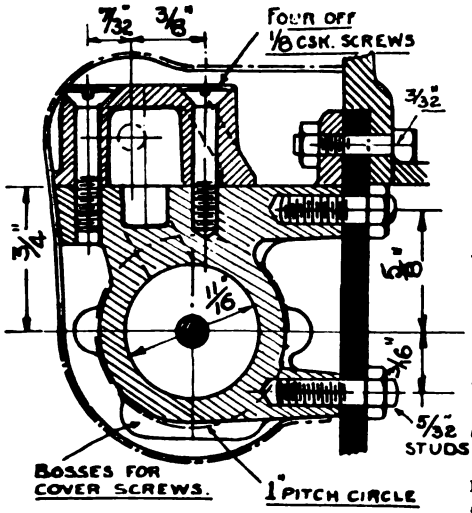


FIG. 8

Cross-section of cylinder on line XY

"dummy" glands are screwed into the steam chest. These glands may be made out of nickel bronze (German silver) polished bright or turned from brass bar and then nickel plated. The cylinder covers are capped with spun or pressed sheet metal caps which are a snap fit on the main covers and may also be nickeled. The back cover supports the slide bars, the stuffing box having an oval flange which is jig drilled at diametrically opposite centers, ⅜ in. radius, to receive the shouldered-down spigots of the rectangular steel slide bars. The slide bars are then secured by nuts as shown in Fig. 5. The pistons may be made in several styles and as the points involved in piston design and packing will be discussed at a later date, reference to their construction may be deferred. However, it is essential that the cylinder bore should be true to one-half a thousandth and the minimum and maximum clearances (including tolerance and allowance) between piston and cylinder should fall between ½ and 1 thousandth of an inch. The piston and piston rod should be true in alignment. This is very essential. The front end of the cylinder should be bell-mouthed but to assist in obtaining perfect alignment the spigot of the back cover should fit tightly in the parallel bore of the cylinder. Six countersunk screws are used to attach the cover bosses, being provided where required in the cylinder castings to accommodate these screws as shown at B, in Fig. 6.

The slide valve is driven by a rectangular nut fitting easily in a slot filed or machined in the back of the valves. The valve is set over, towards the inside, as shown in the detail drawing in Fig. 9, and the nut is therefore drilled and tapped accordingly. This nut provided for an adjustment of the valve on its valve spindle and as this can only be accomplished within the limits of half a turn of the spindle, the thread chosen should be the finest available.

The writer has given considerable attention to superheating in models and also to the effects produced by various arrangements of exhaust nozzles (blast pipes). In the standard arrangement shown herewith (Fig. 3), an adjustable nozzle is provided for. This adjustment can be effected from the outside and therefore experiments can be made with steam up. The blast pipe unit is a complete assembly and may be fitted on the running joint principle, sufficient length of thread being provided in one cylinder and on one arm of the blast pipe to make this possible. The unit is made steam-tight by lock nuts and a joint washer. The nozzle should be silver-soldered to the pipes.

Inside the smokebox the steam pipes (these are dual and joined to a common superheater) should be bent to clear the jet of exhaust steam. A system of running joint is also suggested for fixing the ends of the steam pipes to the valve chest casting. A flanged nipple is screwed inside and outside with a thread of the same or nearly the same pitch. The inside thread should, of course, suit the ¼ in. diameter steam pipe. A lock nut is also provided both the lock nut and the nipple being slightly countersunk on their adjacent faces to provide for a redlead grummet. To fix a steam pipe the nipple is screwed onto the pipe about double its normal or final distance. The pipe is then placed opposite the tapped hole in the valve chest casting and the nipple screwed in up to its flange, the joint being grummeted with some sewing cotton and red lead. The nipple, of course, screws off the pipe to its final position but the lock nut is run down to it and similarly grummeted to make the whole joint steam tight. This arrangement saves using a union and is more compact.

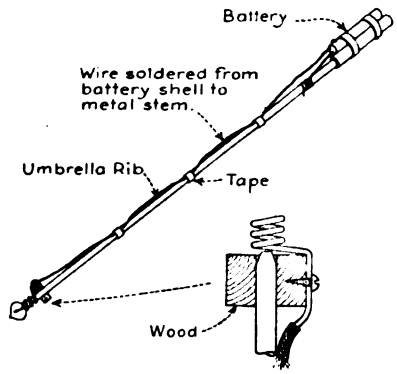
The cylinders are secured to the frames by four well fitting studs 5/32 in. in diameter. An additional support may also be provided by two bolts or studs fitting into a wall cast on the steam chest as shown in Fig. 4.

These studs or bolts also assist in securing the saddle casting to the main frames of the engine.

As the steam chest is none too roomy the corners of the slide valves may require to be removed to provide for sufficient travel. To give additional clearance the lower portions of the bosses round the fixing screws may be chipped away on the inside. The diagrams herewith among other things give the accepted standard dimensions of wheel tires for 2½ in. gauge engines.

Inspection Lamp on Umbrella Stem

IN many places where an inspection must be made in dark locations, as, for instance, back of pipes, or boilers, where an ordinary flashlight cannot be used to advantage, the lamp may be placed on the end of an old, dismantled umbrella cane, with the battery strapped on the handle, as shown in the illustration. For the socket, take a piece of wood and drill a hole so that it will slip tightly over the end of the



cane. An empty thread spool will do nicely. Then wind several turns of No. 16 bare copper wire around the lamp base threads and tack it to the spool as shown in the insert. Connect a piece of lamp cord from this to the inner connection on the battery, and connect the shell to the metal umbrella stem. The push button controls the lamp in the regular way. If desired, a small mirror may be placed on the end, in addition to the lamp, and the two will reveal points which may be entirely inaccessible in any other way.

VICTOR H. TODD.

New Process for Aluminum

A new process has been perfected which will do much to broaden the application of metallic aluminum. It does not produce a new alloy but merely gives aluminum new properties. These new properties give aluminum greater tensile strength and increased electrical conductivity. It is claimed that within a short time aluminum will be replacing copper more than ever before as a conductor of electrical current. Aluminum is used to a great extent to-day in high voltage transmission where resistance is not a large factor.

Digitized by Google

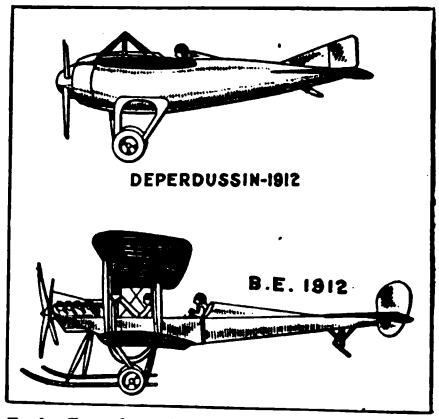
Fuselage Design to Reduce Resistance

THE problem of reducing resistance of an airplane in flight has received the attention of scientists for many years, even prior to the construction of airplanes that would fly. In a very complete paper head by N. Y. Lieberman, M. S. A. E., before the Buffalo section of the society, many interesting facts were brought out. A very interesting table showing the influence of streamline construction in reducing fuselage resistance is reproduced herewith from the S. A. E. Bulletin will show our readers interested in the construction of either full size or model airplanes why it is important to use a streamline construction for every part of an aircraft where it can be incorporated. The values given were determined by wind tunnel tests.

The general design of the fuselage is frequently fixed by considerations other than those of a purely aerodynamic nature. Mounting a flexible gun in the rear cockpit with the average type fuselage causes a break in the lines of air continuity. The outlines of the engine generally have a marked influence on the cross-sectional and fore and aft disposition of both space and lines. Fighting equipment, observation apparatus, the controls, the arrangement of the pilot and crew, all of these have their individual weight in deciding the shape best suited to the particular conditions.

In general discontinuity of outline is avoided as much as possible. The faster the design-speed of the machine, the greater must be the consideration given to the "wake" of the larger bodies. Many designs have consequently been developed, varying in their treatment of virtually the same problem, that of carrying the power plant and its fuel, the pilot and the crew and the accessory load.

The early forms with open framework are all now replaced with a continuously surfaced structure. Apertures are kept down to the minimum since theory indicates and experiments show that these add to the total resistance by disturbing the streamline flow. The main distinction in fuselages centers about the differences between the "short type plus tail booms," and the "long continuous type." The Farman and Voisin construction in French planes, the Vickers Gun-Bus and all the FE derivatives are of the first class. Most of the fuselage construction, however, is of the long continuous type, even when the extended construction merely serves as a boom to the tail as in the Caproni.



Early French and English airplanes showing first closed type fuselage designs

The resistance co-efficients now available on these various types are meager and disconnected. That is, knowing the co-efficient for one form of fuselage does not materially help in determining the resistance of another form. The forms and co-efficients in the table are the results of both early and recent tests. The co-efficients in the table are all for 1 sq. ft. of cross-section at a velocity of 100 M. P. H., the fuselage inclined 6 deg. to the direction of the wind. The fineness ratio or the maximum length divided by the maximum depth is also noted.

Fuselage	Length ÷ Depth	Resistance Lb. per Sq. Ft.	Fuselage	Length ÷ Depth	Resistance Lb. per Sq. Ft.
FARMAN NO.1. (NO RADIATOR)	3.2	6.53	F.E.2B.	4.6	13.88
FARMAN NO.2 (NO RADIATOR)	3.2	8.56	F.E.2C	4.6	13.05
FARMAN NO.3 (NO RADIATOR)	4.3	14.69	F.E.8	3.1	10.00
DEPERDUSSIN (OPEN MOTOR)	5.3	10.20	DEPERDUSSIN (COVERED MOTOR)	5.2	7.55
S.E.4A	4.7	4.92	S.E.5.	5.6	12.85
B E 2C	7.2	5.71	B.E.3	6.2	8.65
AVRO	6.8	11.10	F.E.7	7.6	5.91
STREAMLINE (ROUND SECTION)	6.4	3.80	STREAMLINE (ROUND SECTION)	6.4	4.98
STREAMLINE (SQUARE SECTION)	6.0	4.08	STREAMLINE (SQUARE SECTION)	6.0	5.35

Diagrams showing influence of fuselage design on resistance and how the streamline form is the most efficient

The advantages of streamline construction and the enclosure of the fuselage frame was apparent to experimenters as soon as the first crude wind tunnel tests were made and both the French and English contrived designs as early as 1912 that had enclosure of the fuselage as an object. The French Deperdussin design, illustrated above, may be considered the parent type of the present Spad and it was a product of the same designer. The streamline design resulted in a speed of 120 miles per hour, a remarkable speed for that time nearly a decade ago, as it was made with a 100 horsepower motor. The machine was a single seat monoplane. The English type, the B. E., was a passenger carrying biplane and naturally was not as efficient aerodynamically.

Digitized by Google

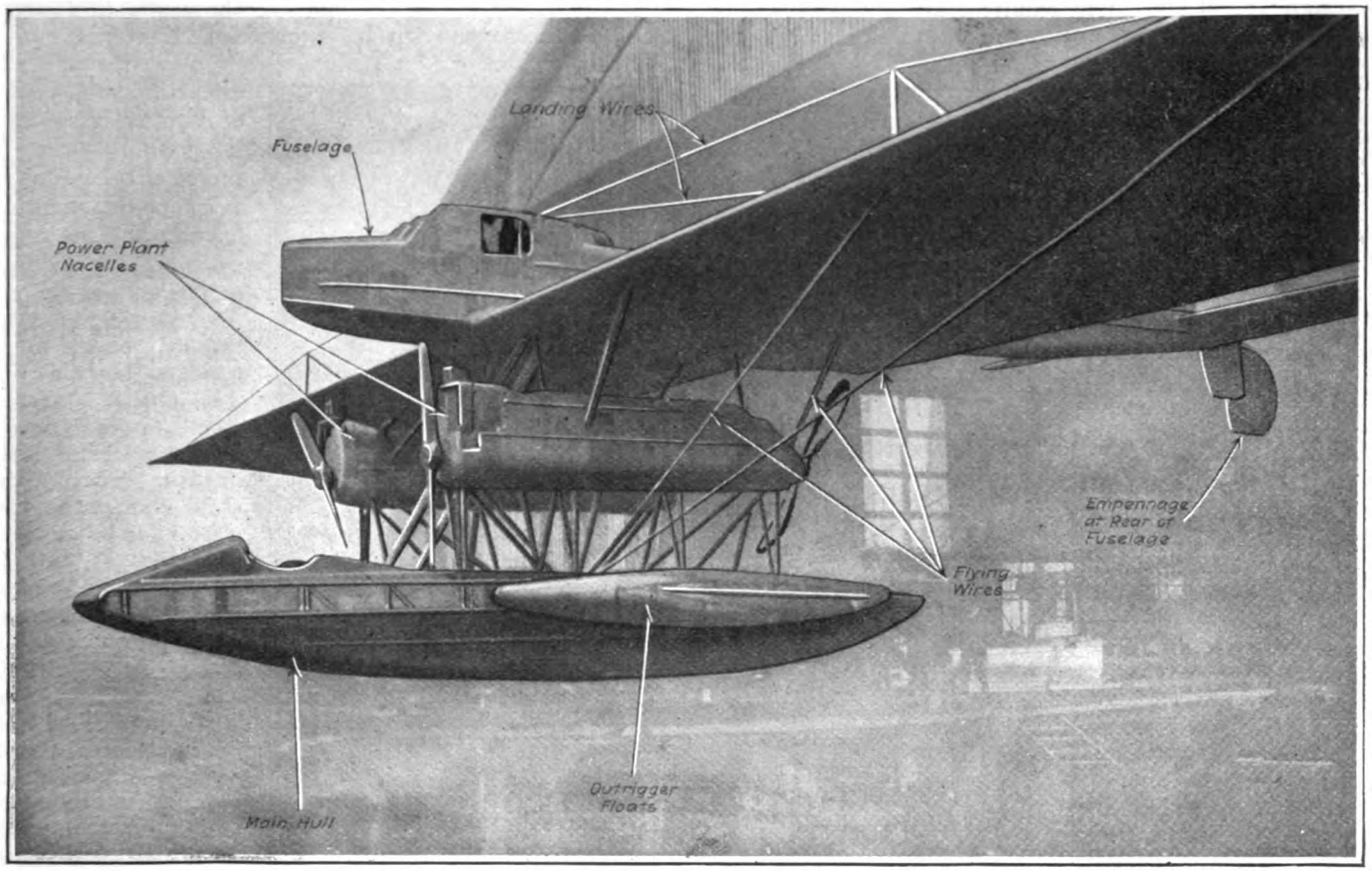
Large Monoplanes Practical

THE Zeppelin-Lindau flying boat may be considered a very interesting development of the monoplane. It is equipped with an aggregate of over 1,000 horsepower, divided into four 260 horsepower motors. The machine has a span of 120 feet, carries fuel for twenty hours and complete armament and instrument equipment, yet is a monoplane with wire trussing at top and bottom of wings. The single hull under the wing may be termed a flying boat rather than a float. The fuselage which supports the tail surfaces is placed above the wings and serves for attachment of the landing wire bracing. The total weight is twelve tons. This machine seems to discredit general belief in the aviation world that monoplanes can be built only in small sizes with any degree of success and therefore any future development along these lines will be watched closely.

The general details of construction can be clearly understood by inspecting the accompanying illustration which has just been received from Germany and which depicts the giant craft outside of its hangar. The power plant arrangement in two nacelles placed under the wings and over the hull, one at each side, is clearly shown. There is a pusher screw at the rear of each engine nacelle and the usual form of tractor screw at the front end. Outrigger floats of metal are placed at each side of the hull under the engine compartments in order to assist in carrying the heavy load when the machine is at rest on the water and the hull settles low in the water. When the machine attains a certain speed, the main hull is sufficient to carry the load and the outrigger floats are lifted clear of the water.

These floats are of aerofoil form at the top, having a cambered upper surface and probably contribute some useful lift when the machine is in flight. There seems to be ample accommodations on this craft, as mechanics can be carried in each engine nacelle, passengers or freight in the hull, and still more passengers and the navigators in the cabin on top of the planes which forms the front end of the fuselage. The machine probably has a useful load capacity, or at least six tons, and is a splendid example of pioneer work in aeronautical engineering because it is so unusual in design. It is evident that this machine was intended for long flights, as every provision seems to have been made for housing the pilots and the use of enclosed nacelles for the engines would permit mechanics to make minor power plant repairs while the airplane was in flight.

It is reasonable to assume that the four engines would be needed only when the machine was fully loaded and that after it had discharged its cargo or bombs and had used the greater part of its fuel that it would be sufficiently lightened to permit of flight with two of the motors. This craft was originally built for bombing purposes and was being tried out when the armistice was signed. It has now been turned over to the Allied Commission and several of the powers want the airship for experimental purposes. Latest reports indicate that the machine is an all metal construction, the wings being made of a metal frame and aluminum alloy sheet covering.



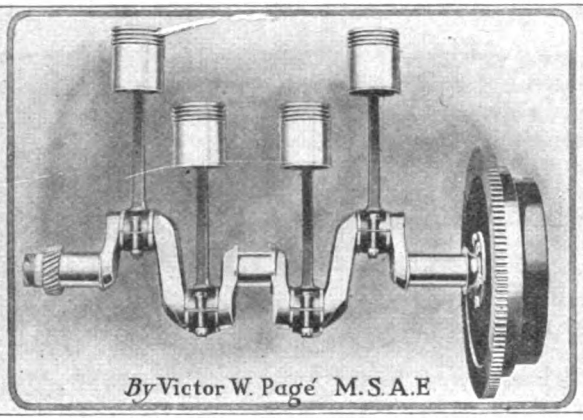
The Zeppelin-Lindau monoplane flying boat is claimed to be the largest craft of this type ever constructed

---

The Paris-London Air Express is now an established fact. The trip is made in from 2½ to 5 hours, depending on the type of airplane used, number of passengers carried and flying conditions. The planes are to leave Paris and London simultaneously at noon and the fare in one direction is $100 or about four times that if the trip is made by rail and boat. Freight is to be carried, the rate varying from $1.25 to $2.50 per pound. De Haviland planes are used by one company and Handley Page types by another. The smaller planes will carry two passengers. The larger has accommodations for ten passengers.

Digitized by Google

FITTING AND ADJUSTING CONNECTING ROD BEARINGS



By Victor W. Page M.S.A.E

PART III.

Refitting Bearings by Scraping

WHEN the bearings are not worn enough to require refitting, the lost motion can often be eliminated by removing one or more of the thin shims or liners ordinarily used to separate the bearing caps from the seat. These are shown at Fig. 2 A. Care must be taken that an even number of shims of the same thickness are removed from each side of the journal. If there is considerable lost motion after one or two shims have been removed, it will be advisable to take out more shims and to scrape the bearing to a fit before the bearing cap is tightened up. It may be necessary to clean up the crankshaft journals as these may be scored, due to not having received clean oil or having had bearings seize upon them. It is not difficult to true up the crank-pins or main journals if the score marks are not deep. A fine file and emery cloth may be used, or a lapping tool such as depicted at Fig. 2 B. The latter is preferable because the file and emery cloth will only tend to smooth the surface and there is always the danger of having the crankpins or journals out of round unless the work is done by an expert, while the lap will have the effect of restoring the crank to proper contour.

A lapping tool may be easily made, as shown at B, the blocks being of lead or hard wood. As the width of these are about half that of the crank-pin, the tool may be worked from side to side as it is rotated. An abrasive paste composed of fine emery powder and oil is placed between the blocks, and the blocks are firmly clamped to the crank-pin. As the lead blocks bed down, the wing nut should be tightened to insure that the abrasive will be held with some degree of pressure against the shaft. A liberal supply of new abrading material is placed between the lapping blocks and crankshaft from time to time and the old mixture cleaned off with gasoline before new material is applied.

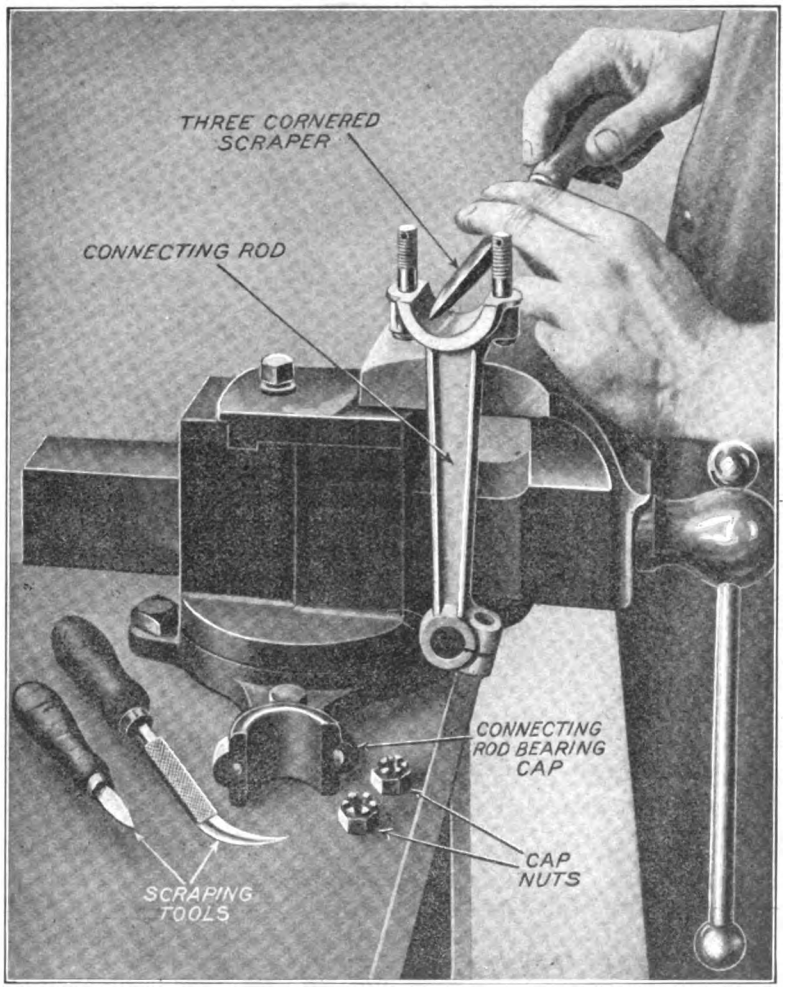


Fig. 1. Illustrating method of scraping in connecting rod bearings and tools used in this process

It is necessary to maintain a side-to-side movement of the lapping tool in order to have the process affect the whole width of the crank-pin equally. The lapping is continued until a smooth surface is obtained. If a crank-pin is worn out of true to any extent the sure method of restoring it is to have it ground down to proper circular form by a competent mechanic having the necessary machine tools to carry on the work accurately. A crank-pin truing tool that may be worked by hand is shown at Fig. 2 K, and if the automobile owner or repairman is possessed of the requisite mechanical skill, though he does not need to be an expert mechanic, it can be used to good advantage in truing roughened crank-pins and will do a good job.

This tool is of recent development, and is known as a "crankshaft equalizer." It is a hand-operated turning tool, carrying cutters which are intended to smooth down scored crank-pins without using a lathe. The feed may be adjusted by suitable screws and the device may be fitted to crank-pins and shaft journals of different diameters by other adjusting screws. This device is not hard to operate, being merely clamped around the crankshaft in the same manner as the lapping tool previously described, and after it has been properly adjusted it is turned around by levers provided for the purpose, the continuous rotary motion removing the metal just as a lathe tool

Digitized by Google

would and with a perfectly smooth cut.

Automobile owners and repairmen who wish to save money during the overhauling period, may do so through the use of another recently devised hand tool for grinding crankshafts instead of doing that work on a lathe or other equipment required. This device, shown at Fig. 3, eliminates the lathe or grinder, the cost of experienced operators, and may be used upon a crankshaft without removing the latter from the engine. The working parts of the Atlas abrasive tool for grinding crankshafts are as follows: 1. A hardened steel cutter which cuts in one direction only. 2. A bronze track bearing, opposite the cutter. This bearing cannot cut a ring in a pin like hard steel nor freeze against a pin from excess friction like soft steel. 3. Adjustable abutment blocks which slip up easily against the face of the crankpin and hold the cutter and track in their proper working place.

Its work is claimed to be accurate to .001 in., fully as good as any machine shop will guarantee with a lathe. It works quickly, as an hour suffices to complete an entire crankshaft. It is adjustable to fit any crankshaft up to 2½ in. diameter. The price is reasonable. Extra cutters, one used at a time, are only a few cents each. Each cutter will true up from ten to twenty pins or bearings, according to their condition.

After the crankshaft is trued the next operation is to fit it to the main bearings or rather to scrape these members to fit the shaft journal. In order to bring the brasses closer together, it may be necessary to remove a little metal from the edges of the caps to compensate for the lost motion. A very simple way of doing this is shown at Fig. 2 D. A piece of medium emery cloth is rested on the surface plate and the box or brass is pushed back and forth over that member by hand, the amount of pressure and rapidity of movement being determined by the amount of metal it is necessary to remove. This is better than filing, because the edges will be flat and there will be no tendency for the bearing caps to rock when placed against the bearing seat. It is important to take enough off the edges of the boxes to insure that they will grip the crank tightly. The outer diameter must be checked with a pair of calipers during this operation to make sure that the surfaces remain parallel, otherwise the bearing brasses will only grip at one end and with such insufficient support they will quickly work loose, both in the bearing seat and bearing cap.

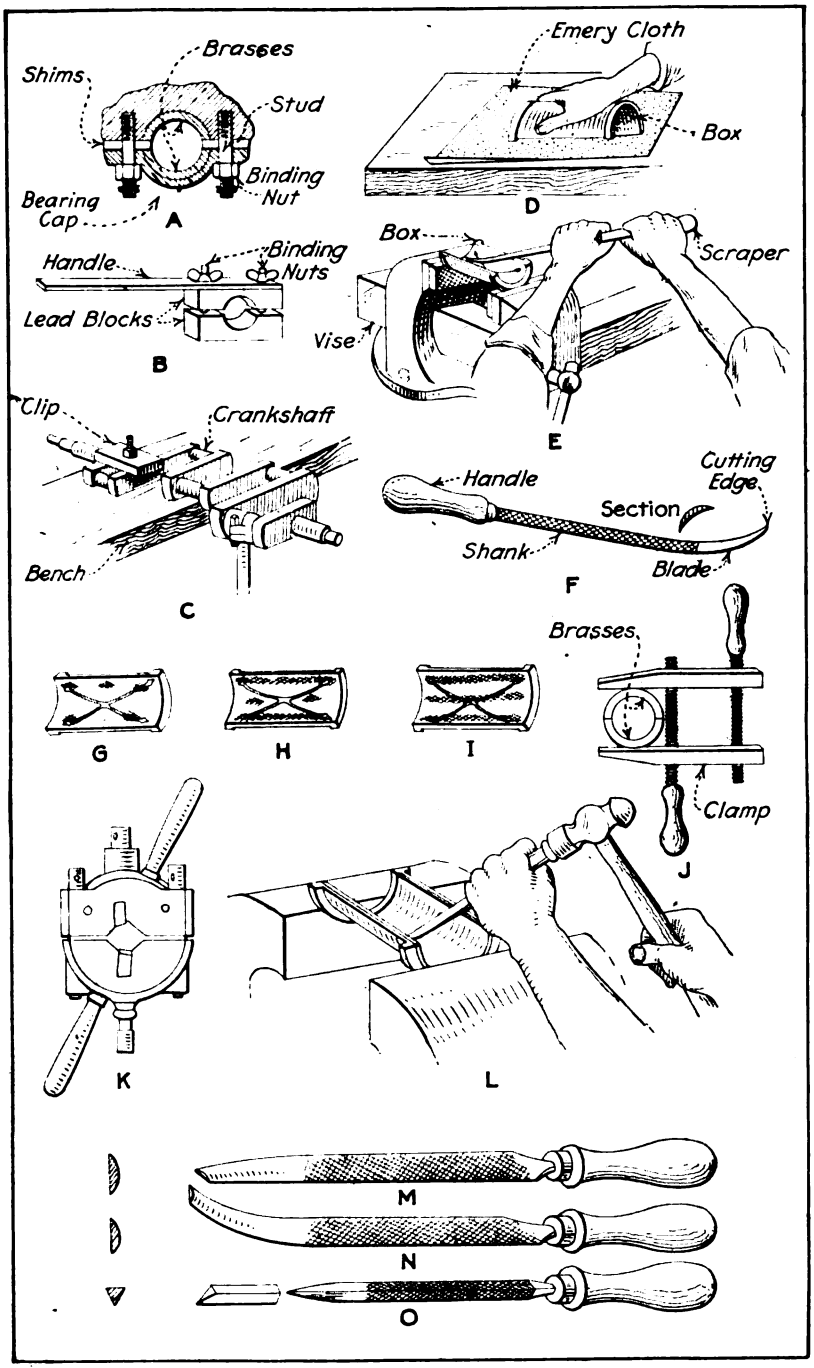


Fig. 2. Tools and processes used in refitting engine bearings

Scraping Brasses to Fit

To insure that the bearing brasses will be a good fit on the trued-up crankpins or crankshaft journals, they must be scraped to fit the various crankshaft journals. The process of scraping, while a tedious one, is not difficult, requiring only patience and some degree of care to do a good job. The surface of the crank-pin is smeared with Prussian blue pigment which is spread evenly over the entire surface. The bearings are then clamped together in the usual manner with the proper bolts, and the crankshaft revolved several times to indicate the high spots on the bearing cap. At the start of the process of scraping in, the bearing may seat only at a few points, as shown at Fig. 2 G. Continued scraping will bring the bearing surface as indicated at H, which is a considerable improvement, while the process may be considered complete when the brass indicates a bearing all over, as at I. The high spots are indicated by blue, as where the shaft does not bear on the bearing there is no color. The high spots are removed by means of a scraping tool of the form shown at Fig. 2 F, which is easily made from a worn-out file. These are forged to shape and ground hollow as indicated in the section and are kept propely sharpened by frequent rubbing on an ordinary oil stone. To scrape properly, the edge of the scraper must be very keen. The straight and curved half-round scrapers, shown at M and N, are used for bearings. The three-cornered scraper, outlined at O, is also used on curved surfaces, and is of special value in rounding off sharp corners. The straight or curved half-round type works well on soft-bearing metals, such as babbitt or white brass, but on yellow brass or bronze it cuts very slowly, and as soon as the edge becomes dull considerable pressure is needed to remove any metal, this calling for frequent sharpening.

When correcting errors on flat or curved surfaces by hand-scraping, it is

Digitized by Google

desirable, of course, to obtain an evenly spotted bearing with as little scraping as possible. When the part to be scraped is first applied to the surface-plate, or to a journal in the case of a bearing, three or four "high" spots may be indicated by the marking material. The time required to reduce these high spots and obtain a bearing that is distributed over the entire surface depends largely upon the way the scraping is started. If the first bearing marks indicate a decided rise in the surface, much time can be saved by scraping larger areas than are covered by the bearing marks; this is especially true of large shaft and engine bearings, etc. An experienced workman will not only remove the heavy marks, but also reduce a larger area; then, when the bearing is tested again, the marks will generally be distributed somewhat. If the heavy marks which usually appear at first are simply removed by light scraping, these "point bearings" are gradually enlarged, but a much longer time will be required to distribute them.

The number of times the bearings must be applied to the journal for testing is important, especially when the box or bearing is large and not easily handled. The time required to distribute the bearing marks evenly depends largely upon one's judgment in "reading" these marks. In the early stages of the scraping operation, the marks should be used partly as a guide for showing the high areas, and instead of merely scraping the marked spot the surface surrounding it should also be reduced, unless it is evident that the unevenness is local. The idea should be to obtain first a few large but generally distributed marks; then an evenly and finely spotted surface can be produced quite easily.

In fitting brasses, when these are of the removable type, two methods may be used. The upper half of the engine base may be inverted on a suitable bench or stand and the boxes fitted by placing the crankshaft in position, clamping down one bearing cap at a time and fitting each bearing in succession until they bed equally, as shown at Figs. 4 and 5. From that time on the bearings should be fitted at the same time so the shaft will be parallel with the bottom of the cylinders. Considerable time and handling of the heavy crankshaft may be saved if a preliminary fitting of the bearing brasses is made by clamping them together with a carpenter's wood clamp, as shown at Fig. 2 J, and leaving the crankshaft attached to the bench as shown at C. The brasses are revolved around the crankshaft journal and are scraped to fit wherever high spots are indicated until they begin to seat fairly. When the brasses assume a finished appearance the final scraping should be carried on with all bearings in place and revolving the crankshaft to determine the area of the seating. When the brasses are properly fitted they will not only show a full bearing surface, but the shaft will not turn unduly hard if revolved with a moderate amount of leverage.

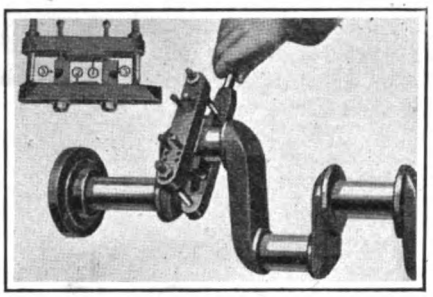


Fig. 3. Special tool for truing crankpins and shaft journals

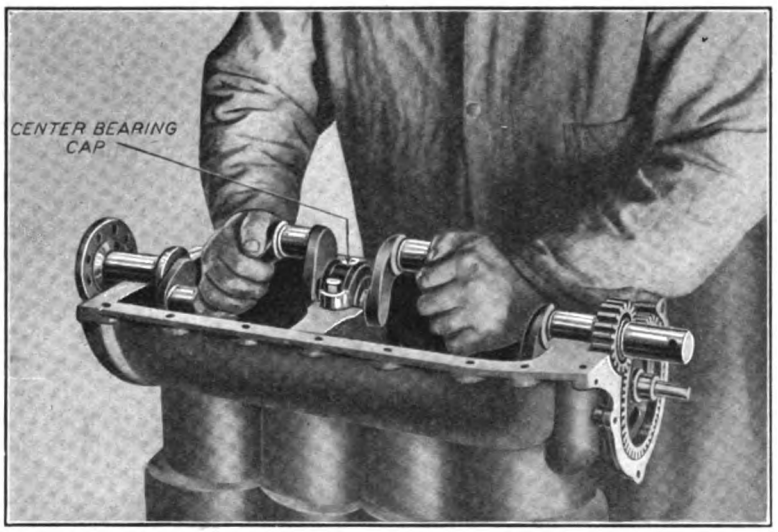


Fig. 4. Showing method of testing main bearings when refitting by rocking the crankshaft by hand

Bearings of white metal or babbitt can be fitted tighter than those of bronze, and care must be observed in supplying lubricant, as considerably more than the usual amount is needed until the bearings are run in by several hours of test block work. Before the scraping process is started it is well to chisel an oil groove in the bearing as shown at Fig. 2 L. Grooves are very helpful in insuring uniform distribution of oil over the entire width of bearing and at the same time act as reservoirs to retain a supply of oil. The tool used is a round-nosed chisel, the effort being made to cut the grooves of uniform depth and having smooth sides. Care should be taken not to cut the grooves too deeply, as this will seriously reduce the strength of the bearing bushing. The shape of the groove ordinarily provided is clearly shown at Fig. 2 G, and it will be observed that the grooves do not extend clear to the edge of the bearing, but stop about a quarter of an inch from that point. The hole through which the oil is supplied to bearing should be drilled through in such a way that it will communicate with the groove to insure positive distribution.

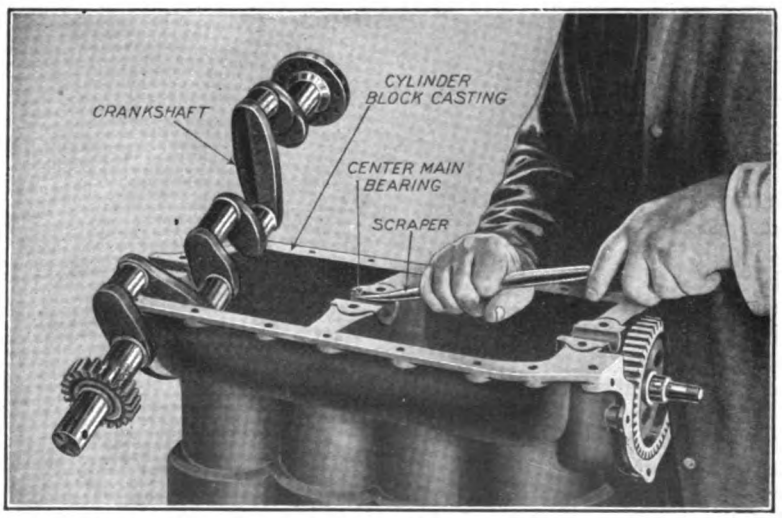


Fig. 5. Showing method of scraping in main bearings to fit crankshaft journals

Digitized by Google

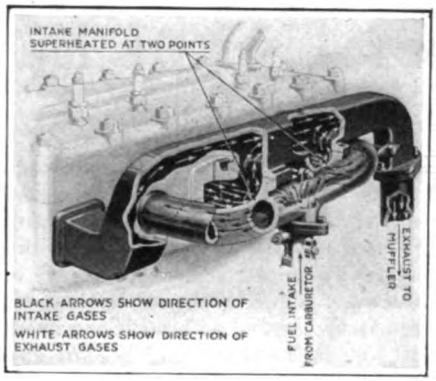
Vaporizing Low Grade Fuels

THE great demand existing for liquid fuels for use with internal combustion motors has resulted in the producers including some of the fractions of lower volatility in the gasoline used today to increase the volume of production to endeavor to cope with the demand. The new fuel is different from the gasoline sold in former years in that it does not vaporize as readily and engine designers have been forced to take this into consideration when new engines are designed. It is a reasonable assumption that the fuels sold for automobile use will not improve in quality as time goes on, so the new engines must be designed with heated manifolds or thermostatic cooling water control to insure sufficient heat as a guarantee of complete vaporization.

With a view to improving carburetion, the intake manifold of several power plants, in both overhead-valve and L-head types of engine, is cast entirely within the detachable cylinder head, connection with the carburetor being effected by an integral cross passage between the third and fourth cylinders, to the opening of which is bolted a short elbow supporting the carburetor. A small portion of this elbow is integral with the exhaust, forming a hot spot of limited proportions to assist in breaking up the fuel before it enters the manifold.

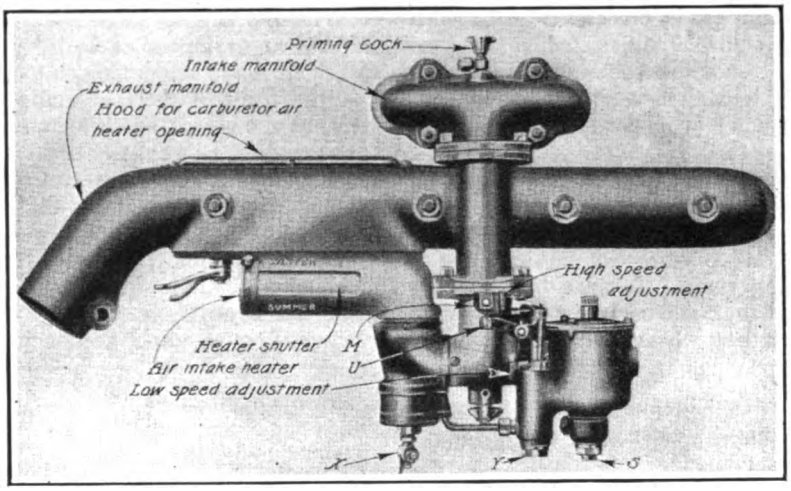
Care must be taken in designing the intake manifold system to secure the application of heat in just the correct proportion, i.e., to secure satisfactory performance on low grade fuels without undue thinning of the gases and consequent loss of power. That complete success has been attained in this respect is witnessed by the performance of one of these engines, 71 horsepower being developed on low grade fuels at 2600 engine revolutions, though the N. A. C. C. rating of the engine is only 29.4 horsepower.

Another well developed motor in which a number of new and valuable features are incorporated is shown in view herewith, the attention of the reader being specially directed to the novel cylinder head construction.

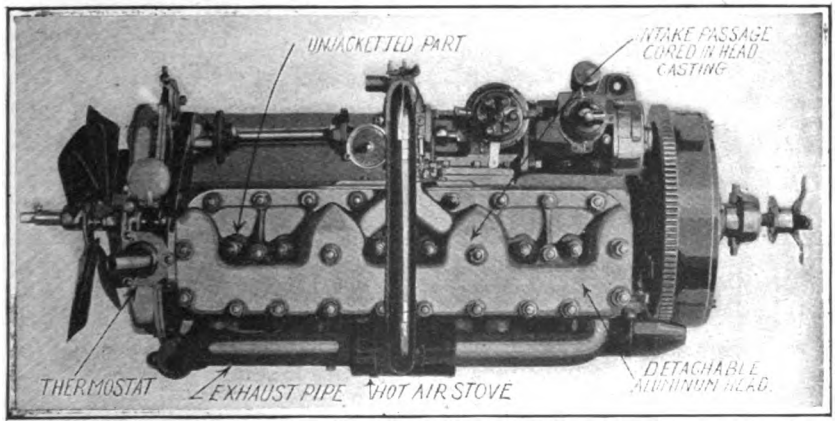


Hot spot manifold of Allen car

The motor has a detachable aluminum head in which are cast not only the usual water jackets, but also all passages of the horizontal intake manifold. The horizontal feed Stromberg carburetor is bolted directly to this head. The combination of the intake manifold with the motor head not only shortens the distance from the carburetor to combustion chamber, but also allows intake passages to be heated directly from the combustion chamber itself. These intake passages are inclined downward from the point of contact with the carburetor, so that any unvaporized particles of gasoline leaving the carburetor will be forced to flow down hill and into a position directly in contact with the combustion chamber. The disadvantages of low grades of gasoline now in general use which prevent complete carburetion and result in the presence of a certain quantity of raw or unvaporized gasoline in the manifold are overcome by this type of construction. By the position of the valve openings, gases immediately upon passing through the valves are directed against an unjacketed and therefore superheated portion of the combustion chamber head. This insurance of complete vaporization and perfect combustion contributes greatly to fuel economy and likewise prevents the impairment of lubrication by the seepage of raw gasoline past the pistons into the oil reservoir.



How intake manifold is heated by having a portion cast with exhaust conduit on Reo cars



Method of arranging gas passages in cast aluminum head of Studebaker engine

The problem is not simply met by heating the mixture as means must be provided to insure just the proper degree of increase in temperature to secure maximum efficiency at all times. For this reason, hot and cold air control is nearly always provided. This is done by altering the temperature of the primary air after it leaves the exhaust heated stove by manually regulated air intake shutters that permit cool air to enter and mix with the heated air in any desired proportions. In cold weather, it may be necessary to entirely close the cold air opening so only heated air will enter the carburetor, in hot weather the reverse procedure may be necessary.

Digitized by Google

SHOP PRACTICE

The Proper Use of Lathe Tools

By George Shipston

THE amateur lathe operator must thoroughly understand lathe tools before he can expect to accomplish successful metal turning. It is regrettable, but none the less true, that few mechanics understand their lathe tools as they should. This article has been prepared for those who desire further information along this line and the author hopes that it will be studied diligently by those who do not already fully understand the subject matter.

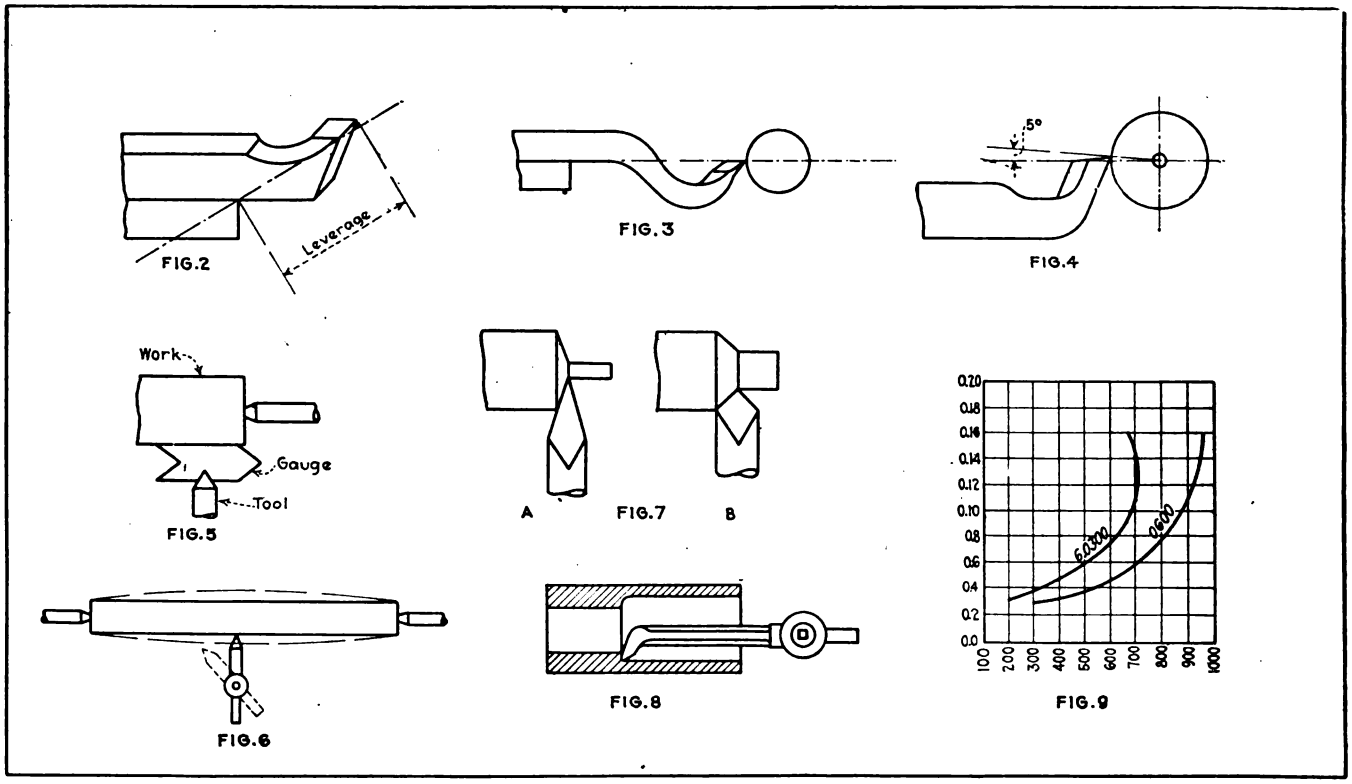
A complete set of lathe tools is shown in Fig. 1. The name of each tool suggests the nature of the work that it is to be used for. While few mechanics are in possession of the complete set of tools illustrated, as many as possible should be obtained as it is desirable to always use the right tool for the right job if good work is to be accomplished.

A few words about grinding tools may not come amiss, especially to those who now believe that it is only a matter of a few misdirected jabs against a grinding wheel. When a tool is being ground it should never be held against the grinding wheel until it becomes real hot. It should not be allowed to reach a temperature where it cannot be held comfortably in the hand. The point of the tool should be occasionally immersed in a convenient receptacle of cold water while it is being ground. If the tool is allowed to become too hot it will lose its hardness and become useless for further work.

The proper angles of the cutting edges of a tool should be maintained during the grinding process. If this is not done the tool cannot function properly. The original angles must be preserved throughout the entire life of the tool if good results are to be expected from its use. Figure 7 (A and B) illustrates two examples of badly ground tools. At A the angle is much too sharp and the point of the tool would be in constant danger of breaking off. The case shown at B is equally bad. It will be seen that the effective cutting edge at B is much greater than that at A. The tool at B will require much more driving power for the lathe it is used on than the tool shown at A. It must always be remembered that the more the cutting edges of a tool approach a line parallel with the axis of the work being turned, the greater the power necessary to run the lathe will be.

More experienced mechanics can preserve the original angles of a lathe tool after repeated grindings. However, this is merely a matter of extended experience and the beginner cannot expect to do this. A small tool gauge should be used by those who lack the necessary experience. Such a small gauge is shown in Fig. 5. Here it is being used to properly set a screw cutting tool at exact right angles to the work mounted between centers.

The matter of mounting a tool in the lathe is very important. If a properly ground tool is badly mounted good work cannot be accomplished. The height of a tool must first be determined. Experience has proven that for all ordinary turning the lathe tool should be mounted about five degrees above the center of the work it is expected to turn. This is shown graphically in Fig. 4. This does not hold true in the case of screw cutting, however. In screw cutting, the lathe tool must be mounted so that the top of its cutting

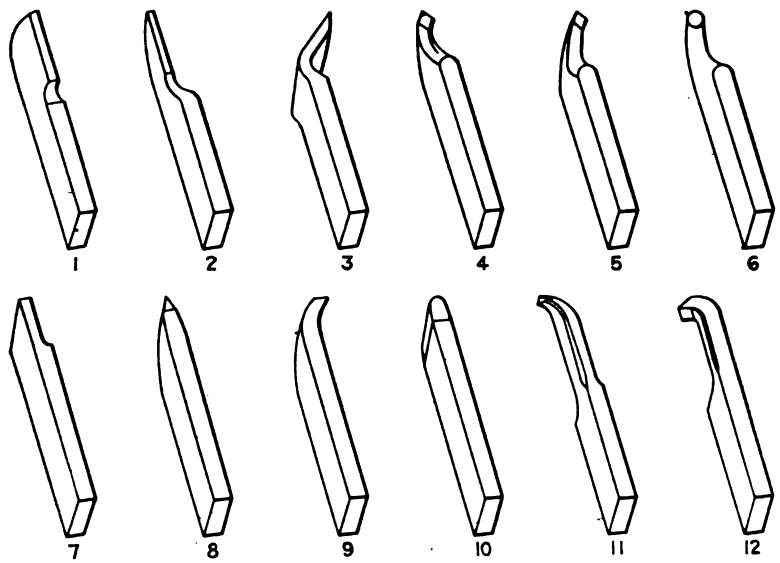


Digitized by Google

edge will come at the exact center of the work. If this is not done accurate threads cannot be cut.

Another important consideration is the distance of the cutting edge of a tool from the supporting piece in the tool post. The greater this distance is the more tendency the tool will have to spring. This is depicted in Fig. 2. It is simply a matter of increasing the effective leverage. The tool should always be so mounted that its cutting edge will be as near to the supporting edge as practical. Care should also be taken to see that the tool is secured rigidly as possible to prevent chattering with its attending evils.

Some may think that the matter of mounting a cutting tool approximately at right angles to the work in the lathe is not important. This is by no means true, as the tool will have a tendency to cut in the manner shown if its angle is changed while the turning is being done. It will be seen that as the angle of the tool increases the distance of its cutting edges from the work also increases. This results in the effect illustrated in Fig. 6.



1. *Left-hand side tool.* 2. *Right-hand side tool.* 3. *Right-hand bent tool.* 4. *Right-hand diamond point tool.* 5. *Left-hand diamond point tool.* 6. *Round nose tool.* 7. *Cutting off tool.* 8. *Threading tool.* 9. *Right-hand tool.* 10. *Roughing tool.* 11. *Boring tool.* 12. *Inside threading tool*

The matter of rake must be considered. Many probably already understand that a tool with a positive rake should not be used to turn brass. For the benefit of those who do not, this part of the subject will be given attention. A tool with a positive rake is one which has an angle that declines *from* the cutting edge and surface of the work being turned. A tool with a negative rake is one with a cutting edge that is at the lower end of an angle that inclines *to* the work. A tool with a positive rake must be used on steel and other metals of a similar nature. If such a tool is used on brass, however, it will have a tendency to "bite in." This is due to a property that is peculiar to the metal. A tool digging in in this manner will, in nine cases out of ten, either ruin the work being turned or the end of the tool will break off. In any event, something will happen which a real good mechanic would be thoroughly ashamed of.

Fig. 3 illustrates the methods used in England for mounting lathe tools. This was originated by Sir Joseph Whitworth. His object was to bring the cutting point of the tool on a level with its line of support. In this way any vertical pressure is sure to force the tool away from the work. This practice is not followed greatly in America, although the writer has seen a few mechanics that claim it to have many advantages.

Side angle on a lathe tool refers to the angle at which the top is ground either to the right or left side. A tool ground in this manner must have either a right-hand rake or a left-hand rake, depending upon the direction of the angle. The right-hand tool must always be used in cutting to the right and a left-hand tool for cutting to the left. Increasing the rake makes it possible to decrease the driving power, as the tool will then have more of a tendency to screw its way along.

The chart shown in Fig. 9 is very interesting. It shows the power required for making cuts of various depths in a piece of steel. The vertical figures represent the depth of the cut while the horizontal figures represent the number of pounds force required to make the cut. It has been found that steel requires about two and one-half times the power for cutting as does cast iron. Wrought iron, which is used considerably, requires about one and one-half times the power. These calculations are based on experiments made with tools ground as correctly as possible. More power would be required if the tools were improperly ground.

An ordinary boring tool is sketched in Fig. 8. The same laws for outside turning do not hold true for inside turning. This is to be expected, as the contour of the cutting surface is entirely different. In one case the tool is cutting on the outside of a circle and in the other case it is cutting on the inside of a circle. If the tool is mounted about five degrees above center for outside turning, just the reverse condition would hold true for inside turning or boring as it is called. In boring, the tool is best mounted so that its cutting edge will come a few degrees below the exact center of the work. Greatest cutting efficiency is realized at this particular point. The clearance of the tool as regards brass and steel is the same in boring as in outside turning.

The cutting edge of a boring tool must not be mounted too far from the tool post or bottom support. If this is done the tool will spring and accurate work simply cannot be accomplished. The tool will have a tendency to spring in two directions. It will be pushed from the surface of the work and it will spring downward. The result of this will be a hole with a slight taper. The more the tool springs the greater the taper will be.

Forged lathe tools are either made of tool steel or crucible steel. These tools can be tempered by heating them slowly and evenly for a distance of about two inches from the cutting point. After the point becomes heated for the required distance to a cherry red, it is picked up with a pair of tongs and the point immersed in a bath of cold water. The entire tool should not be immersed; merely its entire cutting edge. About one and one-half inches of the tools should be exposed to the cooling action of the water. When the point of the tool has become cool it is removed from the bath and carefully cleaned with carborundum cloth. The surface is then wiped with an oily rag. The heat in the shank of the tool will now drive the temper toward the cutting edge. After this edge becomes a dull brown straw color it is completely immersed in water.

When cutting steel, the mechanic should always take the precaution of properly lubricating the point of the tool to assist in cutting. This also offers a certain amount of protection to the cutting edges of the tool and prevents them from becoming dull. A good lubricating substance for long cuts and continued work on steel can be made of very soapy water held in a receptacle above the tool, and allowed to drip on the point. For short cuts, a few drops of lubricating oil placed occasionally on the tool point will suffice.

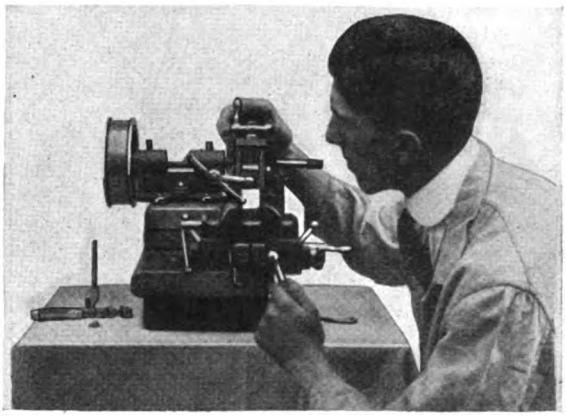
Digitized by Google

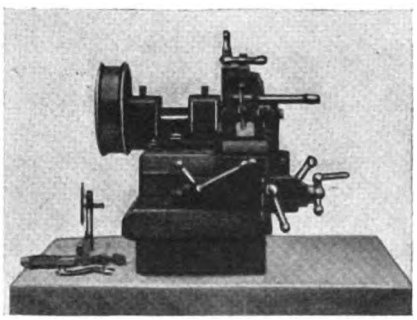
Building A Small Crank Shaper

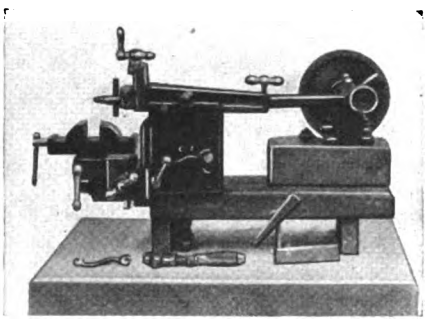
By Joseph Dante, Jr.

The little crank shaper described in this article will provide the mechanical readers of EVERYDAY *with a shop project of real value. When completed the machine will make a very useful addition to the small shop. The author and designer of the machine, Mr. Joseph Dante, Jr., does not need an introduction to our readers as his very practical articles that have appeared in past issues will be well remembered.*
—EDITOR.

HOW many times has the editor told us to take a file and smooth the bottom of this piece or that? The author first constructed this machine with a friction drive. It did not prove successful and he had to resort to the crank drive as shown in the photographs. In the development of the machine many of the parts were made as many as four times. The vertical slide in use now is the fourth one that has been made and is a good one with a very neat appearance. The machine is well adapted to the construction of the many small parts which a model maker has to make. It will be noticed that the vertical slide is a plain one and does not swivel. The vise block is made so it can be turned or swiveled until the base of the vise strikes the cross rail, as it will not clear this rail. The machine is mounted on a suitable wood base and the driving mechanism is built up with a block so that the center line of the driving shaft will line up with the center line of the stroke adjusting rod. It will be seen in the photograph that the baseboard is cut away on the end so as to allow for the cross rail to drop down. In checking up the machine with an indicator, the results were as follows: The vertical slide travels for its full length within .0015 and the cross rail travels for its full length within .006, which the writer thinks is a very good job. The speed of the machine should be about forty strokes per minute.







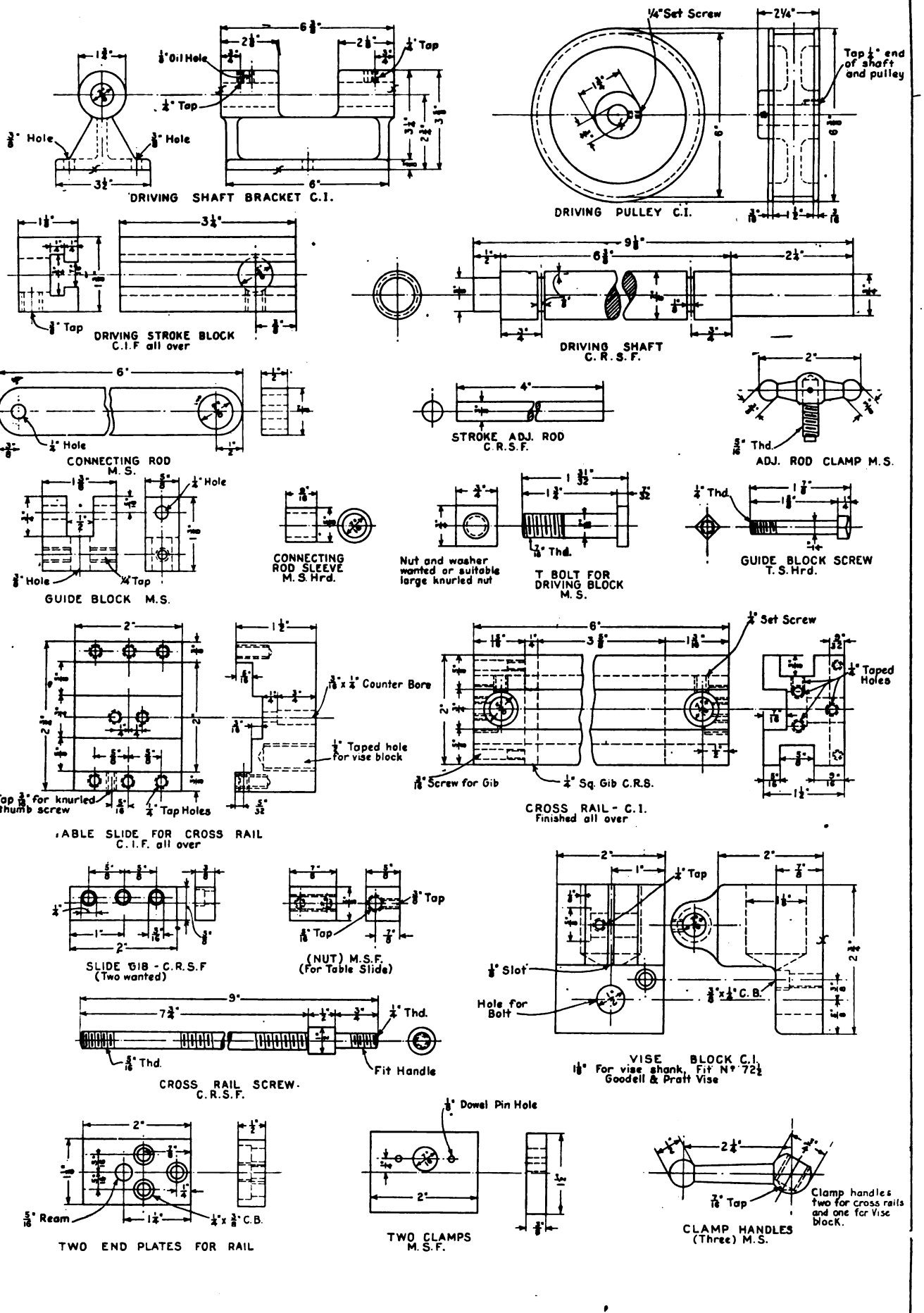
The vise can be swivelled through an arc of 180°. The jaws of the vise are made of cast iron and should be lined up with steel plates in order to prevent them from getting nicked up when clamping the work. The vise will open about 2¾ in. and is about 2½ in. wide. In cutting metals, the writer made the following tests in steels and cast iron. The machine has been able to take a cut of about 1/16 in. deep with a .008 feed per stroke and for brass and bronze it takes cuts ⅛ in. deep with .005 feed per stroke. The reader will notice that next to the cross rail crank there is a ring which has fifty graduations and the screw has a 5/16 in. x 20 thread. A pattern is made for the bed and ram and should be finished as per drawing. The author worked his up with three good twelve-inch files and made a fairly good job out of it. The gibs are all plain stock and no description is needed for them here. The ram is shown with its dimensions and this should be machined if possible. The ⅜ in. hole in the rear of the ram is for the adjusting rod and this is to bring the stroke of the ram to any desired position over the work.

The Vertical Slide. The bottom slide is the first job done. This is a piece of C.M.S. and squared up all over and machined to the dimensions given. If cutters are on hand, the job can be done in a lathe, using the milling attachment which was built by the writer and which has appeared in a past issue of EVERYDAY ENGINEERING. The top slide is a piece of machine steel and is carefully laid out before any work is done on the piece. Then the slot one inch is cut as shown in the drawing. The angles were cut on the milling attachment. Next, the ¼ in. hole was drilled with clapper block clamped to the slide. The taped hole is left until the slide and top plate is put in place, so that both holes can be drilled and the slide taped properly.

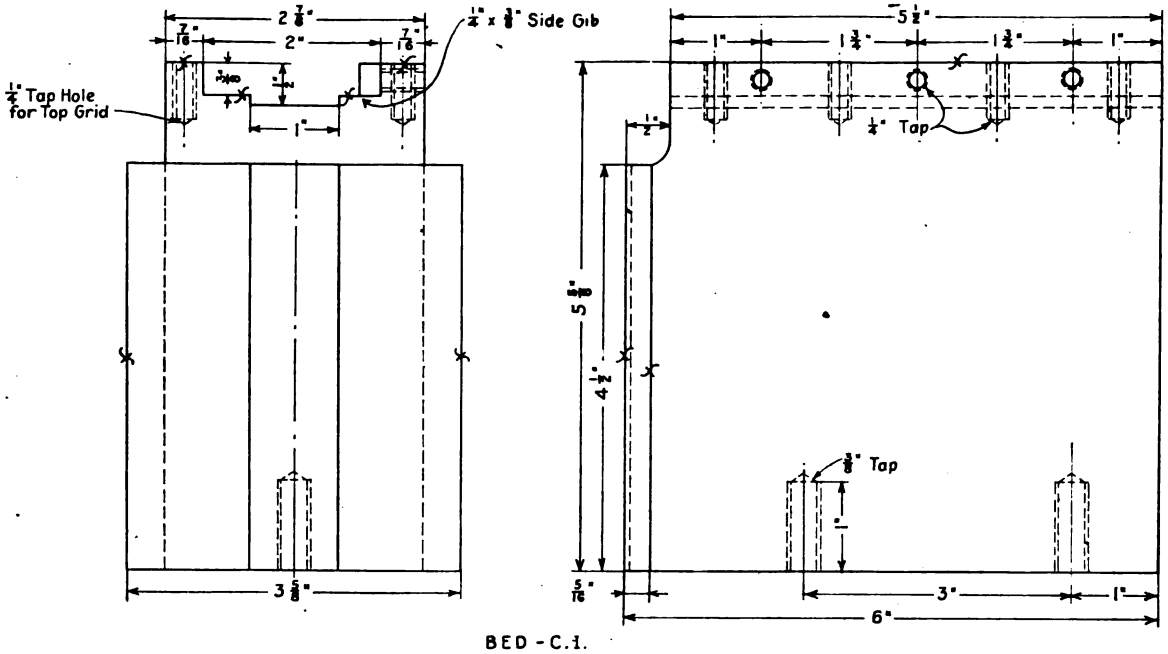
The clapper block is a simple job and there is no need of explaining it here. The top plate is a piece of flat stock nicely polished and machined as per drawing. The screw is die cast and is turned from ⅞ in. stock. A collar is also needed for this screw. When threading the screw for the collar end it would be better if the die was put in a chuck and with the aid of the tail stock center the work can be threaded square and no trouble will be experienced when the collar is finally put in place. The collar should be turned up square in a lathe, using the screw as an arbor. The other parts are the tool post, which is shown with screw and rest collar all in place. The screw and collar should be hardened. The clapper block screw is turned up from square stock and left long enough so as to make a nice button finish flush with the nut after it is put in place. The handles are turned from stock. The drawing calls for two; one for vertical slide and one for cross rail screw.

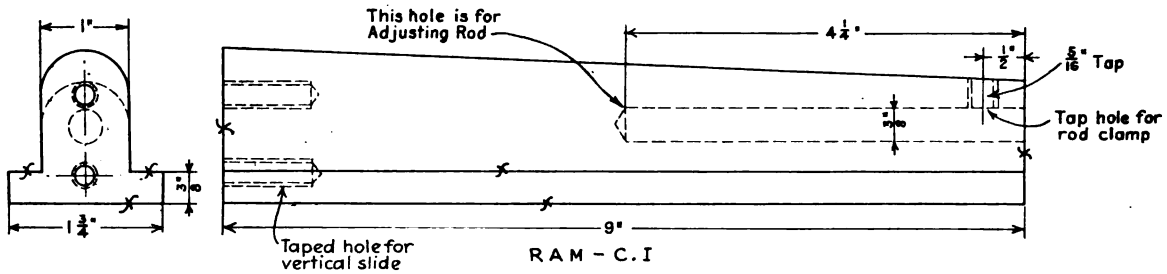
The cross rail is made of cast iron and machined as shown. This should be finished all over and the cross slide should be scraped to the rail. The other parts are the gibs, nut, screw, end plates, etc., which need no description here. There is a binder hole drilled into the slide as shown. The clamp plates are made of flat stock. These plates should be pinned to the rail so as to keep them from moving in all directions when they are loose. The vise block is a casting and is machined according to the drawing. The 1⅛ in. hole was bored out in a lathe using an angle iron to hold the work. The vise is a Goodell-Pratt No. 72½ with a 1⅛ in. shank and it has a right and left screw, which makes just a suitable device for the drive on the shaper. The more to the center the T bolt is set, the larger will be the radius of the stroke

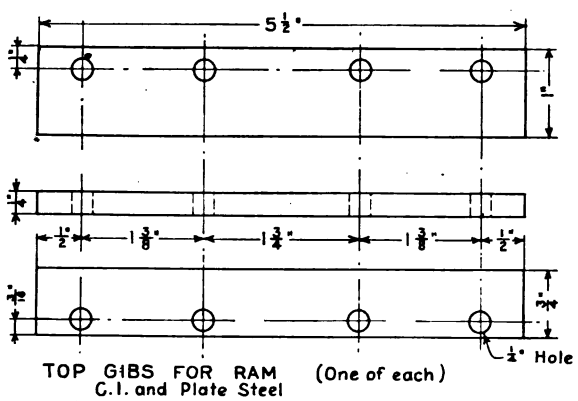
Digitized by Google

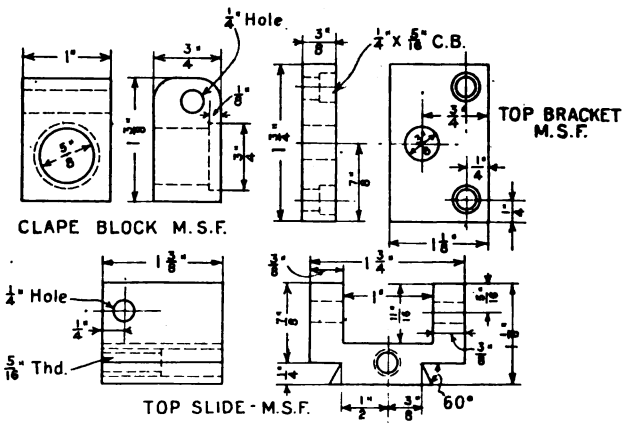


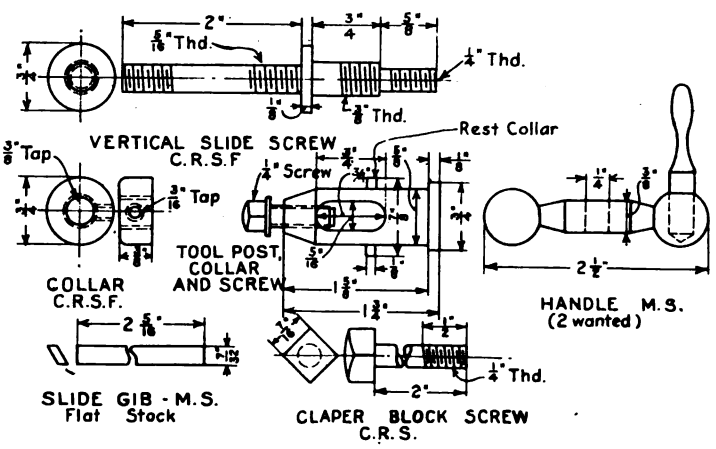
Digitized by Google

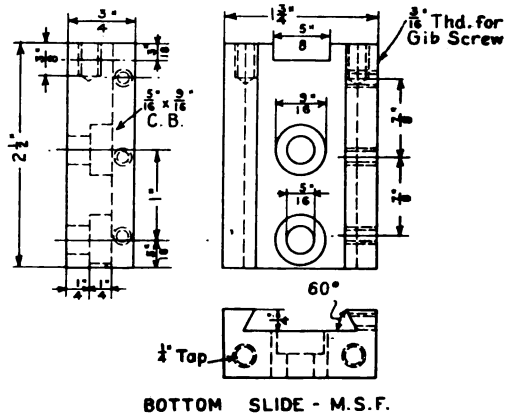












Digitized by Google

each side of the center line. The handle and other minor pieces do not need very much description, so the builder is left to decide for himself whether to use handles or nuts.

Bracket. This is shown on the drawing and is the same thing that the writer is using. The only operations that were done on this piece were the drilling of the oil holes and set screw holes. The bracket, pulley, stroke block and driving shaft all came from a local junk dealer. The shaft was turned up as shown with two slots. This is to keep the shaft from swaying from side to side. To the pulley was added an extra set screw at the end of the shaft, as the other one persisted in coming loose while running. The block was drilled as shown with a 3/8 in. taped hole for the set screw.

The connecting rod is a piece of flat stock with holes drilled in both ends. The 5/8 in. hole in this rod is of the sleeve shown, which is 1/16 in. longer than the width of the rod. This is so that the nut can be tightened up on the T-bolt and at the same time it will leave the rod free to revolve. A small oil hole should be drilled into the connecting rod holes. The sleeve is a simple job and should be hardened if possible. A small block is made of steel. There are two 1/4 in. set screws taped into the 3/8 in. hole and they should be spotted into the adjusting rod, which is a piece of cold-rolled steel 4 in. long. The T-bolt was turned from 3/4 in. square stock and die threaded. The guide block screw was turned up from 3/8 in. square stock, and should be hardened. The adjusting rod clamp was taken from a water faucet and a 5/16 in. threaded stud pinned to it.

To Loosen Rusted Screws

ONE of the simplest and easiest ways of loosening a rusted screw is to apply heat to the head of the screw. A small bar or rod of iron, flat at the end, if reddened in the fire and applied for two or three minutes to the head of the rusty screw will, as soon as it heats the screw, render its withdrawal as easy by the screw-driver as if the screw had been only recently inserted.

Lacquers For Gold

ALCOHOL, 1 gal.; turmeric, 1/2 lb.; moderate for a week, then filter, and add gamboge, 2 oz.; shellac, 6 oz.; gum sandarac, 1 3/4 lb.; dissolve in a warm bath, and add 1 quart common turpentine varnish. For red lacquer use 1 1/2 lb. of annotto instead of the turmeric, and 8 oz. of dragon's blood instead of the gamboge.

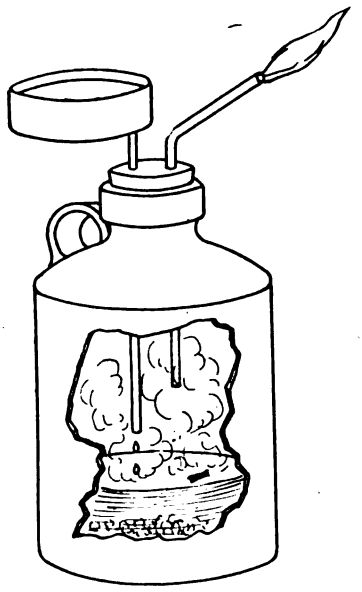
To Brown Gun-Barrels

MIX chloride of antimony to a creamy consistency with olive oil. Apply the mixture evenly to the heated barrel, allow it to act for twelve to twenty-four hours, then remove the excess with a woolen rag and repeat the operation. After the second application has acted for twelve to twenty-four hours, the iron or steel is covered with a bronze-like layer of ferric oxide and antimony, which resists the action of the air and may be made lustrous by brushing with a waxed brush. The sharpening of the chloride of antimony can be effected by adding a little nitric acid to the paste of olive oil and chloride of antimony so as to hasten the operation. Another formula is: Nitric acid, 1.5 parts; sweet spirits of nitre, 1.5; rectified alcohol, 3; blue vitriol, 6; tincture of chloride of iron, 3; distilled water, 100. Dissolve the blue vitriol in the water, then add the other materials. The burnishing and marking can be effected with the burnisher and scratch-brush. The polishing is best effected by rubbing with a piece of smooth, hard wood, called polishing wood. The barrel is finely varnished with shellac varnish and again polished with the hard-wood polisher. Some prefer the tone of brown produced by blue vitriol, 5 parts; sweet spirits of nitre, 5; water, 100. In any case the surface of the iron must be well cleansed and rendered quite bright; it is then freed from grease by rubbing with whiting and water, or better, with powdered quicklime and water. The browning composition is then put on and allowed to remain twenty-four hours. It is then rubbed off with a stiff brush. If not sufficiently browned repeat the last process after browning. Clean the surface well with hot water, and dry it. The surface can be burnished and polished. Varnish with tinsmith's lacquer, or with gum shellac, 2 oz.; dragon's blood, 3 drachms; methylated spirit of wine, 4 pints. The metal should be made hot before applying this varnish and it will present an excellent appearance. If the varnish is not required to color, but only to preserve the actual tint produced on the metal surface by the browning fluid, leave out the dragon's blood.

A Simple Substitute for Bunsen Burner

A SIMPLE but effective substitute for a Bunsen burner, operated by acetylene instead of illuminating gas, can be made from materials costing only a few cents. All that is needed is a medium sized bottle with a large neck. The writer used a jug for this purpose. A cork to fit the neck of the bottle, 4 ins. of 1/16 in. brass tubing, 4 ins. of 3/16 in. tubing and the cover from a small baking powder tin.

The tin cover is intended to hold water and should be soldered to the smaller tubing so that when the tube is run through the cork, the water will drip down into the bottle. Six or eight small holes are drilled in one end of



the larger tube, which is bent at an angle and the other end of this tube also run through the cork.

To operate the burner, fill the bottle about one-third full with calcium carbide, such as is used in acetylene gas generators, put the cork in place, but not too securely, so that it will work as a safety valve in case the burner tube becomes stopped up, and fill the receptacle with water. Gas will immediately begin to generate and by holding a lighted match to the burner it will soon come to a steady flame. The pressure of the gas in the bottle will regulate the flow of water.

This little device may be used for any purpose for which a Bunsen burner is employed. It is especially useful in workshops where illuminating gas is not obtainable.

R. M. HENDRICKS.

Preparation of Potash Water-Glass

MIX 15 parts of pure quartz-sand with 10 of potassium carbonate and 1 of charcoal powder, and fuse the mixture in a crucible. The contents of the crucible, when cold, is taken out, pulverized, and exposed to the air, being frequently stirred during the time. The powder is then several times washed with cold water, and then boiled with 5 parts of water until all is completely dissolved. The solution is then filtered and evaporated to a specific gravity of 1.25. In this manner a sticky, syrupy liquid is obtained which, on exposure to the air, dries to a transparent glass.

Another receipt: Quartz-sand 15 parts, potash 5, and anhydrous soda 4. It is prepared as above.

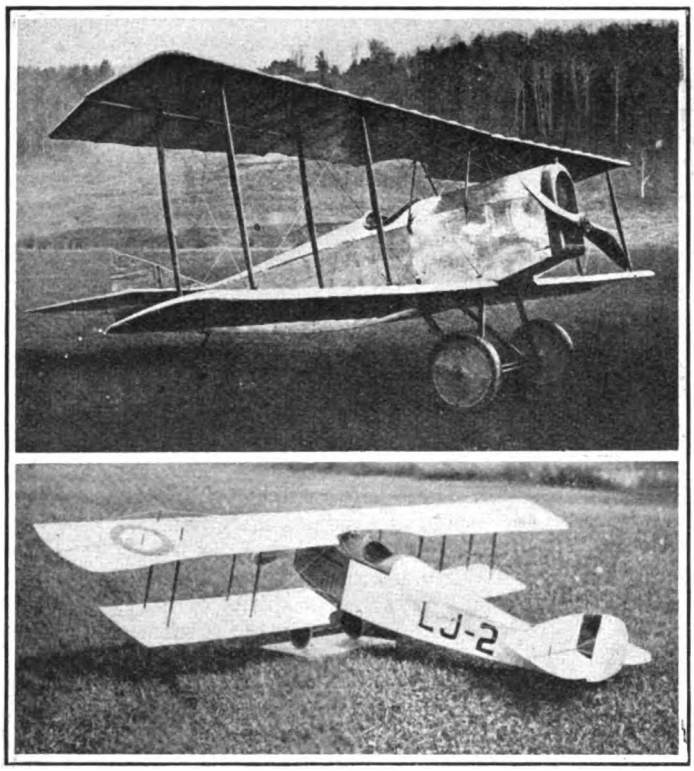
Digitized by Google

Ford Motored Airplane Proves Practical

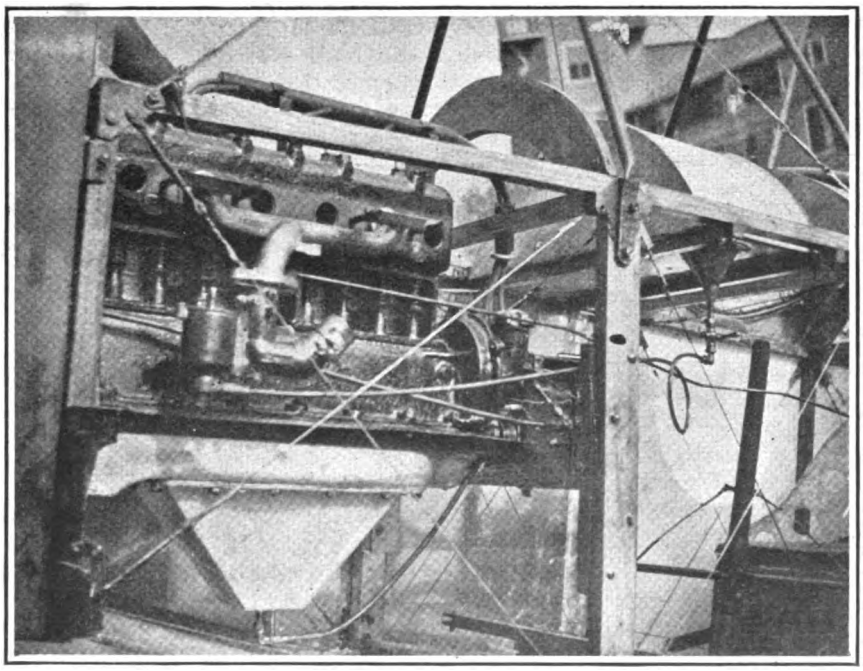
By E. H. Holterman

Former Flying Instructor, U. S. Army

A POINT that is interesting to many aviation enthusiasts, especially those who are building full sized airplanes of their own, is the use of a modified Ford motor as power. The photographs herewith show a successful biplane built and flown by the writer that is equipped with a modified Ford engine and which flies very well indeed when one considers the low horsepower. The motor shown weighs 195 lbs. after alterations have been made, but it is believed that this weight can be cut down in a new form the writer is experimenting with. The propeller that seems to work the best is 6 ft. 6 in. in diameter by 4 ft. 6 in. pitch. The complete machine illustrated weighs 580 lbs., which the writer considers unnecessarily heavy for such a small machine and which can be reduced to less than 500 lbs. by refinement of construction.



The main dimensions of the machine are 18 ft. length, 25 ft. spread, 4 ft. chord, 4 ft. 6 in. gap, and while official speed tests have never been made, from previous experience it is estimated it will fly at least 45 miles per hour. One of the machines illustrated is without a 4 ft. overhang on the upper wings which is shown in the other machine. This added surface will give a better landing speed and will also enable the machine to get off the ground easier.



Views at top show Ford motored airplane flown successfully by E. H. Holterman of Woodstock, Vt. The LJ-2 is the machine after the overhang had been added to the top plane to obtain more surface. The illustration of the modified motor shows method of installation in fuselage

How to Rebuild Ford Motor

To rebuild a Ford motor for use in an airplane, I have found that the following changes are necessary. First, get a Ford motor block that has been used enough to have smoothed the cylinder walls to a glossy finish, but has not been worn to an oval or "out of round" shape. Get a set of Lynite or other light magnalium alloy pistons. In getting connecting rods, try to get them as near an equal weight as possible, as they vary quite a bit in weight. Drill holes along the rods between the flanges to lighten them, and at least two holes into the rods through the bearings for oiling. Balance them up equally after having fitted them to the crankshaft. The crankshaft should be well balanced also. The regular Ford camshaft may be used or one can put in a special, high speed shaft as desired. It is advisable to get some Dodge car valves, as they are a bit larger than the Ford valves. By reaming out the valve seats a bit the Dodge valves will fit nicely and give you more power. You can either put on an Atwater Kent timer with battery and cells or mount a small magneto for ignition as desired.

Special Precautions for Oiling

For the base or oil pan you can use the Ford crank case by cutting the rear end off so that it will come within the flange of the crankshaft, and weld a piece on with a pocket for a piece of felt packing to keep the oil from coming out. The front end is cut off at the beginning of the oil case. Cut slots about three inches long in the inspection plate between the dip grooves of the connecting rods to allow the oil to drop into the oil sump. This sump is nothing more than an oil receptacle from which the oil is pumped through a tube on to the bearings. By taking a copper pipe and attaching small nipples such as they use on shower baths so that the oil will be pumped directly on to the bearings, you will have no trouble with bearings. A small gear pump attached to the oil sump (below your oil level) driven

Digitized by Google

either by a chain or shaft and gears will keep a constant stream of oil to your bearings. A Zenith carbureter gives good results and is very light, having an aluminum manifold.

Mounting Nose Type Radiator

If the motor is to be used as a tractor, and you wish to have the radiator in the nose, an extension with two flanges will have to be made, one flange to be bolted to the flange on the crankshaft, then a space of a few inches (corresponding to radiator depth), then another flange, and if preferred a shaft extended from this second flange for the propeller. The cylinder head will either have to be machined off along the outlet "hump" and another piece welded on with the outlet for the water turned in the opposite direction, or else plug up the opening for the water and tap into the head at the opposite end. If the radiator is to be overhead or along the side, the cylinder head can be used as it is by making a simple connection, and no propeller extension will be necessary to go through the radiator. No water pump is needed. Keep the weight down on everything, taking off more when you think you have taken off as much as possible.



Pilot Holterman in the Ford motored airplane built and flown by him

The building of such a machine is not beyond mechanical skill of the average amateur, as the construction of practically all parts excepting alterations in the motor can be done with the ordinary wood working manual training equipment. The work of construction of such machines is made considerably easier by purchasing supplies which are available on the open market, these comprising everything from a complete set of blueprints to all of the metal fittings and wooden parts in completed or knockdown form. Modified motors may also be obtained from dealers who are making a specialty of this work.

Common Failings of Amateur Builders

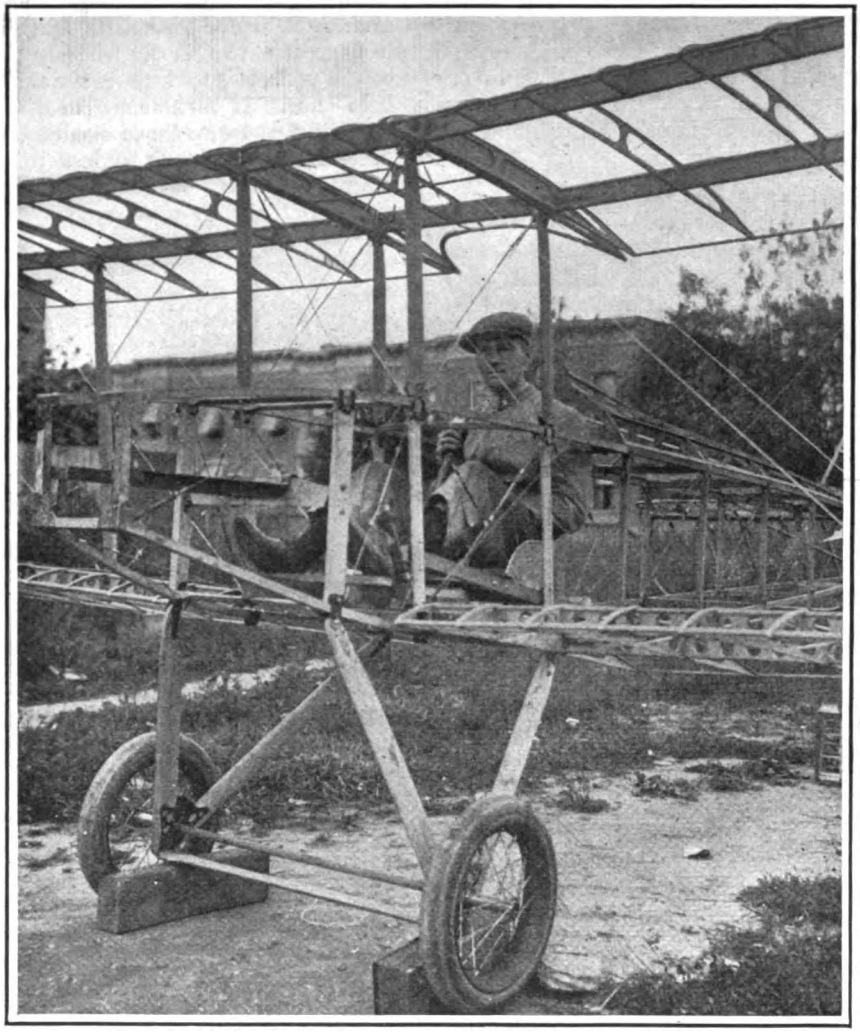
It has been my experience that the common failing of amateur aircraft builders is to build their machine heavier than really needed because they do not realize the necessity for light construction to insure successful flying with low powered motors. Those who have had experience in the Air Service have a realization of the strength and size of various structural parts, but most amateurs make them too large and of unsuitable materials. There is no reason for the use of heavy construction in a small low powered airplane because the flying speed is low and the stresses on the parts are not severe. Particular attention should be given to paring down weight in small items, as these mount up to an astonishing total in the aggregate. Machines examined by the writer that have been built by amateurs have had 3/8" bolts used where 3/16" or 1/4" would have had ample strength, and fittings of 1/8" sheet metal when 1/16" gauge stock would have been amply strong. Aluminum should be used wherever possible in preference to heavier metals. Do not use heavy 19 strand wire cable and correspondingly large turnbuckles for taking loads that are way under the capacity of "aviator cord" cable or hard wire and lighter turnbuckles.

FLEXIBLE PONTOONS FOR SHIP SALVAGE

IN view of the importance of salving ships sunk during the war, and of the all-round costliness of the ordinary barges or lighters used for ship-lifting, special interest is attachable to the experiments recently carried out on the raising of the S.S. "Main." The S.S. "Main" was sunk by gunfire from a German submarine in Luce Bay. Salvage operations were undertaken by the Ardrossan Salvage Company, and Vickers' flexible pontoons were used.

Made of special canvas and cables, the completed pontoons weigh only 1 ton; but, when inflated with air and submerged in water, are capable of lifting 100 tons. Two of these pontoons were used, being fixed to the sternpost of the sunken ship and inflated by means of an air-compressor on a small tug. The vessel was successfully raised, and was beached for pumping.

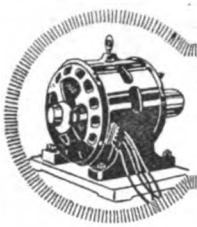
An advantage of these canvas pontoons is that, when not in use, they can be packed into a very small compass, and stored in the hold of the salvage ship until required.



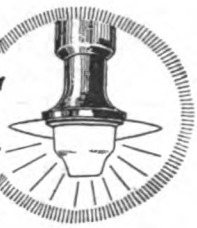
Copyright, Underwood & Underwood

John F. McMahan, a Brooklyn, N. Y., aviation enthusiast and expert builder of model and full size airplanes, seated in the fuselage of airplane built by him which is to be powered with a Ford motor. He has previously built and sold a similar machine. The illustration shows many details of construction in both wings and fuselage framework

Digitized by Google



ELECTRICAL PROGRESS DIGEST



Air From the Turbine Room Used for Heating

THE temperature of a turbine room in an electrical generating station is kept at a temperature much too high for the comfort of the operators. A large lighting company in Springfield, Mass., put a plan into operation which permits the utilization of this surplus heat in the heating of various other departments of its organization. In the winter the air is drawn from beneath the roof of the turbine room into the basement of the switch house where a blower discharges it through steam coil heaters. Another system of ducts collects the air and discharges it through ceiling registers into the switchboard room. In this way a comfortable temperature is maintained in all departments.

Electricity In Agriculture

THE prejudice of the German farmers against electrical appliances has now been overcome, and they are being used for a variety of purposes.

Small progress has been made with electric ploughing machines, but the war has produced a great development of ploughs driven by petrol engines. Threshing-machines driven by electric motors have become extensively used, mechanical milking machines have been found capable of replacing milking by hand, and electrically-heated hatching machines are coming into favor.

The stimulation of the growth of crops by subjecting them to electric radiation has not yet become practical owing to the lack of physiological knowledge of plant growth, and the absence of data from which the best voltage and form of current can be ascertained. It has, however, been demonstrated that the humidity of the air plays an important rôle in determining the effect of the electric radiation. The use of artificial illumination of crops certainly hastens growth, but the cost is such as to render it commercially useless. The drying of crops by electric heaters is effective, but too costly; on the other hand, the drying process has been carried out successfully, for example, at Duisburg, by utilizing the waste heat of electric generating stations. Promising experiments have also been performed at the Dresden Technical College in the artificial heating of the ground by the waste heat of such stations.

Pupinized Short Telephone Cables

THE loading of short telephone cables with Pupin coils decreases the damping, but does not necessarily increase the efficiency of the whole conducting circuit. There is a certain length of cable (between 3 and 6 km.) which may be called the critical length, above which the loading with inductance improves the efficiency. For lengths less than the critical value the efficiency depends greatly on whether a central battery or local battery is used. Furthermore, the efficiency of such short-loaded sections is determined to a great extent by the characteristics of the sections to which it is joined at both ends. If a short length of cable lies between to overhead sections, it is useless to pupinize it unless the adjacent overhead lines are also pupinized. If the cable is connected only at one end to overhead conductors and at the other end directly to the apparatus, the activity in the receiving and sending apparatus (with local battery) increases with moderate loading of the cable, but falls again with heavier loading, as long as the overhead line is not also pupinized. The longer the overhead line, the more certain is the gain achieved by loading the cable. On the other hand, with a central battery there is no object in pupinizing the cable unless the overhead line is similarly treated. If the short cable section is directly connected to apparatus at both ends and a local battery is used, the efficiency may be raised by moderate loading of the cable, but it will fall again with too great loading. On the other hand, if a central battery is used, the use of loading in a local service is undesirable under any circumstances.

Projected Hydro-Electric Installations In Spain

ACCORDING to the *Rivista Tecnica d'Elettricita,* numerous applications have been lodged for concessions to construct hydro-electric generating stations in Spain.

The falls of the Iucar, near Valentia, will supply to the town a power of 6,400 h.p. The hydro-electric station at Linares has been linked up by a 70,000-volt line to the generating station of Penarroya. A company with a capital of 150 million francs has been formed to exploit the falls of the Douro, near the frontier between Spain and Portugal. The total available power is 150,000 h.p., and it is intended to transmit power to Madrid and Bilbao, and it is hoped that power from this station will be utilized by the northern and eastern railways of the peninsula.

The Photo-Electric Cell In Wireless Communication

THE photo-electric cell which has been described in the *Physical Review* (2nd series Vol. VII No. 1) had recently been tried as a receptor of wireless signals with marked success. Experiments have been made in both receiving and transmitting. The tube not only holds possibilities as a receptor, but as a producer of electrical oscillations as well. If the photo-electric cell is developed to a point where it will be practical to apply it in a commercial way, the change will be a revolutionary one.

The photo-electric cell was developed by Kunz and Stebbins. It has an inner coating of an alkali metal (sodium, potassium, etc.,) which is rendered sensitive by the introduction of hydrogen while the tube is excited. This results in the formation of a hydride, which under, the action of light, changes the effective resistance of the tube.

The photo-electric cell has been employed in many different ways. It has been used as a photometer in stellar photometry, physiology of plants, photo-chemistry and for the transmission, reflection, and radiation of light. The cell is used in connection with a battery with a potential of from 120 to 200 volts, and a galvanometer of high sensitivity.

Use of Tungsten for Contact Points

PLATINUM for use as contact points has many advantages. It is not oxidizable, is not attacked by acids or gases and is capable of withstanding great heat.

A writer in the *London Electrician* recently described his experiences with tungsten as a substitute for platinum. Tungsten is a metal that possesses nearly all the properties of platinum and it has been found to make very good contact points. The author of the article experimented with vibrating contacts of tungsten on a heavy current circuit and after a considerable period found that they stood up nearly as well as platinum contacts. The author suggested the employment of a sharp-pointed lower electrode.

Digitized by Google

An Electrically-Equipped Lighter

By William H. Easton

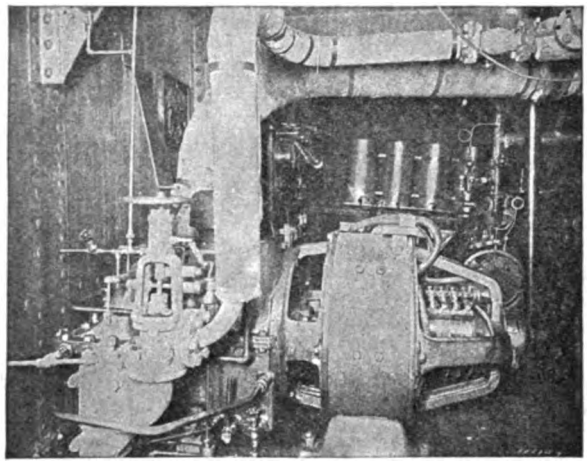
PENNSYLVANIA Railroad Lighter No. 151 enjoys the distinction of being the first vessel of her type to be equipped with electrically-operated winches exclusively. She is used for carrying express shipments around New York Harbor; and as this service is one in which time is an important factor her winches were arranged for electric drive, instead of the usual steam engines, because it was believed that the use of electricity would materially reduce the time required for handling cargoes. She has now been in commission about two years, and experience goes to show that this idea was correct; for, although it is difficult to carry out an accurate efficiency test in the handling of miscellaneous packages, it is generally conceded by those who are familiar with her work that No. 151 can take care of 300 tons while the average steam-operated lighter is disposing of 200 tons.

As shown by the illustration, No. 151 has two systems of booms, one forward consisting of a single main boom with a maximum capacity of 10 tons, and one aft, of the mast and yard type, with a maximum capacity of 2 tons. Most steam lighters of the capacity of No. 151 have only one boom system; but with electrical operation two can readily be employed because the motor-driven winches are so compact that they can be housed in a very small compartment. This compartment is situated in the hull just forward of the pilot house; all the lines run down in front of the pilot house to their respective winches in most direct manner possible.

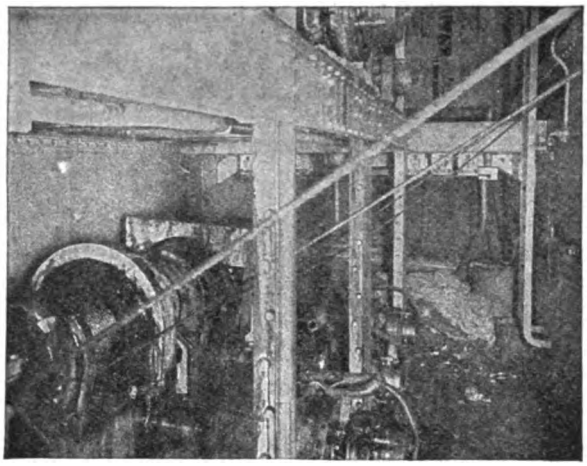
There are eight motors altogether, their purpose and size being shown in the following table:

Service	H.P.
For Forward Boom—	
Main Hoist	24
Main Boom	24
Starboard Guy	15
Port Guy	15
For Aft Booms—	
Starboard Hoist	15
Starboard Guy	15
Port Hoist	15
Port Guy	15

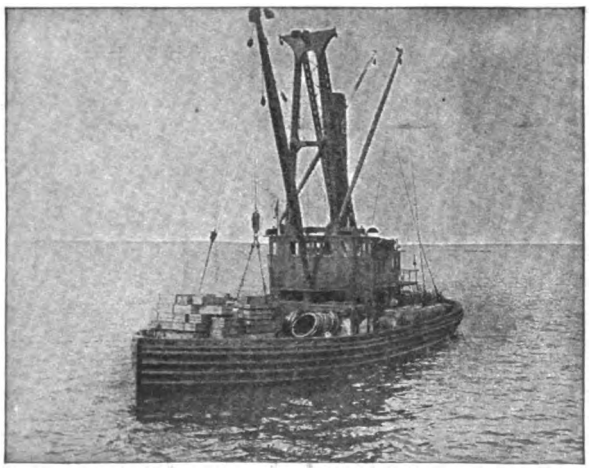
These motors, shown in the photograph, are of the Westinghouse direct-current crane type, totally enclosed and equipped with magnetic brakes. Each motor is geared directly to its winch and the winches are arranged in two rows, one being placed above the other.



The turbine-driven generator in the hold of the lighter



The motor-driven winches aboard the lighter



The electrically-equipped lighter

The control of the winches is located in the pilot house. The four controllers (one for each motor) for the forward boom are located at the forward end of the pilot house. For the aft booms, there are two sets of controllers, one located at each side of the pilot house, either of which can be used. The object of this arrangement is to give the operator an unobstructed view of the operations of the booms under all conditions.

The controllers in the pilot house are of the type known as "master switches." They do not control motors directly, but control the operation of a series of magnetically actuated switches, which make the actual connections. These switches are mounted on panels located in the motor compartment, and some of them can be seen in the upper right-hand corner of the photograph. There are several advantages of this arrangement. In the first place, the master switches handle only small currents needed to energize the magnets and so are light in construction and easily handled. Secondly, the heavy cables carrying the motor currents are of minimum length, and do not have to be run up to the pilot house and down again. Finally, the magnet switches permit the use of automatic acceleration; that is, the operator is not obliged to operate the master switches slowly in order to prevent burning out the motors by applying the currents too suddenly. He merely moves the handles at any speed he pleases, and the magnet switches then close in the proper order and at the proper rate. The motors are thus protected from injury, and all of their operations are carried out at the maximum speed consistent with safety. Each controller provides a number of motor speeds.

The current for operating the motors is generated by a 25-kilowatt, 125-volt Westinghouse turbine generator, shown in the top photograph. This unit consists of a high-speed turbine geared to a standard generator. It is operated by steam at pressures of from 75 to 250 lbs., and can be used either condensing or non-condensing. A governor keeps the speed, and therefore the voltage, constant, and an emergency stop prevents accidents.

Digitized by Google

EXPERIMENTAL CHEMISTRY

The Preparation and Use of Permanganate Solutions

By Albert T. Fellows

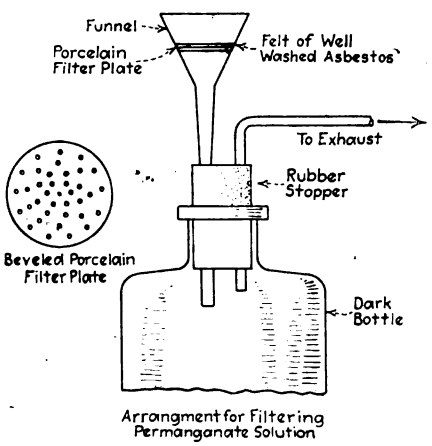
TO the amateur chemist struggling along in his laboratory, the preparation and use of volumetric solutions of potassium permanganate opens up a new field which is really a branch of quantitative analysis. Not only is it of value to him to know how to go about the determinations, but he also receives from carrying out these determinations a vast amount of practical knowledge such as he would obtain only at college or any industrial laboratory. The procedure which the writer is about to describe is exactly the same as that used at any laboratory carrying on determinations of the various elements, and the best of it is that all of it can be done with a very small laboratory equipment and at slight expense.

To make that which follows clearer and more interesting, let us first look into the theoretical side of the matter. Potassium permanganate, when in an acid solution and when any oxidizable matter is present, breaks down according to the equation: $2KMnO_4 \leftrightarrows K_2O + 2MnO + 5O$. Thus, we see that every two molecules of permanganate is equivalent to five atoms of oxygen, and as two molecules of hydrogen is equivalent to one of oxygen ($2H + O \leftrightarrows H_2O$) the two molecules of permanganate is equal to 10 of H. Shortly we shall use these ten molecules of H, but for the present attention is directed to the five molecules of oxygen. Now bearing in mind that two molecules of permanganate equal ten molecules of hydrogen, and recalling our definition of a normal solution (it is upon this basis that we make our solutions) which is a solution that contains in one liter the weight of active constituent that will react with one gram of hydrogen, and 316 gms. of permanganate, then our normal solution will contain 31.6 gms. per liter and the tenth normal (N/10) the one usually employed, one-tenth of this or 3.16 gms. in 1000 ccs. of water. In one cc. there are 0.00316 gms. (move decimal point). Now let us prepare some of this solution.

At this point our troubles begin. We cannot weigh our permanganate out accurately and dissolve it in a liter of water, as the salt cannot be obtained in such high purity, and even distilled water contains some readily oxidizable matter which is attacked by the permanganate precipitating MnO_2, which further hastens the decomposition.

To overcome these difficulties we must weigh out about 3.3 gms. of pure potassium permanganate crystals and dissolve this amount in one liter of distilled water. This is then boiled for about five minutes and the solution allowed to stand in a bottle with a plug of cotton in the neck for five or six days, during which period the permanganate has plenty of time to oxidize all the organic matter which is present.

After this, we carefully filter it through an asbestos pad (paper would



Arrangment for Filtering Permanganate Solution

introduce more organic matter) into a brown glass stoppered bottle or even one which is painted black, as light hastens decomposition. A convenient method of filtering is to insert a two-hole rubber stopper in the bottle carrying a 6-in. funnel and another tube connected to the exhaust. In the funnel is a ½-in. porcelain filter plate supporting a well-washed felt of asbestos. By starting the exhaust the solution is thoroughly and quickly filtered.

Our real work should begin now that we have a pure solution of the permanganate, but it is much too concentrated, so we must dilute it considerably. This is called standardizing and there are many methods. The one which is perhaps the easiest and quickest from our standpoint follows: First prepare a N/10 solution of oxalic acid. After this, get the purest crystallized oxalic acid obtainable and weigh out 6.25 gms. and dissolve this in 1000 ccs. of H_2O. This is slightly below its real value, for, to be exact, we should dissolve 6.255 gms. of 100 per cent. oxalic acid in 1000 ccs. of H_2O. Of course, 100 per cent. oxalic acid is not to be had, and such a high degree of accuracy will probably not be required for our purpose. Take 10 ccs. of this N/10 oxalic acid solution and transfer it to a beaker with a pipette and add 1 cc. of pure concentrated sulphuric acid. This warms up considerably, and before it cools add the permanganate solution from a burrette in small quantities, shaking the flask after each addition and toward the end reducing the flow to drops. When the last drop is added it imparts a pinkish tint to the solution which persists for ½ minute. Then carefully note the number of ccs. used and then dilute the test solution with a specially distilled water (water distilled as usual, but before beginning the distillation adding about one gram of potassium permanganate to get rid of the ever present organic matter) so that the permanganate solution corresponds volume for volume with the N/10 oxalic acid solution at 25 deg. C.

To get it quite clear how the solution is diluted, let us take a practical example. First we took 1000 ccs. of pure potassium permanganate solution and 50 ccs. for the burrette and measured this accurately into the burrette. This left 950 ccs. in the bottle. Assuming that 9.5 ccs. of permanganate was sufficient to impart a pink tint to the acid for ½ minute, we must add 47.5 ccs. of the specially distilled water as the 9.5 ccs. of permanganate ought to be equal to the 10 ccs. of acid. Then we must add 0.05 ccs. for every 10 ccs. in the bottle, as there are

Digitized by Google

95 or 47.5 ccs. This is thoroughly mixed and a new test made till 10 ccs. of the acid just decolorizes the 10 ccs. of the permanganate. We must not forget to discard the contents of the burrette after each trial and to use a burrette having a glass stopcock, and above all to be scrupulously clean.

Now that we have our N/10 solution let us learn how to use it. Potassium permanganate may be used in volumetric determinations of a number of elements, some of which are iron, calcium, manganese, phosphorus, molybdenum, oxalic acid, hydrogen peroxide and red lead, etc.

As space is limited, let us take as an example an analysis of an iron ore, as the determination of iron is perhaps of the greatest importance. It is based upon the oxidizing action of the permanganate to change iron in the ferrous condition to the ferric.

For analysis we take a 10 gm. sample of ore, powder it and treat it with 10 ccs. of concentrated hydrochloric acid. Upon heating, the iron is dissolved and a residue is left. This is filtered off and the filtrate is saved. Some of the iron in the filtrate is in the ferric condition and must be reduced. This is accomplished by adding about 3 gms. of granulated zinc to the flask containing the iron solution and closed by a small funnel. Ten ccs. of concentrated sulphuric acid are added, and when all the zinc is dissolved the solution is ready to be titrated.

Now we run in the permanganate solution very slowly (this is called titrating). The solution turns a yellowish tint as each drop of the crimson purple permanganate solution is quickly decolorized. At the end we must go very slowly, for the last drop imparts a pink tint to the whole solution for ½ minute. Now we note the number of ccs. consumed, and, as each cc. is equal to 0.005589 gms. of iron in the ferrous state, to find out how much iron was in the solution we multiply the number of ccs. consumed by 0.005589 and the answer is the number of gms. of iron in the solution. For instance, if 45 ccs. were required to produce the pink tint, then there was 45 times 0.005589 or 0.240905 gms. of iron in the 10 gm. sample.

The following is the table we will use frequently in making our calculations, the same as in the foregoing example.

One cc. of N/10 Potassium Permanganate is equal to:

Potassium permanganate...	0.0031606
Iron (ferrous).....	0.005589
Ferrous carbonate.....	0.011505
Ferrous oxide.....	0.007138
Ferrous sulphate anhydrous $FeSO_4$.....	0.015085
Ferrous sulphate $2FeSO_4 3H_2$	0.017767
Oxalic acid (crystallized)..	0.006255

Now we see that these figures are the molecular weights of the substance moved four places to the left, and we will be able to deduce them for ourselves.

If our answer is reported, as, say iron in ferrous sulphate, to find the amount of the element in the compound we use the following:

Fe in FeO is 0.77727%
Fe in $FeSO_4$ is 0.36751%
Fe in $FeSO_4$ $7H_2O$ is 0.2008%
Fe in $FeSO_4(NH)_2SO_4 6HO$ is 0.14239%

These percents are also easily found by means of solving a simple proportion, such as the following for example: Fe : FeO :: X : 100, by substituting the atomic and molecular weights required.

Producing Low Temperatures

By G. E. Meredith

WANTING to test several samples of insulating compounds under winter conditions, the writer began to look up the subject of freezing mixtures, using materials at hand such as ice, sulphuric acid, caustic potash, etc. Several hand books were found with practically the same information in them, part of which is given below.

Snow or crushed ice two parts and salt (sodium chloride) one part. Temperature lowered approximately to 5° F.

Snow or crushed ice three parts, salt (sodium chloride) two parts and sal ammoniac (ammonium chloride) one part. Temperature lowered approximately to —12° F.

Snow or crushed ice three parts and dilute sulphuric acid (oil of vitrol) two parts. Temperature lowered approximately from 32° F. to —23° F.

Snow or crushed ice eight parts and muratic acid (hydrochloric acid) five parts. Temperature lowered approximately from 32° F. to —27° F.

Snow or crushed ice three parts and caustic potash four parts. Temperature lowered approximately from 32° F. to —51° F.

In testing the compound, it was in a quart glass jar and this was in turn placed inside a two-gallon earthen jar. The ice was packed between the jars and commercial battery acid 1.250° poured onto it. The temperature was lowered in the inner jar to 28° F. in a few minutes and the writer was able to hold it there for about one-half hour. This meant a lowering of the temperature of 57° F. from room temperature.

The inner jar was a quart bottle with the top cut off. It was a rather novel sight to see the jar with a heavy layer of frost on it in the middle of July. The temperature of the solution was much lower than the inside of the inner jar, and by using a Dewar flask for the ice and acid, a much lower temperature would be produced, as the radiation is cut down.

Finding the Flash Point of Kerosene

KEROSENE is a liquid which is being utilized more and more in the household for both light and heat.

A very large number of fires are laid to the account of petroleum, and the danger is by no means small. The greater number of these fires are due to the overturning of lamps and oil stoves. In many of these cases the oil continues to burn fiercely after the stove or lamp has been upset. However, this should not be, for an oil is procurable on the market which would extinguish such a blaze. This oil is carefully fractionized and freed from the more volatile products. Furthermore, this oil does not cost any more than the more dangerous kind, and is fully as economical.

The problem of determining whether an oil is safe or not is one which is eminently fitted for the amateur chemist to solve. It is known as finding the flash point or the fire test of the oil.

The flashing point of kerosene may be approximately determined by proceeding in the following manner: Pour a small quantity of the kerosene to be tested in a small crucible or evaporating dish. Then place the crucible upon a water-bath and a theremometer is suspended in the oil.

Heat the water carefully until the thermometer registers 30° C. (86° F.). At this temperature cautiously draw a lighted match across the surface of the liquid.

If the oil does not inflame, repeat the match test at each rise of 5° C. until it does flash. Do not permit the oil to burn, but allow it to cool to the 5° point at which it was before it ignited. For example, at 45° C. a certain sample did not flash, at 50° C. it did flash. The analyst allows it to cool to 45° C. again and then very cautiously repeats it till at, say, 47° C. it flashes once more. The flashing point in this case is 47° C. and not 50° C.

Experience has shown that there is no danger with an oil possessing a flashing point of 40° C. (104° F.). The best grade oil sold in the United States is known as water white and flashes at 65.5° C. (150° F.). However, the writer understands that there are large quantities of oil on the market having a flashing point of from 24° to 40° C. Such oil constitutes a very great source of fire danger. The author has found no difficulty in procuring an oil with a fire test of from 60° to 62° C. The safe limit is 40° C. or 104° F. In certain countries this point has been fixed by law as the minimum.

Digitized by Google

An Experiment in Physical Chemistry

IN the realm of physical chemistry theory is king. Demonstrations and experiments are few in number. But, those experiments which do appear are bound to be excellent ones. This is principally due to the fact that many of them have been devised and performed by the great masters such as Faraday, Fischer, Ostwald, Van't Hoff, Coehn, Haber and many others. Physical chemistry is quantitative in nature not qualitative; it wants to know not only how, but how much.

The reader will recall that in his high-school chemistry, he learned that all thiosulphates (especially including the acid) are rather unstable and break down into sulphur, water and sulphur dioxide as expressed by the equation: $Na_2S_2O_3 + 2HCl = 2NaCl + H_2O + S + SO_2$ or in an ionic equation simply $H + S_2O_3 = HSO_3 + S$. It will be advantageous for the experimenter to repeat this qualitative experiment to refresh his memory.

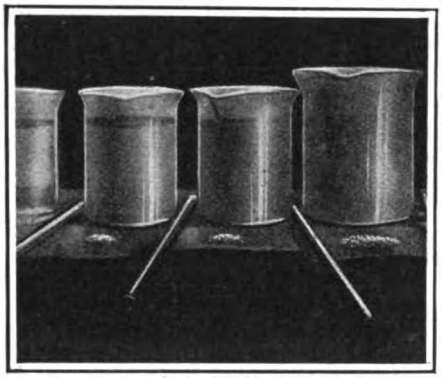
Make a concentrated solution of the hypo. (as the sodium thiosulphate is commonly called) and add a few drops of concentrated hydrochloric acid. At first, nothing appears to take place, but after several seconds a white milky precipitate of sulphur is seen in the solution and the odor of sulphur dioxide is apparent.

From such experiments as these physical chemistry strives to draw broad generalizations. These are almost always obtained by quantitative experiments. In this case, it is to prove that certain reactions take place in a time relation to the masses of the reacting substances. In other words, we are working in a sub-topic under the head of "The Law of Mass Action."

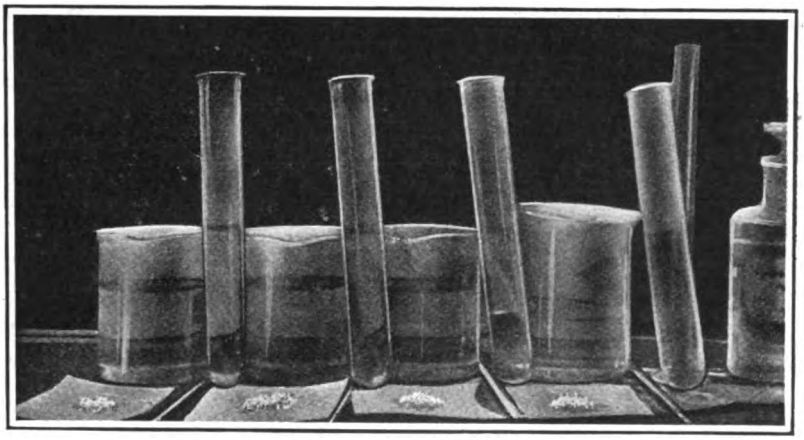
This particular experiment is easily adapted to the resources of the youthful scientist. The procedure is as follows: Weigh very carefully 0.1, 0.2, 0.3, and 0.5 gram of sodium thiosulphate ($Na_2S_2O_35H_2O$) into four separate beakers. Add 100 cc's of distilled water to the salt in each beaker and allow it to dissolve. In three separate test tubes prepare dilute solutions of hydrochloric acid by adding 1 cc. of concentrated hydrochloric acid to 20 cc. of water. In a fourth test tube, place 1 cc. of the concentrated acid without any water whatsoever in the tube.

Arrange the beakers in a row according to the hypo content, the test tubes so that the one containing the 1cc. of concentrated acid is before the beaker with the highest hypo. content.

This is shown in the first photograph, the beakers containing the clear solutions are in back of their respective test tubes and the piles of hypo. before the beakers graphically shows the quantity in solution.



The beakers after eleven minutes



The four test tubes and beakers with the sodium thiosulphate before them

Pour the four test tubes of acid into their respective beakers, noting the exact time. Carefully watch the beakers and at the first sign of a separation of sulphur note the exact time.

In the second photograph, the beakers are shown after eleven minutes have elapsed. One can see the last three beakers exhibit varying degrees of milkyness, while the first is still perfectly clear.

For the beakers above illustrated, the following results were obtained:

No. 1 (extreme left)	19	minutes
No. 2	8	"
No. 3	6	"
No. 4 (extreme right)	3	"

If any of the readers fail to get identical results they ought not to feel discouraged for their results are probably correct though differing from those above. This is inevitable since the purity of the sodium thiosulphate, the concentration of the acid, the temperature and many other causes are bound to cause the results to vary.

Ostwald, Holleman and V. Oettingen, who have carefully studied this reaction, are all agreed that the sulphur is immediately formed on mixing the acid and salt solutions. They explain this peculiar phenomenon by assuming that the sulphur remains in solution until a definite concentration is reached or a certain change has taken place which causes the appearance of visible sulphur particles.

An older hypothesis is that the thiosulphuric acid formed by the interaction of the acid and the salt remains entirely unchanged till the sulphur appears, and the decomposition is started at this moment. However, this is incorrect, for if we treat a dilute thiosulphate solution with the acid and neutralize this acid with a base before the sulphur has started to deposit, it is found that the deposit will appear in due time.

Holleman believes that a certain part of the free thiosulphuric acid must decompose, but the sulphur is in such a finely divided state that it cannot be detected till it has gathered together in larger particles. This is, by the way, a nice little opportunity for some serious research by the amateur chemist, for who can tell but that one of the readers may be able to make some useful contribution to the solution of this problem.

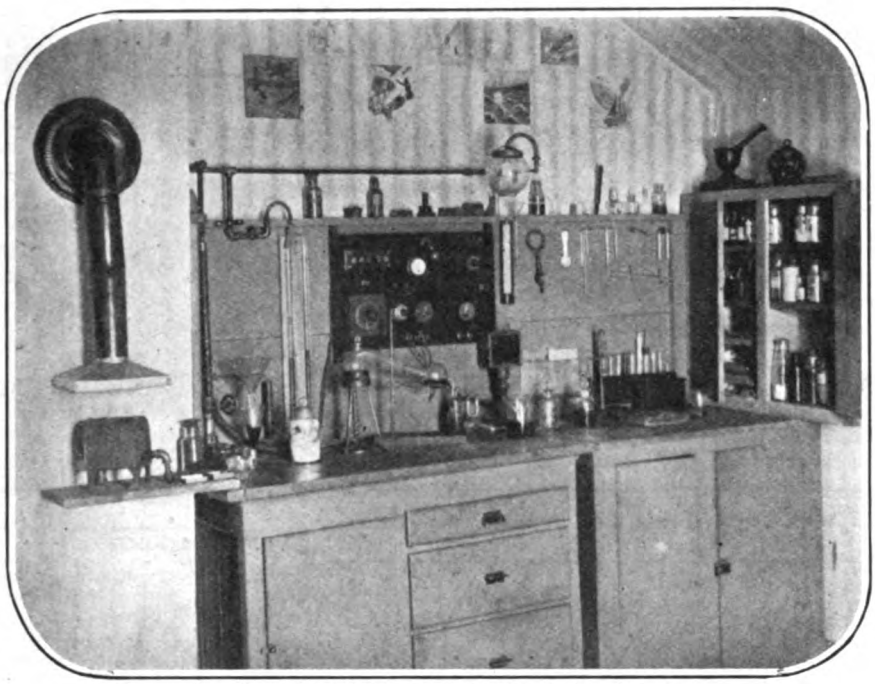
Those amateur chemists who limit their experimental work entirely to the realm of strict chemistry are missing much by not devoting some time to experiments in the fascinating field of physical chemistry. Physical chemistry is nearly as broad and interesting as the science of chemistry itself. It is only during the last half century that physical chemistry has been elevated to the plane of a distinct and separate branch of science. Some very important discoveries have been made in this branch of science and more will be made.

Digitized by Google

Readers' Workshops Page

FROM month to month descriptions of the workshops of our readers' will appear on this page together with photographs of the shops and any noteworthy piece of work that may have been made in them. This will be a feature of EVERYDAY ENGINEERING MAGAZINE as long as we are able to obtain the descriptions. All descriptions sent in will be paid for at our regular space rates.

To the fellow who owns a shop or laboratory, there is always a certain pleasure in seeing the shops of others to learn what they are doing and how they have arranged their apparatus. The following description is that of the shop of Mr. Ernest C. Neubert in the owner's words:



A well equipped laboratory for chemical and electro-chemical work

"My shop or laboratory is nine by twenty-one feet, with three windows and two doors, all of which slide into the partitions.

"The walls and ceiling are of car-siding, 7/8 of an inch thick, giving a solid wall on which to fasten instruments and shelves. The walls, ceiling and shelves are painted white to give all the illumination possible.

"There are thirty-five drawers under the benches, each 14 x 22 inches, and from four to eight inches deep; also many cabinets above the benches, all of which were made during spare time. The switchboard, drawers, benches and cabinets are varnished with light oak, and shellaced. There is a dark-room, 7 x 9 feet, and another small room used for lumber and extra equipment.

"I made the desk shown in the picture. The five drawers on each side, and the bookshelves above, are of yellow pine; the top, thirty inches by six feet, and the legs are of red wood, varnished with light oak.

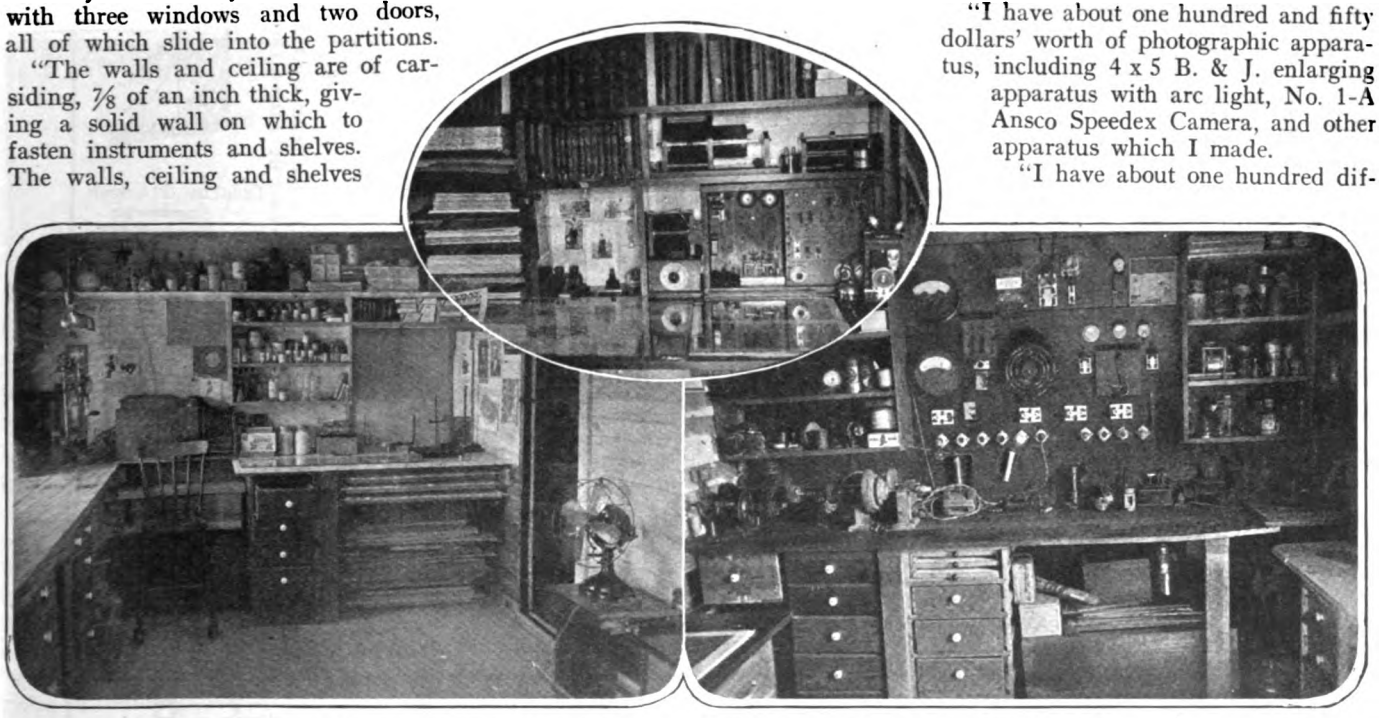
"I have about one hundred dollars' worth of wireless apparatus, mostly of my own construction, and about two hundred and fifty dollars' worth of books, including I. C. S. Reference Library, Hawkins' Electrical Guides, and numbers of others on photography, chemistry, and all branches of electricity; also a complete set of magazines since 1915, including Everyday Engineering, Popular Mechanics, Popular Science, Electrical Experimenter, Wireless Age, Electrical Review, and others.

"My power board includes watt meter, three volt meters, two ammeters, two rheostats, and motor generator. I have four storage batteries of three cells each, and have made three good Tesla coils from time to time.

"I have about one hundred and fifty dollars' worth of photographic apparatus, including 4 x 5 B. & J. enlarging apparatus with arc light, No. 1-A Ansco Speedex Camera, and other apparatus which I made.

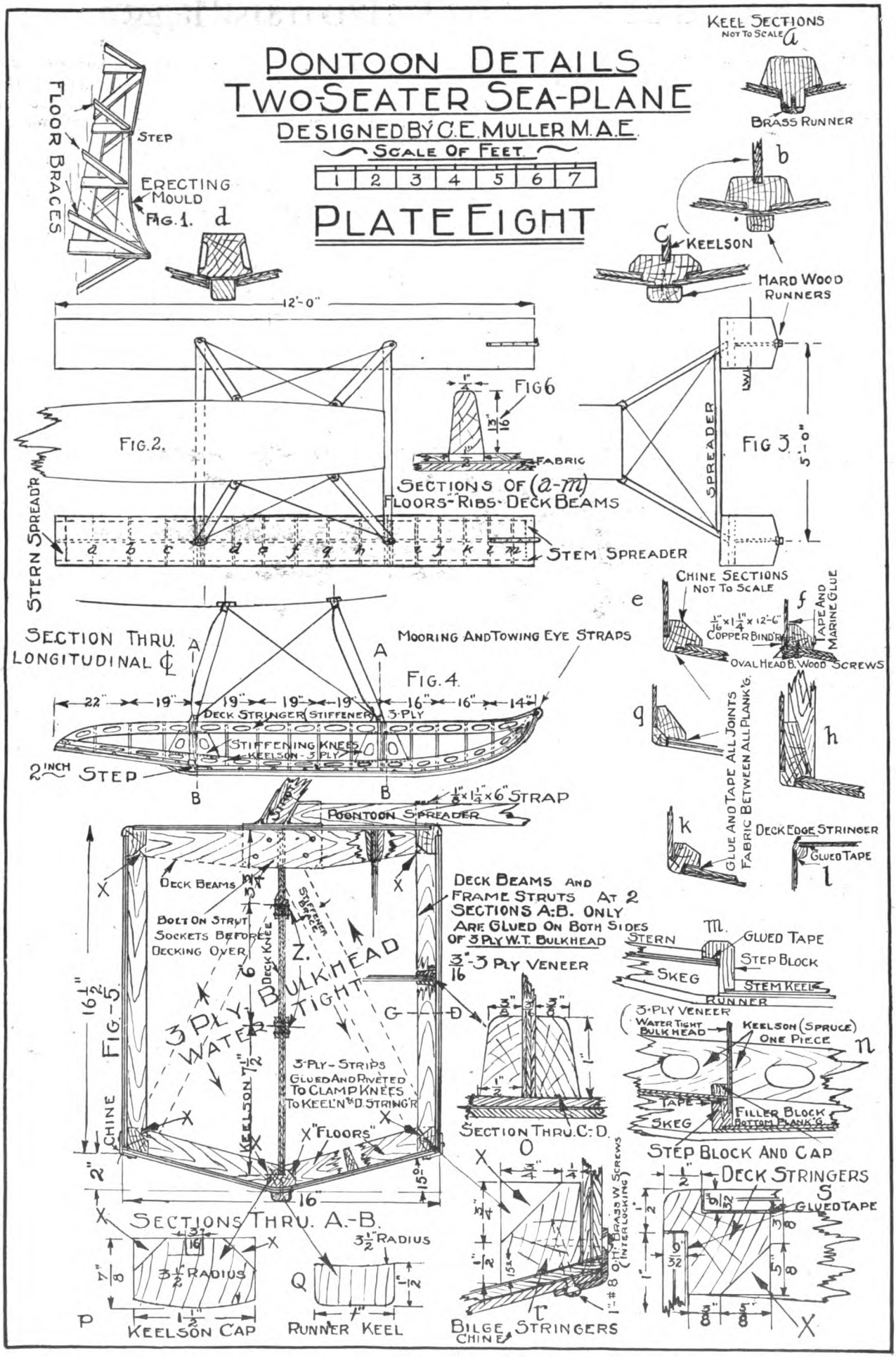
"I have about one hundred different kinds of chemicals, and own about one hundred dollars' worth of tools, including bench drill, breast drill, complete set of twist drills, wood bits, and set of chisels, pliers, planes, ham-

(*Continued on page 327*)



Several views in the workshop and laboratory of Mr. Ernest C. Neubert of Neosho, Mo.

Digitized by Google



Digitized by Google

Building A Two-Passenger Seaplane

By Charles E. Muller, M.A.E.
Consulting Aeronautical Engineer

PART SIX

Pontoon Construction

THIS subject is so large and fascinating that it is rather difficult to confine the types and processes with specific instructions to the limits of this article. A brief classification of methods of planking will follow the description of all the various components that enter into the construction of the pontoons for this two-seater seaplane, and no particular difficulty should be experienced in building them.

Keels and Keelsons

A study of the keel sections a-b-c-d and in Fig. 5, Plate 8, will give a fair idea of the more common and practical methods of constructing these members. Keelsons are illustrated in b-c and in Fig. 5. They are employed to stiffen the float longitudinally, also strengthen the bottom to withstand the terrific impacts of landing shocks and the water pressure at high speeds. Sometimes more than one keelson is used for rigidity in wide floats and flying boats. The keelson is usually notched over the "floors" (this is the technical name given to the cross frames or ribs of the bottom structure), especially when the keelson extends to the bottom planking without using the cap strips.

For the pontoons described this is recommended, but the cap strips are cut in short lengths and are fitted between the floors, this locking them in position. Keelsons are made of various woods—the determining factor being the depth of section permitted. When used without caps, thin, deep sections of spruce, white pine, Port Oxford and white cedar, yellow pine, an even bass wood are used.

Chine Stringers

Sections shown in sketches e, f, g, h, k and in Fig. 5 will illustrate the general methods of chine stringer construction. Keels and chine stringers are usually made of white ash, white oak or spruce. Ash is recommended for the floats. Chine and deck edge stringers are always, where possible, continuous members from stem to stern.

Bulkheads

Owing to the 100 per cent over capacity of flotation in these pontoons, they are each divided only into three watertight compartments by the two main bulkheads of three-ply wood. It is made by (Marine) glueing three laminations of birch or beechwood, about ⅛" thick recommended in this case, laid so the center layer grain runs 90 degrees to that of the outside layers. The bulkheads also serve as formers and stiffeners to the hulls and rigid anchorages for the strut fastenings. They, in turn, are strengthened by battens diagonally braced to chine stringers, and by knees of the same material, clamped to the center deck stringer and to the keelson by seam strips that are glued and riveted as shown at z in Fig. 5, Plate 8. A cross section of the floors, ribs and deck beams used throughout the pontoons is shown at Fig. 6. The only exceptions are where they are fastened to the bulkheads shown in Fig. 5. These are tapered one side only, the untapered side is glued and riveted to the bulkhead. White ash for frame floors, etc., is recommended, as this material will retain the screw threads better than the soft woods and stand the impacts better.

The false keel runner, shown at Fig. Q, is a hard wood strip sometimes shod with a brass strip to stand the wear and tear of sliding up the ways or on to the rafts. On light machines of this construction, ash or oak false keels will suffice without the metal strip, as they are so easily renewed. The false keel is continuous from the mooring eye strap to the stern. The chine, as the junction of the bottom and sides is called, is protected by methods shown at e, f, g, h, k and r. That shown at r has been selected because it is simplest and very satisfactory in every way.

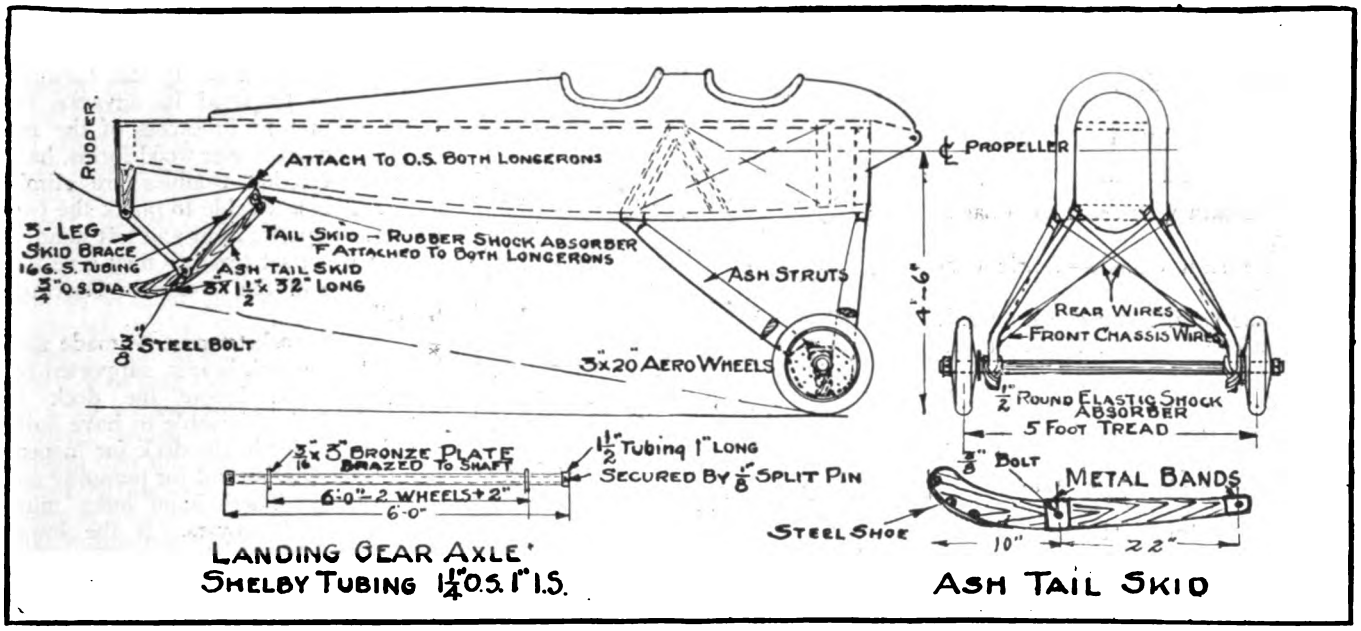


Plate 9. Wheeled landing gear to be substituted for pontoons if desired

Step

The step is made of 2" x 2" x 15" white ash or oak, tapered from its lineal center to a ¼" edge with a rabbet for the planking and the bulkhead, as shown at n. The step clamp (cap strip) is made of same material 1½" x 1⅝" x 15", as per the cross section at n.

Filler Block and Skeg

This block, sometimes called the "dead wood wedge," may be added or be an integral part of the keelson. The skeg is of hard wood and it is used to fill in the recess behind the step, making a solid bearing for the after part of the runner. It should be very strong as often the seaplane is balanced on this

Digitized by Google

point to turn it or raise it to place small trucks under the floats. This differs from boat practice as the skeg, sometimes called a shoe, is usually of metal attached to the dead wood extending sternward with a bearing for the rudder and providing protection for the propeller.

The stern and stern spreaders are ash pieces shaped to strengthen the bow and stern, holding the chine and deck stringers rigidly.

Planking

The planking is undoubtedly the main step of the pontoon, bracing it in lieu of wiring and must be watertight. Taking advantage of the wide experimentation and practical testing of this type of machine, I strongly recommend the double skin, opposite diagonal planking for this flat back and flat side pontoon. Careful consideration has been given to the contraction and expansion due to the constant wetting and drying which these floats are subjected to under severe conditions. Available space only permits bring description of the commonly used methods that have proven satisfactory in actual service. They are divided into groups to assist the reader to gather a fundamental knowledge of planking.

Group I

Deck Planking

1. Single skin with seam strip backing.
2. Single skin outside—fabric covering.
3. Double skin, inner one diagonal, outer one planked, fore and aft, fabric between.
4. Double skin, except outer skin is planked diagonally opposite.

5-6. Three-ply laminated wood with or without fabric covering.

Group II

Bottom Planking

1. Single skin with seam strip backing.
2. Double skin, inner 45 degree diagonal, out skin diagonally opposite, fabric between.
3. Double skin, diagonally opposite, fabric between.
4. Treble skin, two inner skins diagonally opposite, outer planked longitudinally, fabric between all skins.
5. Three-ply laminated wood.

Group III

1. Three-ply laminated wood.
2. Double skin, diagonally opposite, fabric between.

Planking woods used are white pine, spruce, white cedar, Spanish cedar and mahogany.

Plank Fastenings

Plank fastenings, for material of the thickness used in these floats are brass and copper rivets known as canoe rivets. These vary from ⅜" long upward. When long rivets are used through stringers, or ribs, etc., a washer or burr is used to rivet the end over. Short rivets can be driven in and turned over in alternating directions nearly as fast as wood screws and will not loosen up so readily. Wood screws will strip the thread in the wood if driven too hard but may be used advantageously in stringers, beams, etc. All wood screws used are of brass and have flat heads.

Fabric Covering

Fabric covering for the outside or between layers for small floats must be very strong and light, but with sufficient body to hold the "Liquid Marine Glue" with which it is saturated when applied. Linen covering used on airplane wings has proven very satisfactory, also silk and cotton have been used. The finishing room, where varnishing, painting, glueing, etc., are done, should be kept at not less than 65° minimum to 80° maximum. It should be dry and well ventilated. Follow explicity the directions sent with the special glue.

The planking is carefully sandpapered to a smooth finish, thoroughly brushed and a thin sizing coat of glue applied, when thoroughly dried. A second coat is then added over which the linen or silk is rapidly stretched, before the glue sets. By using Jeffery's Waterproof Liquid Glue, the need of hot irons is eliminated. Satisfactory results are produced by smoothing the fabric with a cold iron or block of wood. A third coat of glue is applied over the fabric, thoroughly covering it. The outside planking is then laid on. Sometimes the planking is sewn together with bronze wire instead of riveting. The wire stitching runs with the grain and is bedded in flush with the outside planking, particularly in "treble skin" construction, where the outside plank is laid longitudinally.

A word of warning may not be amiss regarding the fabric covering. The shape of this pontoon is surely so simple that if care be taken to eliminate all puckers and air pockets, by working them to the edges and copper tacking along the stringers, no difficulty will ensue. The simple form described has been chosen with the requirements of the amateur builder in view.

Building the Pontoons

The erection mould, Fig. 1, is usually used where the pontoons are large like the N. C. flying boat hulls, or large seaplane pontoons, but the smaller ones, like canoes, launches, and small boats, are built keel up. In this case ws save this time and expense if the two sides be constructed on a temporary table top of ⅞" x 20" wide x 14' long. This may also be used to form the chine and deck edged stringers on, if the side elevation Fig. 5 be carefully laid out, and blocks properly located and fastened.

A level floor may be used for the same purpose and also to lay out the deck stringers and keelson. Then the pontoon sides are placed top edge down on horses or boxes, then fastened to the two watertight bulkheads next the keelson and floors, followed by fitting the keelson cap and step. Great care must be taken to have the sides line up, which is best accomplished by the use of a 24-inch steel square. A slight variation in these pontoons will manifest this discrepancy by a turning tendency in the water or a "weather helm" while flying. Check up carefully before planking. Be sure to glue and tape all stringers where planks are fastened. Start the planking at the step work aft to the stern, then from the step forward.

The planks forward of the step are steamed in the center and bent over the keelson cap to approximately 15 degrees above the horizontal. Aft of the step, the planking is horizontal and easily applied, then place the step in position, glue and rivet to the bulkhead. then plank forward. If the forward planking is prepared in advance by being steam bent in excess of the required 15 degrees over wood forms, half your construction troubles are eliminated. It is advisable to plank the two pontoons opposite right and left handed so that when set together they give the appearance of the so-called "Herringbone."

The strut sockets must be made and bolted to the deck beams, supported by the bulkheads, before the deck is planked. It is advisable to have suitable hand holes in the deck for inspection of the interior and for pumping out the seepage. These hand holes must have watertight covers. If the lower wings are increased to a four-foot chord, the rear strut anchorage is located farther aft (approximately six inches), this necessitates the rear bulkhead and step being placed at the new position. As designed, the chord of the lower wing is two feet six inches, as outlined in Part I, August, 1919.

Wheeled Landing Gear

As previously stated, this machine may also be used for flying over land if sufficiently large bodies of water are not available for making the experimental flights. The details of a landing gear suitable for transforming the machine from a seaplane to an airplane that can take off from and alight on land is outlined at Plate 9. The construction is very simple, in fact it is considerably easier to build a landing gear than it is to construct the pontoons.

Digitized by Google

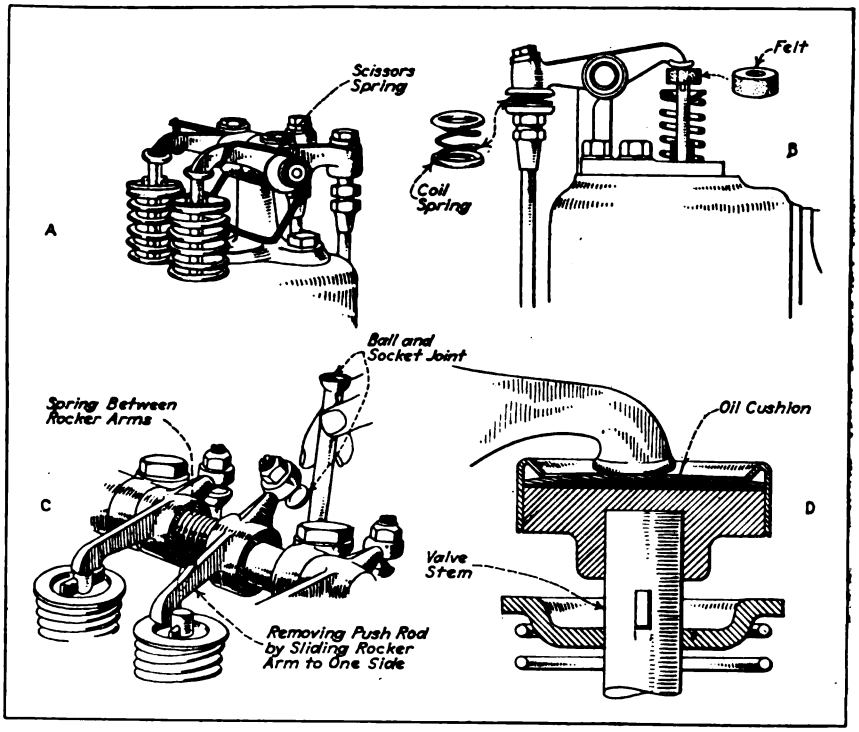
EVERYDAY MOTORIST

Silencing Noisy Overhead Valves

ONE of the disadvantages advanced by those who do not favor the overhead valve type of motor is that after these have been operated for a time they are apt to become noisy due to lost motion at the various points in the valve operating linkage. There is really no excuse for this lost motion in any engine that is properly taken care of and parts kept oiled. It is evident that many inexperienced motorists may neglect such essentials as push rod adjustments to maintain the desired clearances between the ends of the rocker arms and valve stems. A number of methods for taking up this lost motion automatically are given in accompanying illustration. At A, a scissors spring bent up of spring wire is installed around the valve rocker bearing pins in such a way that one end of the spring fits under each valve rocker and keeps the other end of the lever in firm contact with the push rod. The system shown at B does the same thing except that a coil spring is interposed between the rocker arm and tappet rods. A piece of felt in the form of washer is placed over the end of the valve stem and is kept saturated with oil so that the end of the valve stem is constantly lubricated. In some engines of recent development the rocker arms are mounted on a hollow shaft through which oil circulates, thus insuring that this bearing will always be properly lubricated. A ball and socket joint is used at the ends of the tappet rods which is not apt to wear as quickly as the old type yoke and pin connection. In one modern engine a spring is placed between the rocker arms and by compressing this spring either rocker arm may be pushed to one side and the push rod or tappet easily removed. With this type of valve operating mechanism if the caps or sockets on the tappet rods are kept full of oil there will be practically no noise in the valve operating mechanism. A simple fitting is shown at D consisting of a cap member designed to be installed on the top of the valve stems between that member and the end of the rocker arm. An oil cushion is interposed between dished plate and the top of the cap, the function of this being to absorb the shock of the rocker arm end and also to permit of a closer adjustment than would be possible if the rocker arm operated directly against the end of the valve stem.

Benzol as Fuel

THE secretary of the Automobile Association of Great Britain has sent out some figures tending to show the economy to British motorists of using benzol as fuel. The figures converted into U. S. measure are as follows: Price of No. 1 gasoline today, 60 cents a U. S. gallon; price of N. B. A. benzol, 54 cents a gallon; initial saving, 6 cents. It must further be remembered that at least 15 per cent. more mileage can be obtained from benzol than from the best petrol, and that therefore the equivalent prices per gallon of benzol and gasoline are 45.5 cents for the former, as against 60 cents for the latter. On a yearly mileage of 10,000 miles on a car doing 16 miles to the gallon this is equivalent to the saving of $90, to say nothing of the sweeter running and extra power said to be obtained from this fuel.



Methods of silencing overhead valve motors recently developed

Cleaning Paste for Hands

A satisfactory hand cleaning paste for the home or shop worker should have incorporated a satisfactory detergent or cleaner of sufficient strength to attack grease, dyes or inks, as well as the more soluble dirt and at the same time should not contain any excess of alkali as this will injure the skin. The green soap which forms the base for this formula below, together with the ammonia water and oil of turpentine embody all the features mentioned above. An abrasive or dirt cutter is very essential and finely powdered pumice stone is the best that can be used. Scenting oils are added to impart a pleasing odor to the preparation. The ingredients are:

Soft soap.....90 ounces
Ammonia water..... 6 ounces
Turpentine, sufficient to form a stiff paste.....
Powdered pumice stone....30 ounces
Essential oil (either oil of wintergreen or oil of sassafras ..... 3 ounces

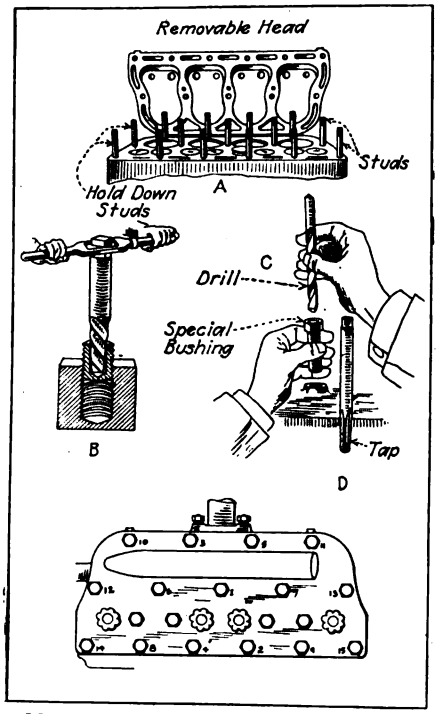
Mix the soap and ammonia water and add the turpentine. Heat the mixture by using a double kettle to secure a water bath. Allow the mixture to heat until a jelly-like mass is formed and while still heated, add the pumice stone and stir well while adding, so that it will incorporate thoroughly without forming lumps. After all the pumice stone has been added, continue to stir for five minutes, at the same time, dropping in the essential oil

Digitized by Google

that is to be used for perfuming. Set aside to cool for some five to ten minutes and while still syrupy, pour into containers.

Removing A Broken Stud

WHEN the detachable cylinder head type of motor, as shown at A in accompanying cut, is repaired, unless care is taken in tightening down the retaining nuts, one is apt to twist off a stud bolt where it goes into the cylinder block casting and usually it twists off flush with the casting so that its removal is not an easy matter with ordinary tools. One way is to drill a hole into the center of the stud and then using a specially fluted stud extractor and tap wrench, as shown at B. Sometimes the broken portion may be so tightly rusted in the cylinder block that it must be drilled out. Special sets as shown at C may be obtained to fit the popular cars using this system of head construction. A bushing that acts as a guide for the tap drill is placed in the bolt hole and insures that the hole will be centered and not damage the thread in the head casting. The remaining portion of the stud is cleaned out with the tap, so a new

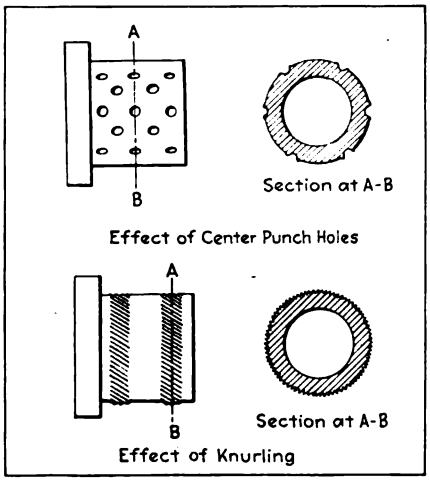


Methods of removing broken stud from cylinder block

bolt or stud may be placed in the hole. Even such a simple thing as tightening down the head casting retention nuts may be improperly done. To insure an even bedding down of the head, it is advisable to screw down the nuts in the order indicated at D. Nut number 1 is the first to be screwed down because it is at the center of the casting, then numbers 2 and 3 are tightened down, and the rest in the numerical order indicated to insure even clamping.

A Putting-on Tool

HOW often at some time or other have mechanics wished for something in the way of a putting-on tool. As it is always easy if a piece is too large to remove metal in order to bring it to proper size this proposition does not worry even the poorest mechanics. But what is to be done if the piece is too small? A common method and a brutal one is to take center-punch and upset the surface of the metal in order that it shall be a tighter fit in the hole. A bushing or a rod, if not too small, is often treated in this manner and may be forced into the hole, but one resort-



Enlarging outside diameter of small bushing in an emergency

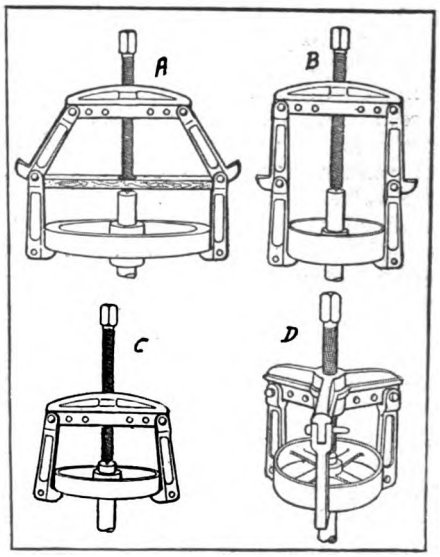
ing to such methods may seriously distort the piece. A more effective method of "putting-on" is by means of a common coarse knurl, knurling the bushing the entire circumference in several places. This will have the effect of expanding the outside diameter almost one-thirty-second of an inch if desired and is much neater and infinitely superior to the use of prick-punch marks, which is an unsightly and unreliable method of increasing the effective diameter. The great advantage of knurling is that the metal is equally and uniformly expanded, does not look bad if for any reason the bushing or rod is withdrawn and what is more important for anything that must be a tight fit, it is not apt to work loose. Another method is to sweat some solder on the outside of the piece, this being easily done if the bushing is of brass or bronze. The layer of solder should be applied as uniformly as possible over the entire surface.

If the car engine employs the thermo-syphon system of cooling be sure to keep the cooling system filled with water. When the water falls below the inlet connection of the radiator then circulation is seriously retarded. Even the circulating pump system needs to have a full radiator at all times in order to insure the best results.

Utility of Wheel Puller

THE wheel puller is a very useful appliance. Special forms suited for the general run of repair-shop work are shown herewith. The type shown at A is a two-armed puller having two sets of arms, the lower set may be attached to the upper arm as indicated. This makes it possible to handle work of relatively small diameter that is beyond reach of one set of arms as shown at B, or on work of large diameter that would be beyond the capacity or spread of the beam when used as at A. In this case a piece of wood is being used as a spreader for the arms. It is relatively easy to move work near the end of the shaft, this involving the use of only one set of arms as shown at C. The use of the three-armed puller, which is a superior form for general service to that shown at C, inasmuch as it is not apt to rock over to one side or the other when the pressure is applied is shown at D.

When exploring the lower parts of the chassis, check over the brake rods to see if they have pull springs to insure full release when intended as this will prevent bands dragging, and a hot brake drum will be avoided.



Showing use of two and three arm wheel and gear pullers

Excessive and continuous carbonization in one cylinder of a multiple cylinder engine generally can be traced to a bad set of piston rings, which allow too much lubricant to work by into the combustion chamber. The fitting of new rings is necessary in such cases to remedy the faulty condition.

The motorist should remember that ordinary vaseline is perhaps the best medium available for coating battery terminals and connectors. The vaseline acts to minimize corrosion from acid or water that may have been spilled on the sealing compound.

Digitized by Google

Superchargers and Supercharging Aviation Engines

A Concise Explanation of the Advantages of Supercharging to Maintain Sea-Level Horsepower in Aircraft Power Plants at High Altitudes

By Major George E. A. Hallett, U.S.A., M.S.A.E.

THE need for aeronautical engines that will deliver the same power at 20,000 or even 30,000 ft. altitude as they develop at sea level is very real and very great, in not only military but also in commercial aviation. Much success has already been attained with supercharging devices in this country and a certain amount of success in Europe. It must be admitted that there have been some failures also. Supercharging, as the term is generally used, means forcing a charge of greater volume than that which is normally drawn into the cylinders by the suction of the pistons in conventional internal-combustion engines.

Why Supercharging Is Needed

At 20,000 ft. altitude the atmospheric pressure is roughly one-half that at sea level; hence about one-half the weight of charge is drawn into the engine and less than one-half the power is developed. At 25,000 ft. altitude less than 25 per cent. of sea-level power is delivered. If at these altitudes air is supplied to the carburetor at sea-level pressure, or approximately 14.7 lbs. per sq. in. absolute, the power developed by the engine becomes approximately the same as when running at sea level. The low atmospheric pressure and density at great altitudes offer greatly reduced resistance to high airplane speeds; hence the same power that will drive a plane at speed of 120 m. p. h. at sea level will drive it much faster at 20,000 ft., and still faster at 30,000 ft. altitude, and with approximately the same consumption of fuel per horsepower-hour.

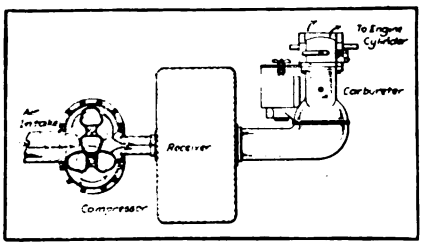


Fig. 1—Root type blower

There is little to be gained by supercharging at sea level to increase the power of a given size engine, because the clearance volume must be made greater than normal to prevent preignition, with consequent decrease in expansion ratio and comparatively poor fuel economy. The fact that the clearance volume is increased removes the possibility of the engine developing full power at great altitudes unless a supercharging capacity greater than anything heretofore considered feasible is available. Supercharging, therefore, is most useful in maintaining sea-level horsepower in engines ascending to or working at great altitudes.

Major Hallett is Chief of the Power Plant Section, Engineering Division, Air Service, Dayton, Ohio. The discussion herewith is condensed from a paper presented at the Annual Meeting, January 7 and 8, 1920, of the Society of Automotive Engineers. Considerable interest obtains at the present time in supercharging aircraft engines, and it is believed that an authoritative exposition of this character will prove of interest to all our readers, even those who are not specially interested in aviation, because of the general engineering information it contains.

Forms of Superchargers

Superchargers usually take the form of a mechanical blower or pump, and, of course, require a driving gear of some kind. The type of blowers or compressors used to date include the reciprocating, Root displacement and centrifugal types. The reciprocating type was tried by the Royal Aircraft Factory early in the war, on an air-cooled R. A. F. engine, with practically no success. It seems that this type of blower was found to be comparatively heavy and also unsuitable, due to the pulsating pressure of the air delivered.

The Root type blower was tried by the Royal Aircraft Factory with little or no success. The trouble reported was "rough" running of the engine on account of the pressure pulsations in the air discharged by the blower, which tended to overcharge some cylinders and undercharge others, thus causing uneven impulses. It is reported that mechanical troubles also developed with this type of blower. George W. Lewis, of the National Advisory Committee for Aeronautics, is working on an improved Root type blower, shown at Fig. 1. Here the pulsations in the air discharged are synchronized with the suction strokes of the engine. It will be interesting to note how this develops.

The centrifugal type of blower was used by Prof. Rateau, in France, early in the war. He employed the exhaust gases of the engine to drive a high-speed single-stage turbine direct connected to the centrifugal blower, shown in Fig. 2. Some success was had from the start, but he encountered many mechanical troubles. It is claimed in recent reports that some fairly good results are being obtained by the French.

The Royal Aircraft Factory experimented in 1916 and 1917 with a gear-driven centrifugal blower, but as soon as an endeavor was made to run it at speeds that would step-up the pressure to the 5 or 6 lbs. required, great difficulties were encountered on account of the inertia and momentum of the compressor rotor and the high-speed end of the gear-train, which resulted repeatedly in the breakage of the gears when the engine was accelerated or decelerated. To eliminate this trouble a friction clutch, designed to slip under excess torque, was tried, but only partial success was achieved, and the clutch itself gave considerable trouble. Light flexible vanes were then tried on the compressor impeller, but this expedient has not proved successful to date. Similar experiments were conducted by the A. E. F. in France, but were concluded by the signing of the armistice.

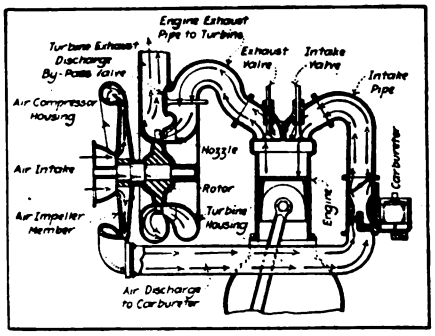


Fig 2—Centrifugal type blower

The United States Air Service started work on the Rateau type of turbo-compressor soon after we entered the war. The work was done under the supervision of E. H. Sherbondy, who

Digitized by Google

worked in conjunction with the Rateau-Bateau-Smoot Co., which handled the Rateau patents in this country, and designed a turbo-compressor which seemingly embodied many improvements over the Rateau type. Three of these machines were built and given ground tests on Liberty engines. The arrangement of the engine and the supercharger is shown in Fig. 3. Considerable trouble was encountered due to overheating of the exhaust-driven turbine, and even the use of a special heat-resisting metal in this part did not overcome the trouble. Soon after Mr. Sherbondy began work on the turbo-compressor, Dr. S. A. Moss, chief of the turbine research department of the General Electric Co., asked permission to carry on some work on the same general type. He built one turbo-compressor which was also a modification of the Rateau type but differed considerably from Mr. Sherbondy's machine. This device was tested on a Liberty engine at the summit of Pike's Peak and developed approximately sea-level horsepower there, at an altitude of 14,000 ft. It was capable of making the engine preignite at that height. The Moss supercharger, as first built, was of rather crude construction, and much mechanical trouble was encountered with all parts except the rotating element.

After the armistice was signed all work on the development of superchargers was stopped. When the engineering division of the Air Service took over McCook Field and started to plan peace-time development, the supercharger situation was carefully considered. It was decided that it was important to continue development work along this line. It then became necessary to decide whether work should be continued on both the Sherbondy and the Moss machines, and, if not, which one should be developed. It was noted that although Dr. Moss' machine was comparatively crude, it contained some inherent advantages over the Sherbondy type, and no way was seen to overcome the faults of the Sherbondy machine. Therefore, the latter was dropped and the General Electric Co. was given a contract to rebuild the old supercharger designed Dr. Moss. The new device is now being tested in actual flight and giving very interesting results. Figures on the results obtained with the present Moss supercharger are naturally confidential. The indications are that the turbo-compressor is very durable and probably will outlast an aviation engine.

Carburetor Locations

There is still some question as to the best location for the carburetor in relation to the blower in supercharged engines. Apparently all positions have been tried:

(1) It is possible to use the centrifugal type of blower as a carburetor by placing a fuel jet within its housing and allowing the rotor to do the mixing. As the rotor usually runs over 20,000 r. p. m., it will certainly mix liquid fuel with air. This system would require a manual fuel adjustment, such as is used with the Gnome engine, for different speeds. With this arrangement there would be danger of an explosion in the blower in case the engine

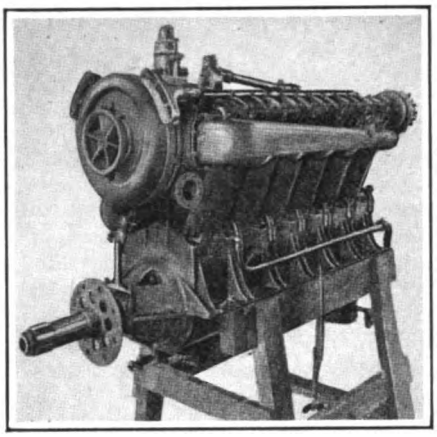


Fig. 3—How turbine type air compressor is installed on Liberty 12 aircraft motor

back-fire, because the mixture in the blower would be under pressure higher than atmospheric.

(2) The carburetor can be placed on the suction side of the blower. In this case the evaporation of the fuel will assist in cooling the charge during compression and the action of the compressor will improve the mixing of the fuel, but the danger from explosion remains to be overcome.

(3) When the carburetor is placed in the "normal" position and air is forced through it, it becomes necessary to

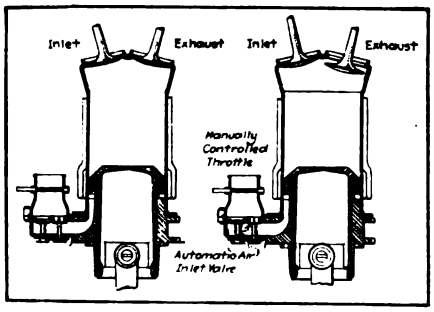


Fig. 5—Engine with built in supercharging piston construction

"balance" the float-chamber with supercharger pressure. This somewhat complicates the feeding of fuel. Pressure gas-feed systems are "banned" in military planes and in any case with a pressure system the tanks would have to be made comparatively heavy to withstand the pressure which would be used at great altitudes. Where gasoline pumps are used it is necessary to regulate their discharge pressure as the plane ascends, because the fuel must reach the float-chamber at a pressure about 2½ lb. higher than that at the supercharger outlet. If the difference in fuel and float-chamber pressure is not kept in constant relation, the quality of the mixture fed to the engine will vary on account of the change in fuel level in the float-chamber. The engineering division has developed a very simple device that solves this problem effectively and is entirely automatic.

It would naturally seem at first thought that the extremely low temperatures always found at great altitudes would make possible the easy solution of cooling problems, but in reality the low density of the air reduces its heat conductivity and capacity for heat absorption to such a point that a supercharged engine developing sea-level power at 20,000 ft. requires a little more cooling surface than it does when developing normal power at sea level.

The Liberty engine and many others run best with a water temperature of about 170 deg. Fahr. To maintain the cooling water at this temperature in the reduced atmospheric pressure at 25,000 ft. it is necessary to use several pounds of air pressure in the radiator to prevent the water from boiling away. Very effective radiator shutters are needed when the engine is throttled to make a descent from altitudes of over 20,000 ft. to prevent the water in the radiator from freezing before warmer air is reached.

Contrary to expectations, the Moss turbo-compressor now being tested at McCook Field does not complicate the pilot's controls. On a normal engine the pilot handles the throttle and the altitude carburetor control which thins down the mixture as he ascends. With the turbo-compressor the altitude control becomes unnecessary up to the altitude at which the engine can no longer deliver sea-level power, but is used, as with a normal engine, if the plane is driven higher.

How Engine Speed Is Controlled

With the Moss turbo-compressor, when flying at low altitudes, the exhaust pressure is allowed to "waste" through manually operated "gates" in the exhaust pipes. As the plane ascends the pilot closes these gates a little at a time, and after he reaches a great altitude he can speed and retard the plane by the use of these gates. He uses the throttle only in case he wants to descend rapidly, when he closes it. In our test flights, we have provided the pilot with a sealed altimeter connected only to the supercharger pressure, so that it shows to what altitude this pressure corresponds. When at great altitude the pilot closes the exhaust gates until the pressure in the carburetors causes the altimeter to show sea-level

Digitized by Google

pressure. This makes it unnecessary for him to do any calculating. If he makes the gage read lower than sea level, the engine will preignite. We have already been able to obtain sea-level pressure in the carburetors at well over 20,000 ft. The exact height cannot be mentioned at present.

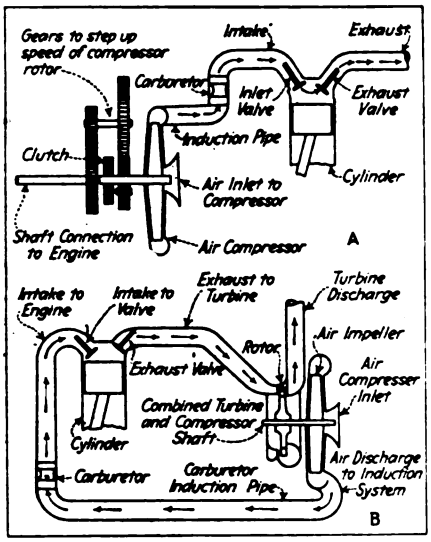


Fig. 6—Showing difference between gear driven and exhaust gas driven superchargers

With a normal engine the falling off in power as the plane ascends does not cause as much of a drop in propeller speed as might be expected, because of the reduction in density of the air in which the propeller is working. Our best engines do not lose over 75 r. p. m. at 20,000 ft. When an engine is supercharged so that the power remains constant as the plane ascends, the propeller tends to "race" at great altitudes. Therefore it is necessary either to use a variable-pitch propeller or to put on one that holds the engine speed down too low for best performance on the ground, but also does not allow the engine to race too much at great altitude. In our present tests we are using an oversize propeller and getting surprisingly good results, but we also have variable-pitch propellers about ready for test and should get much better performance with them.

There is an English make of supercharging engine in which air is compressed under the piston and by-passed through cylinder ports at the bottom of every stroke (see Fig. 5), supercharging at the end of the suction stroke and scavenging at the end of the exhaust stroke. It is claimed by the inventor that this scavenging makes possible the use of higher compression and greatly improves the fuel economy and brake mean effective pressure. It is believed that this engine will give rather limited supercharging and it may prove difficult to control the mixing or stratification of the air and mixture at some speeds.

It is believed that supercharging engines of the type mentioned will necessarily give a rather limited amount of supercharging. It is also believed that considerable difficulty will be encountered in obtaining the desired stratification in mixing conditions in the combustion chamber through any wide range of throttle positions. Also, some mechanical friction is added in this type of engine and it must be borne in mind that friction is particularly undesirable at great altitudes because it remains nearly constant from the ground up to great altitudes while the power falls off rapidly; therefore, the mechanical efficiency of the engine becomes very low.

It is already common practice to build aviation engines with compression so high that the throttle cannot be fully opened on the ground without injury to the engine. In this way, perhaps, the same power is obtained at 5,000 ft. as can be obtained on the ground. It has been suggested that this idea be carried further and that an "oversize" engine be built with much higher compression so that the throttle cannot be opened fully until a considerable altitude, such as 10,000 or 15,000 ft., is reached. It has been stated that such an engine could be made lighter, in proportion to the cylinder sizes, than a conventional engine, on account of the fact that the throttle would never be opened near the ground, but it is believed that when this idea is investigated it will be found that it is the inertia forces quite as much as the explosion forces that determine the necessary strength in most high-speed airplane engine parts and that therefore such an engine could not be built light enough to make it practical. In any case, it is doubtful whether this would give a really good solution for flying at 25,000 or 30,000 ft.

It is possible that centrifugal compressors can be operated satisfactorily by gears or by a belt drive. It is known that some designers are working on both of these problems..

The turbo-compressor in which an exhaust-driven turbine is used for driving the centrifugal compressor seems to present one fairly good way of accomplishing the desired purpose. The turbo-compressor itself is very simple, as there is only one moving part, namely, the rotating element consisting of the turbine wheel and compression impeller. The bearings of this rotating element do not seem to wear noticeably and the device imposes very little drag on the engine when not being used for supercharging. The turbo-compressor is also an effective exhaust muffler.

The Future of the Supercharger

It is believed that when the present type of turbo-compressor now being tested by the engineering division has been more fully developed, it can be built into an engine in a form which will add less weight and less head-resistance than the present machine, and naturally when we know exactly what additional cooling surface is required at a given height it will not be difficult to build this cooling surface into the airplane in such a form that

(*Continued on page* 336)

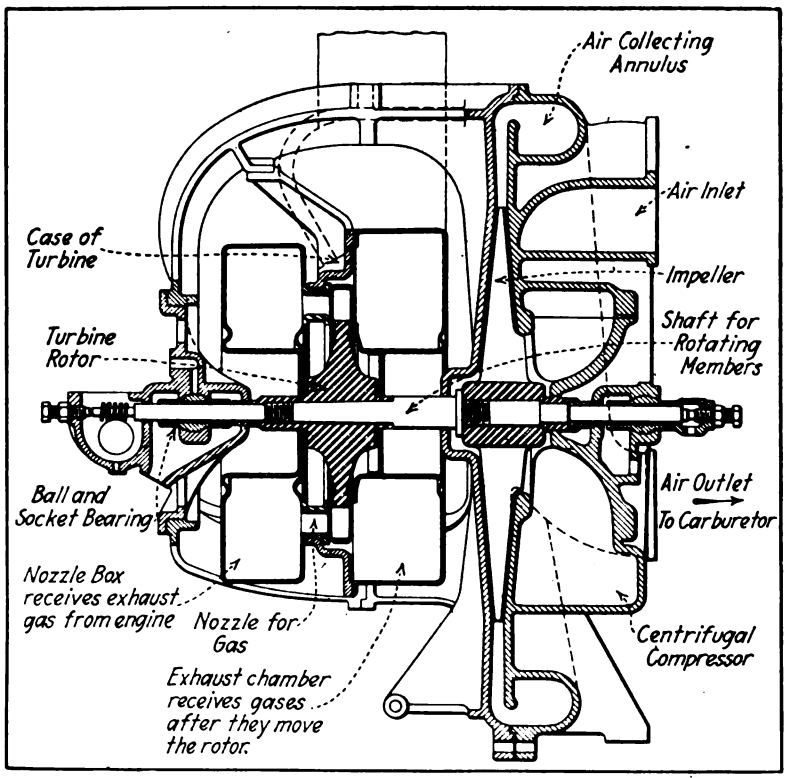


Fig. 7—The Rateau turbine driven centrifugal compressor for supercharging purposes

Digitized by Google



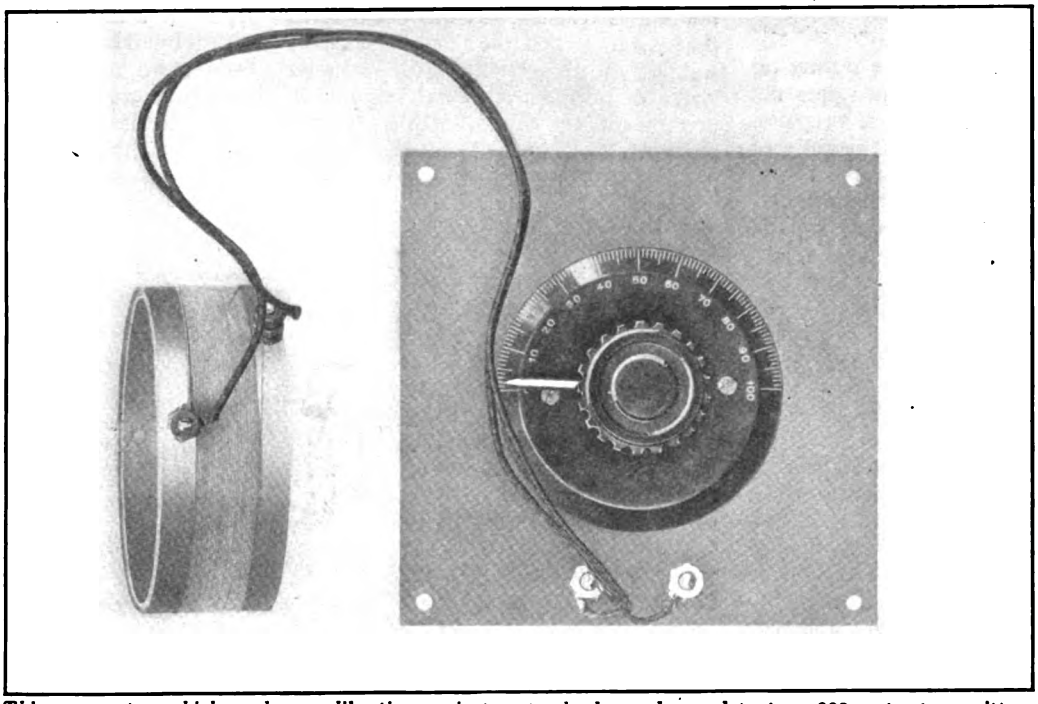
THE JUNIOR EXPERIMENTER

A Wavemeter for Tuning Transmitters

Do Your Part Toward Keeping Radio Work in Favor With the Government — Tune Your Transmitter

EVERY transmitting station needs a 200-meter wavemeter, for the good will of the inspectors and the Government depends upon sharp and accurate tuning.

So many times experimenters say, "No, I haven't a wavemeter because I can't get it calibrated, and they cost too much to buy already made."



This wavemeter, which needs no calibration against a standard, can be used to tune 200-meter transmitters

Those two disadvantages have been overcome in the type described in this article. The condenser presents the greatest difficulty. The condenser selected was of the Clapp-Eastham balanced type, fitted with bakelite end pieces as described in the December, 1919, and January, 1920, issues. It was calibrated against a standard condenser and gave the following capacities with a scale having 100° to a semicircle

10° = 0.00008 mfd.
20° = 0.00013
30° = 0.00018
40° = 0.00023
50° = 0.00028
60° = 0.00034
70° = 0.00040
80° = 0.00047
90° = 0.00055

With these figures the experimenter can draw his own calibration curve for the capacity of the condenser.

Connected to an inductance of 70,000 cms., the wavelength is:

10° = 140 meters
20° = 180
30° = 210
40° = 240
50° = 265
60° = 290
70° = 315
80° = 340
90° = 370

The coil must be made with great care, so that the inductance will not vary appreciably from 70,000 cms. A slight difference will not make a large error, so that it is practical to assume the accuracy of this instrument without actually calibrating it against a wavemeter.

A coil of this inductance can be made with 24 turns of No. 24 single silk covered wire wound on a form 3 ins. in diameter. This winding should occupy a space 0.6 in. long. The wires are run directly to brass screws which also act as terminals for the leads. No shellac or varnish should be used on the wire as this increases its capacity and throws out the calibration. Inductance of the leads can be neglected if they are not more than 18 ins. long. The lead wires should be bound together with string as this reduces their inductance and keeps it constant.

To measure the wavelength of a transmitter, one side of a crystal detector, shunted by a pair of telephones, is connected to one part of the condenser, or, if an audion is used, a wire can be run from the condenser to the grid. No other connection to the wavemeter is necessary.

Digitized by Google

Simple Experiments in Science for Beginners

By Judson Burns

EVERY young experimenter has a desire to extend his knowledge of science. The best and most practical way to do this is by experimentation. When an experiment illustrating some law is made, the person making it will remember the law much better than he would if he just read of it in a book. The writer does not wish to create the impression that reading and studying is not of value. The point to be brought out is that the performance of an experiment will do much more to impress a fact upon one's mind than mere reading can do. Not only this, but it will also greatly assist in understanding the principle involved. The few simple experiments outlined in the following paragraphs can be performed easily with very little preparation.

The first experiment has to do with atmospheric pressure. It is known that the atmosphere or air, as we are more inclined to call it, exerts a pressure of 14.7 lbs. per square in. upon the entire surface of the earth. If this pressure

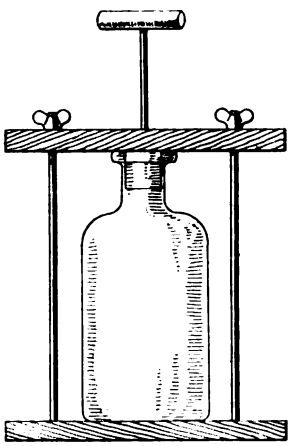


Fig. 4

is reduced in a vessel by a vacuum pump, the air on the outside will exert a pressure which will be equal to the difference in pressure on the outside and inside of the vessel. The pressure on the outside then will depend entirely upon the degree of the vacuum or the amount of air removed from the interior of the vessels.

The experiment illustrated in Fig. 1 will show that the atmosphere does exert a great pressure upon the earth. The materials needed are very simple. A shallow dish, a drinking glass, a candle and some water are all that is necessary to carry out the experiment. First, the candle is placed in the center of the shallow dish. Water is then poured into the dish. When this is done, the candle is lighted with a match, and while the candle is burning the glass is placed over it. When the glass is placed over the burning candle, the candle will be extinguished in an instant owing to the fact that it will consume all of the available supply of oxygen within the glass. This consumption of the oxygen within the glass will reduce the atmospheric pressure and part of the water in the shallow

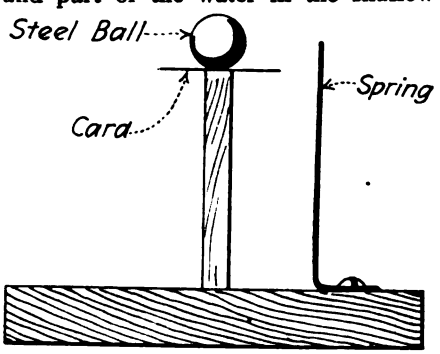


Fig. 3

dish will rise in the glass, force the remaining air upward until it is compressed to such an extent that the pressure on the outside and inside of the glass will be the same. This simple experiment is very instructive and never fails to interest those who watch it.

The experiment illustrated in Fig. 2 has to do with inertia. All matter has inertia. In other words, all matter is lazy. When in motion it does not have ambition to stop unless the forces that are moving it are overcome by friction. On the other hand, when matter is at

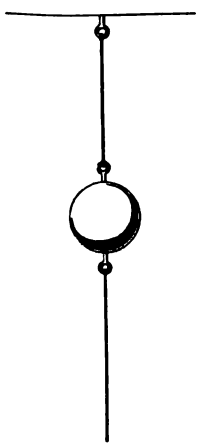


Fig. 2

rest it resists any force that tends to set it in motion. When a sudden force is applied to matter the property of inertia is very well illustrated. The inertia ball shown in Fig. 2 is used in the experiment. In the event that such a ball cannot be obtained, any heavy iron weight can be employed as a substitute. With the weight hanging in the manner shown, the end of the string is pulled and the force gradually increased until the string breaks. In this instance, the string will be sure to break between the ceiling and weight. If the end of the string is given a sudden jerk the string will be sure to break between the ball and the hand and the ball will remain attached to the ceiling. The sudden application of force to the weight causes it to offer considerable resistance and the string will therefore break between the band and weight. In other words, the ball is lazy and refused to move when a force is suddenly applied.

Another experiment showing the effect of inertia can be made by the use of the simple little piece of apparatus illustrated in Fig. 3. A large ball-bearing is placed upon a piece of cardboard which in turn rests upon a pedestal. A small piece of springy brass or watch spring is so fixed that when it is drawn back and allowed to go forward it will strike the cardboard under the ball-bearing a sharp blow. This causes the cardboard to fly from under the ball

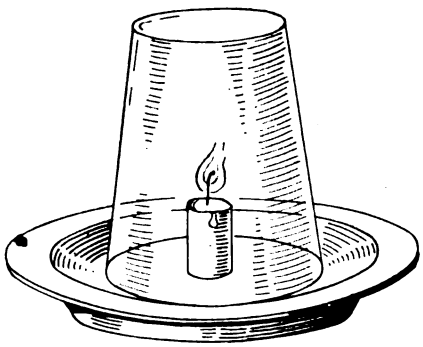


Fig. 1

and leaves the ball perched upon the top of the pedestal. If a piece of cardboard is gradually forced from under the ball, the ball would be sure to roll off. However, if a sudden application of force is applied to the cardboard it can be forced from under the ball without moving the latter owing to its inertia.

Inertia plays a great part in the science of mechanics. It is a property that mechanical engineers must ever watch for. In everyday life, the effect of inertia can be seen. If it was not for inertia, street cars and automobiles could reach full speed instantly.

All solid and gaseous matter is compressible. By this is meant that it can be forced to occupy a smaller space by the application of pressure. There is, of course, a definite limit to compressibility which is different for different

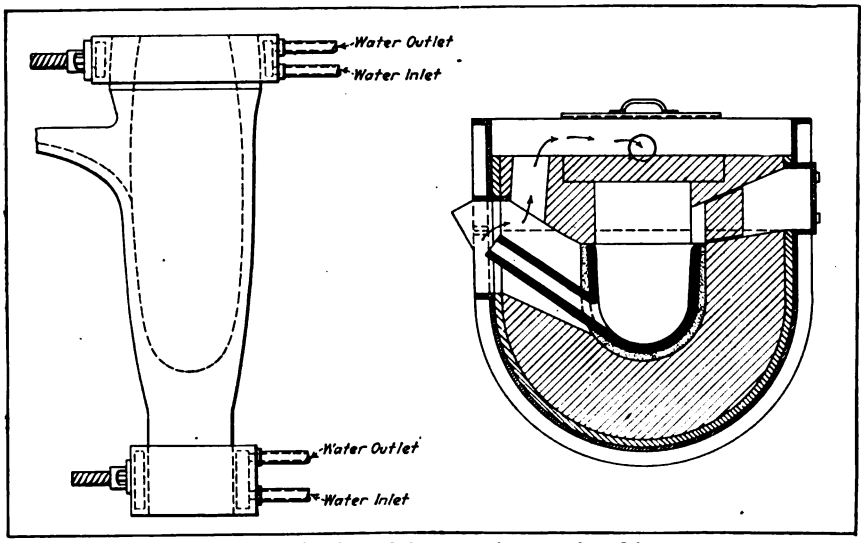
(*Continued on page* 331)

Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

We illustrate in the cuts accompanying this article an incandescent electric furnace. It is based on the principle of having the crucible, muffler or corresponding part of the furnace a conductor for the current. The current must be of high amperage, like a welding current. Its line is connected to the extreme ends of the furnace receptacle, and the current in its passage brings it up to any desired degree of heat. The degree of heat attained depends on the current and on the resistance of the same receptacle. It is clear that the degree of heat is thus easily regulated, and that by properly proportioning current and resistance, and by maintaining a constant voltage, an almost mathematical accuracy of temperature can be kept up indefinitely. A good conductor of heat is generally a good conductor of electricity. A plumbago crucible will conduct both; a metal crucible is a still better heat and electric conductor. Therefore a plumbago crucible for high heats and a metal one for low heats would seem to be the best selections.



Electrically heated furnaces for metal melting

One cut shows a furnace for melting metals. It is arranged to pour its charge by tipping. The conductors are connected at the sides of the crucible with water cooled joints. The intense current passes through the pot or crucible, brings it to incandescence, as great as desired, and melts its charge and keeps it in fusion as long as is required. The profile of another furnace is shown in the next illustration. This is also a tipping furnace; the heavy black line indicates the current carrying section. It suggests that a very heavy current must be required. A ventilating conduit carries off vapors while pouring. The voltage, of course, is low, so that a reasonable economy may be looked for. The third cut shows a heater for heat treatment of metals and the like. This is a cylinder of metal or other conductor, whose ends are connected by water-cooled joints to the electric line. Here especially it appears that a case is presented in which the facility of regulating the heat within a range of comparatively few degrees would be most valuable. In advanced heat treatment of steel, and nothing now passes except advanced methods, the pyrometer is constantly in use. But here the furnace itself is its own pyrometer to a great extent. Of course, as the furnace is used, the conductivity of its container and of the lining will vary somewhat, so it cannot be taken as a substitute for the accurate instrument.

Electric heating if the current is produced in a coal-consuming plant is very wasteful. The remorseless second law of thermodynamics gets in its work at the steam engine end of the plant. But once the current and voltage are produced the economy involved in their direct use may be very high. The heat engine, if a steam engine, with its low range of temperatures is the occasion of the loss. If the watts of electric energy are cheaply produced the efficiency may be very high. It is also most important to have the walls of the furnace of materials of low thermal conductivity. Little or almost no heat should escape by external cooling. The cut shows how such loss is guarded against in the carefully thought out construction of the furnaces shown.

A note of warning is sounded by a Swiss contemporary about aluminum electric conductors. The greatest care is prescribed for their handling by linemen. Bare pliers and other tools should not be used on them, a slip of sheet metal should be placed between the jaws of the tool and the wire. Where copper or iron is in contact with it the place should be protected from all moisture, as the metals form a galvanic couple with the aluminum, which will bring about its corrosion. Where it is wired to pole insulators the conductor and tie may be served with thinner wire to protect the conductor from wear.

Tungsten carbide has been produced of hardness only a little inferior to that of the diamond. It can replace bort, as the crude diamond is called, in diamond drills, stone saws, wire-drawing dies and the like. Its hardness is placed at 9.8 on the scale on which the diamond is 10.

From Berlin comes the idea of utilizing the electrolysis of water for the production of very high pressures for laboratory and experimental uses. A fraction of a cubic centimeter of water gives ¾ litre of gas at atmospheric pressure. The enormous pressure of 1860 atmospheres can be produced under the above conditions. The use of a U-shaped tube, arranged for the production of the gas in one end, will give the pressure in the other end away from the gases of decomposition, if desired.

It has been found that lead-coated iron resists the sand blast. The soft lead cushions the blows so that little or no effect results from the impact of the grains of sand. This has given a hint for the treatment of the blades of turbine water wheels. These wear away rapidly in sandy waters, so it is now proposed to coat them with lead, melted on, and make them secure against wear. The other impurities of streams, such as floating wood are easily screened out, but there is no getting rid of sand.

The rapid deterioration of porcelain insulators has brought out the suggestion that they should be made out of melted quartz. In the case of porcelain insulators at the end of the first year of service less than 1% are found to be defective; after 8 years, 6% and the deterioration then becomes very rapid.

Iron coated with lead has been produced, which is claimed to be better than tin plating and cheaper. The iron after pickling and washing is dipped into a solution of antimony chloride and then into melted lead, withdrawn and quenched in oil. Melted antimony sometimes is substituted for the lead. It is excellent for roofs, but cannot be used for pipes as galvanic corrosion is brought about by the lead forming a couple with the iron where the coating may be removed as at the joints.

A good deal of attention has been attracted to "kapok" as a filling for life-preservers. It is the fibrous mass of long hairs surrounding a tree seed from Java originally. There is also an Indian kapok. Twenty-four ounces in a life preserver will support a man in the water, and it never gets water-logged.

In Switzerland experiments have been tried with a mixture of coal gas and acetylene in equal proportions for car illumination. It is found to work well and to endure compression to nine atmospheres.

Concrete structures have proved anything but fireproof; the columns made of the material succumb to the heat in conflagrations. The U. S. Bureau of Standards has taken up the subject of making them fire-resisting. A coating of plaster of paris has been found efficacious. This material hardens by combining with water, so in a fire this has to be expelled, before the plaster falls to powder or loses its strength and shape. This takes time and during that time anything under it is protected in great measure against the penetration of heat. One suggestion is to make a form of plaster

Digitized by Google

of finished outer contour but hollow, and to put the concrete into the interior by pouring. The reinforcing bars are put into the space also. The evaporation of the water from the plaster is a reminder of alum fillings for fireproof safes; this filling operates by absorption of the heat required to evaporate the water of crystallization of the alum; this absorption of heat keeps the safe from intense heat.

The liquid in a Zeiss level on an instrument captured from the Germans, was analyzed and found to contain a mixture of 90% benzol with alcohol. The viscosity of benzol is less than that of alcohol but greater than that of ether or carbon disulphide. Its coefficient of expansion is greater than that of alcohol and less than that of ether, and about the same as that of carbon disulphide. A certain amount of viscosity is not always to be regarded as a disadvantage in spirit levels.

For filling holes in castings the following mixture may be employed: Sulphur—50 parts; iron filings—20 parts; graphite—20 parts; all by weight and in powder. The powder is to be melted into place with a hot iron.

For sticking glass letters for shop windows on the glass panes, mix copal varnish—30 parts; turpentine—10 parts; glue in a minimum of water—10 parts; slaked lime—20 parts.

A green light in a signal lantern, it is said, can be distinguished from a red one irrespective of the color, by looking at them indirectly. The green light, it is said, gets brighter off the line of vision, while the red light gets fainter. This gives a hint of how a color-blind person might pass an examination calling for such a test.

It is important that the operation of a photographic shutter should not shake the camera. To test it for the quietness of its action a pencil may be fastened to the front of the box, projecting therefrom in a perpendicular line. The camera is arranged with the pencil in contact with a sheet of paper on the wall in front of it, the pencil point pressing lightly on the paper. The shutter is then sprung. If there is no motion, the pencil will not move and there will only be the mark of its point; if the camera is jarred by the action, the pencil point will make a line, straight or crooked, as the case may be.

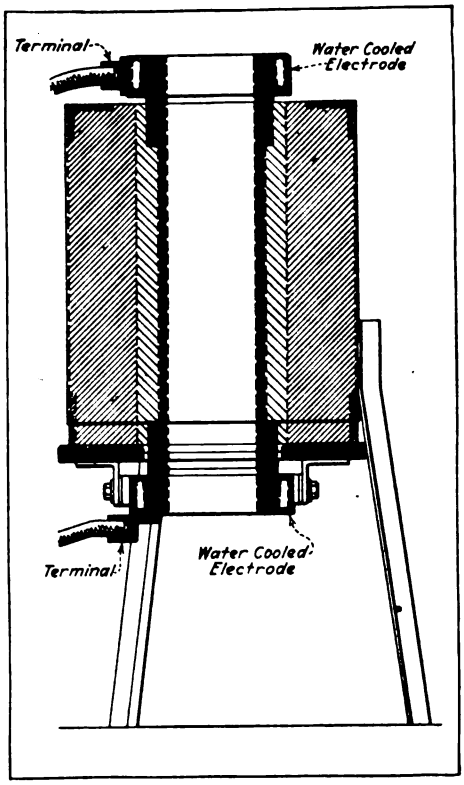
Concrete tanks are in use in England for holding mineral oils. A coating of rich cement is applied to the interior to make the tank more impervious, or else a solution of water glass is applied. Another use for concrete is for railroad cars; large gondolas have been successfully built using this material for the body.

Spitzbergen coal is attracting attention in England on account of the coal shortage in the home country. Owing to the cold, the coal is frozen, so there is no trouble with water in the mining operations.

The Sperry gyroscopic compass has a rotor weighing 45 lbs. which turns at the rate of 8,600 revolutions per minute. It is in an exhausted case, and after the current is turned off will operate for an hour by its own inertia. Owing to the motion of the earth, if a ship is going north the compass has to be corrected, as it is thrown off the meridian, when the ship is following the meridian course. A very curious use of the stabilizing gyroscope is to careen a ship. This operation is a sort of last recourse in some cases to get the vessel off a shoal; a ship draws less water careened to one side than when on an even keel.

Pulverized coal to be used as fuel is sometimes mixed with oil and is then termed colloidal fuel. This assimilates it to liquid fuel, and saves 1/3 of the expensive oil. It may be made liquid, semi-liquid or solid; in the latter form, it can be liquefied by heat. It is thought possible to use it in Diesel engines. It is said that Diesel invented his engine for the purpose of using powdered fuel instead of gas or oil or gasoline.

Considerable attention is now being given to the improved lighting of factories. A Chicago factory is cited in which by trebling the light the production was increased from 8% to 27% a pretty wide range. In a leather works the percentage of rejects was diminished 80% by improved lighting. The increased cost of such lighting is put at 1% of the payroll; in one of the great Detroit factories it is put at 0.3%.



Electrically heated furnace for heat treatment of metals

A registering compass for ships is a very old idea, but now comes a compass with a mirror mounted on the compass card, and with a selenium cell, which can be set so as to receive the reflection from the mirror, a lamp being provided for the purpose of giving light, to affect the conductivity of the selenium. As long as the light shines on the selenium nothing happens, but as soon as the ship is allowed to diverge from her course, the mirror is turned, by the action of the magnetic needle, the ray of light is deflected, the selenium changes its resistance and an alarm bell rings. The selenium cell is in circuit with a battery, and this rings the bell.

A very old idea has been brought forward in the journal of the Royal Society of England. It is to the effect that windmills may be used to charge storage batteries. This was done in this country, in at least one instance, many years ago. The author of the paper in question favors small windmills, as more economical of construction. He brings out a curious point to the effect that a windmill loses 9% of its power for every 1,000 feet increase in altitude.

The Arctic sea is less salt than the other ocean regions. It is attributed to the fact that as the fresh water from the great rivers enter it, their waters do not mingle with the rest on account of the freezing; the absence of diffusion keeps the surface water at any rate fresher than normal. Of the other oceans the Atlantic is reported the saltest, presumably because much of the evaporated water does not run directly back, the rivers taking the water from their water sheds back into the interior, before it runs into the ocean again. The Pacific is next in saltness, and the Indian Ocean the next.

For taking down rivetted work, as in scrapping ships or in removing bolts, bolt-heads and nuts and similar service, considerable success has been attained with a species of gun. It has a short barrel provided with a plunger, fitting the bore, and is discharged by about an ounce of powder. The plunger is expelled by the explosion and breaks away the bolt-head or other object it is pointed at. The end of the plunger is held within about an inch of the thing to be hit. Places inaccessible to the ordinary chisel can be readily got at by this contrivance.

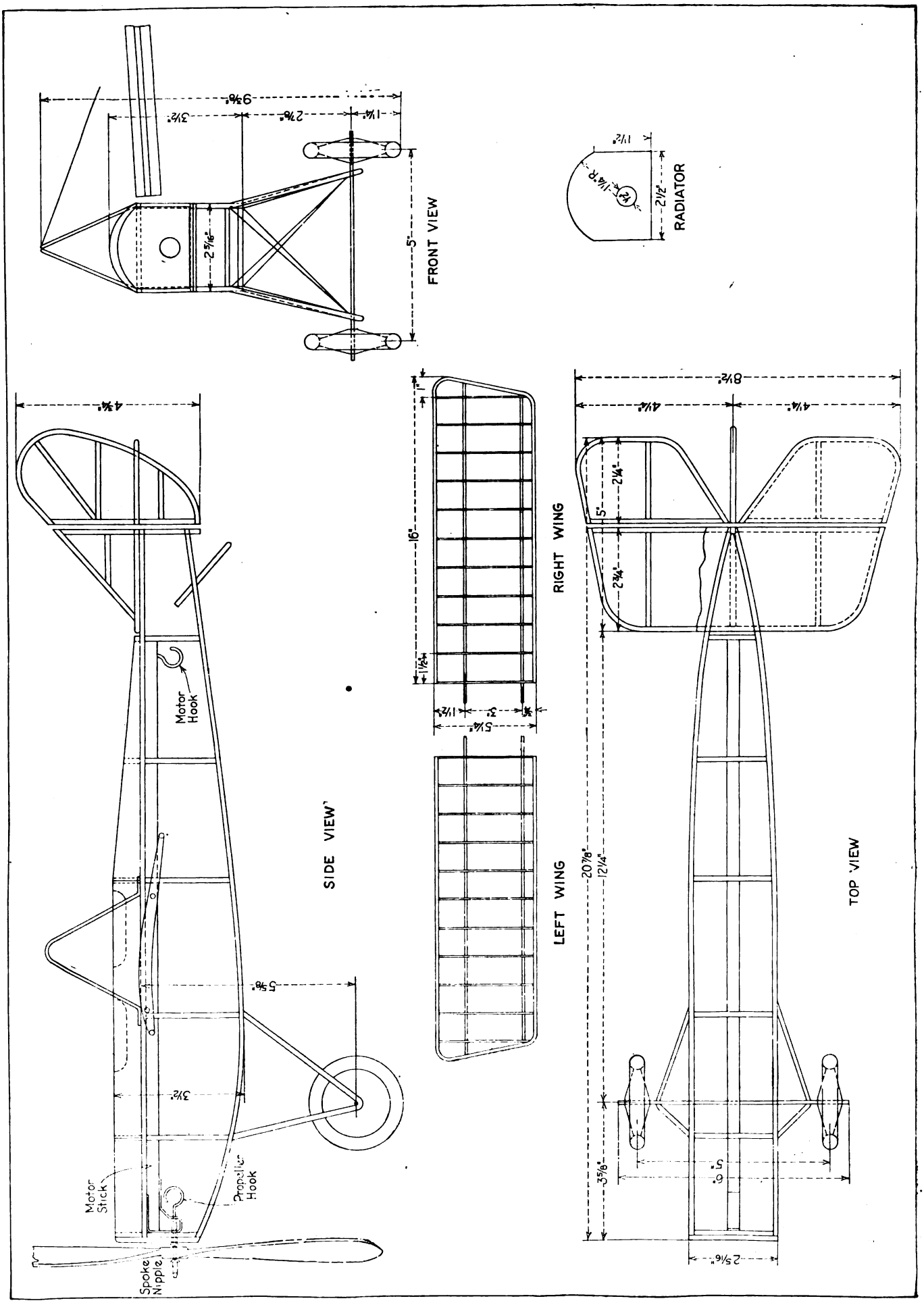
Thin mud has been experimented with in England for putting out colliery fires. Almost any material can be used, even coal slack, if fine enough, will answer. It is almost essential to have lime and clay present in the mixture. The material should be sifted after pulverizing, if not of sufficient fineness. It can be forced through pipes to a distance of 750 feet, even if there are bends in the pipe. This result was attained with a pressure of forty-five feet head of water.

During the war the English automobilists operated cars with coal gas in place of gasoline. Now it is felt that this material as a gasoline substitute should not be given up altogether and a committee report on it has been issued. Rigid or semi-rigid containers are advised. Great india rubber cloth bags were often used hitherto, carried on the tops of the tonneau hood. It is recommended that existing facilities for the use of gas should not be abandoned. The cost of compression alone on each thousand feet represents about fourteen cents per gallon of the gasoline it replaces. The treatment of this subject brings forcibly before us what the scarcity of gasoline in England meant; even now they are not prepared to put the inconvenient and expensive gas fuel into the discard.

The famous Sudbury, Canada, copper and nickel ores have been found to contain palladium and platinum, the former one predominating. In general, it appears, all sulphide copper ores contain metals of the platinum group, and a considerable amount is now recovered. The Canada Copper Co. reports in a ton of matte, the following quantities of the precious metals: gold—.05 ounce; silver—1.75 ounce; platinum—.10 ounce; palladium—.15 ounce.

An ingenious and very obvious way to get rid of the shine of the surface of some silver trophy cups, which were to be photographed, and which gave only a blur when taken directly as they were, consisted in filling them with ice water. This produced the usual deposit of drops of water on their surface and they photographed perfectly. It is said that one of the most famous cups in the world, the American Cup, won by the old yacht "America" has no bottom, so this method wouldn't work in its case.

Digitized by Google



Digitized by Google

A-34 Inch Spread Monoplane Model

By H. C. Ellis

BEFORE attempting to construct this model, study the drawings carefully. This machine should not weight over six ounces when completed if care is taken in the construction. This model has proven to be a fast and stable flyer and will withstand rough usage. Before taking up the construction of this model it is advisable for the reader to obtain the following: A small drill holder, one or more No. 61 drills, a sharp knife, a small hammer, a package of small nails ¼" long known as brads and a medium size can of Le Page's glue.

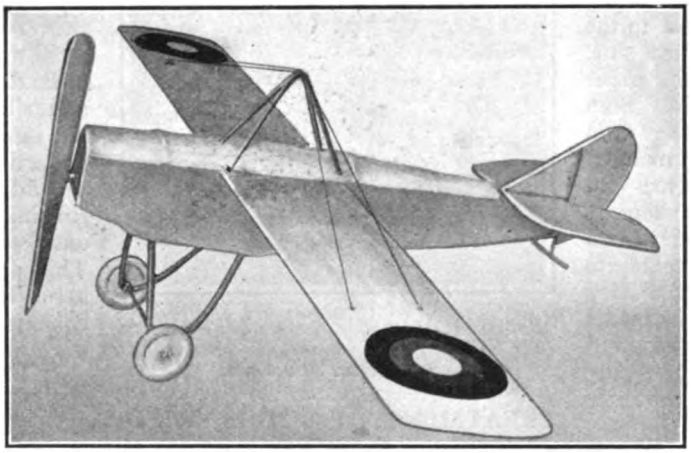
Fuselage

The Fuselage is built up of ⅛" square spruce. Obtain a board large enough to enable you to lay out full size the outline of the fuselage, stablizers, elevators and rudder. Care must be taken so as to make the curves exact. Now place along the lines of the layout headless nails, any size will do to hold the material in place while it is drying. Boil the longerons of the fuselage and the strips that form the edges of the stablizers, elevators and rudder in water at least half an hour. Then place the moist strips in the molding frame and allow to dry at least twenty-four hours. In the mean time the fuselage struts may be cut to size shown on the drawing. After the longerons are thoroughly dry mark off the positions for the fuselage struts. Using the No. 61 drill, bore holes in the longerons of the fuselage at the points where the struts are to be placed. Place a little glue on each end of the struts and by using the small hammer and nails fasten them in position to the longerons members. Care should be taken so as to avoid splitting the wood.

The radiator is of 1-16" spruce shaped as shown in the drawing and is fastened to the fuselage with nails and glue. The landing gear is of ¼" reed bent to the shape shown by passing over a gas or candle flame. It is then bound to the fuselage with thread and glued. The axle is a piece of ⅛" steel rod cut to the length shown and bound with thread to the landing gear and glued. Aluminum disc wheels 2" in diameter are used.

Tail Skid and Motor Stick

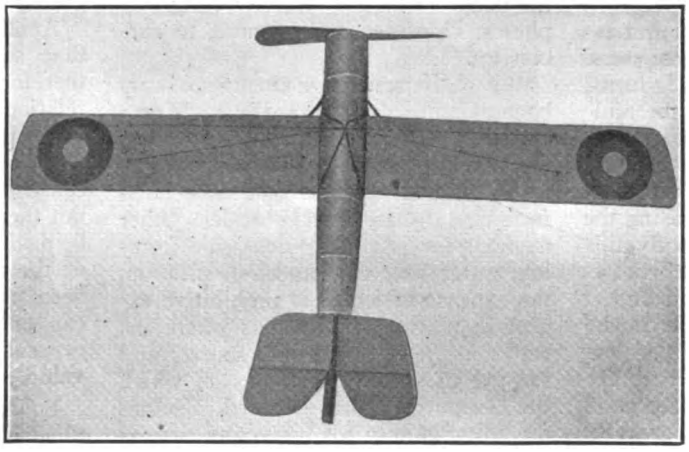
The tail skid is of ⅛" square spruce cut to the size shown and fastened to the fuselage. The motor stick is of spruce 5-16" square. This is fastened in the fuselage at two points only, that is, it is bound with thread and glued to the first and second fuselage struts. Before placing same in the fuselage attach propeller hanger, motor hook and propeller shaft as shown in the drawing.



This flying monoplane model has speed and graceful lines

Propeller Shaft and Motor Hook

The propeller is made of poplar or white pine, 12" in diameter and is medium pitch. If the builder is not experienced in carving propellers it is best to purchase same from a model supply house as this is the most difficult part of the model to make. The porpeller is attached to a 1-16" plain bearing propeller shaft as ball bearing shafts do not always give satisfaction, especially if not properly installed.



Plan view of monoplane model that weighs less than six ounces

The propeller hanger is made from aluminum 1-16" thick and is bent to the form shown in drawing. The motor hook is bent from a 1-16" steel rod to the shape shown.

Turtle Deck Formers

Make the turtle deck formers to the size indicated and fasten in place to the fuselage in the position shown, by glueing and drill a hole with No. 61 drill, place a small brad in it for extra strength. These formers are cut from 1-16" spruce.

Motors

Seventeen feet of ⅛" flat rubber is required for the motive power. This should be looped into 14 even strands. Place one end in the propeller hook and the other in the motor hook, before the fuselage is covered with the paper.

Main Planes

The ribs are cut from spruce 1-16" thick. The rib should be laid out full size, as it is reduced in the drawing. Care must be taken when cutting these ribs out to be sure and have them all the exact size and all holes for the wing beams, which are ⅛" dowels must be in line. As there is a number of ribs to be made, a metal pattern or template may be cut and drilled to act as a jig to insure uniformity in ribs. After the ribs are placed on the wing beams and are properly spaced according to the drawing they are glued and allowed to dry. After the glue is dry the edges, which are ⅛" reed, are put on. This is done by tying the reed back over the wing beams with strong thread and glueing the reed to the ribs. The wing tips are bent to the shape shown by bending only after heating by passing them over a gas or candle flame. Care should be taken so as to make all the tips the same shape. ⅛" Aluminum tubing is used for the wing beam sockets so as to permit the builder to dismantle the model easily. If unable to obtain aluminum tubing, brass or copper may be used. Two pieces of the tubing are required, cut to the length and attached to the fuselage at the points shown by the wing spars on the side view by binding and glueing.

Digitized by Google

Stabilizers, rudder and elevators.

The stabilizers, elevators and rudder are made of 1/8" reed for the edging and 1/8" square spruce for the filling in pieces. The elevators can be made in one piece with the stabilizer if desired as they are not movable after they are attached to the fuselage.

Covering and Doping.

Bamboo paper is used for covering the main planes, fuselage and controls. Cover the bottom first and allow to dry. After it is dry the extending edges may be trimmed off close to the reed edges. Then cover the top side. Care must be taken to have the paper lay even and without wrinkles. Both sides of the elevators, stabilizers and rudder are covered in this manner. After the covering is completed and the glue is perfectly dry, the dope is applied. This is best applied with a soft brush as a stiff brush is liable to puncture the paper covering. This dope can be purchased from any model supply house. Four ounces is required to dope the covering properly. Apply the dope evenly—then place away to dry.

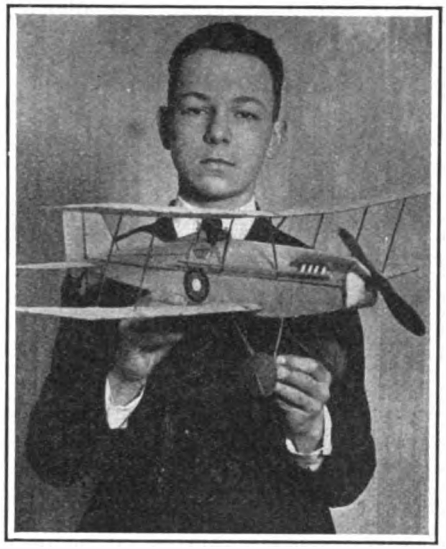
Assembling and Flying.

After the covering is thoroughly dry, the model may be assembled. If the elevator and stabilizers are made separately they may be joined together by drilling holes through the edges of same with a No. 61 drill and then joining them with fine wire. The rudder is attached to the rudder post in the same way. The extending ends of the wing beams are inserted in the aluminum sleeves forming part of the fuselage. The propeller is placed on the shaft so that the entering edge cuts the air first.

After the model is completed and assembled choose a field free from trees. Wind the propeller about 75 turns, grasp the model at a point in the middle of the fuselage holding the propeller from turning with the left hand. Launch gently forward from you in a level line at the same time releasing the propeller. Do not attempt to fly this model in a strong wind as the wind is liable to force it to the ground and it may be broken. To fly this model from the ground choose a hard and level surface. Wind the propeller 175 times, then place model on the ground and it will rise and make a graceful flight, but not as long a flight as when hand launched

SIMPLE TEST FOR BELTING

Strong vinegar will not affect belts of good quality except to darken the leather slightly, but if they are of poor quality, their fibres will swell and become gelatinous, so that this forms a good test for belting. A piece is cut off and immersed in the liquid for sufficient time to determine the action of the vinegar on the leather.



Robert Jares, a Chicago model enthusiast, has built a model biplane flier that will fly 130 feet in 20 seconds

TREATMENT OF BOILER FEED WATER

IT is surprising, considering the importance of procuring a satisfactory softened water for boiler feeding purposes, that, except for certain special methods for producing small quantities of softened cold water, there have been no changes in the chemical methods employed for more than fifty years. Hydrate of lime, in the form of lime water or milk of lime, still remains the most economical and practicable means for neutralizing acids, absorbing carbon dioxide and converting bicarbonates to carbonates or hydrates. Soda ash is the usual substance for converting sulphates, chlorides and nitrates to carbonates.

Where the respective amounts of carbonates and sulphates are in high proportion, a single substance, sodium hydrate, may be employed both for absolutely carbon dioxide and for transforming sulphates and chlorides. Other methods for producing non-scale forming water are, of course, distillation, the expense of which is prohibitive except in marine applications where sea water is the only possible source, and the use of so-called Zeolites on which the Germutite system is based. Zeolites are suitable only for correcting permanent hardness, they introduce into the treated water, sodium carbonate in quantities proportional to the amount of lime and magnesium carbonates removed. For this reason, they are not suitable for softening water for boiler feed purposes. While the chemical reagents used for softening water are limited chiefly by the availability and cheapness of certain substances, the engineering methods and appliances by means of which the softening process is carried out have undergone a radical evolution even during the last year or so, so that their efficiency has been increased considerably. These improvements have to do principally with the correct use of heat for hastening or accelerating the chemical reaction and the perfection of means by which the chemical reagents are fed more accurately, the labor of handling chemicals and removing precipitates from the apparatus being thus greatly lessened.

FINISHING WOOD

To finish wooden handles, gun stocks and similar articles of wood and at the same time to preserve them, soak the articles in linseed oil for a week or so and then give them an occasional rubbing at intervals of a day or two until the desired polish is obtained. This preserves the wood and gives a natural finish that many consider greatly superior to the usual artificial finishes and colorings.

WOOD FOR A RIGID AIRSHIP HULL

A well-known British firm of aircraft constructors has taken out a patent for a new design of rigid airship hull. A gas-tight shell is to be made up of several layers of wood veneer with fabric layers between, the whole cemented and stitched with fine copper wire, and with interior longitudinal and transverse bracing. The outer shell is intended to give the structure its chief strength and also acts as gas container. All the machinery and crew are carried inside the hull, there being no outside projections except the necessary fins and rudders for navigation which will mean a greatly lessened air resistance.

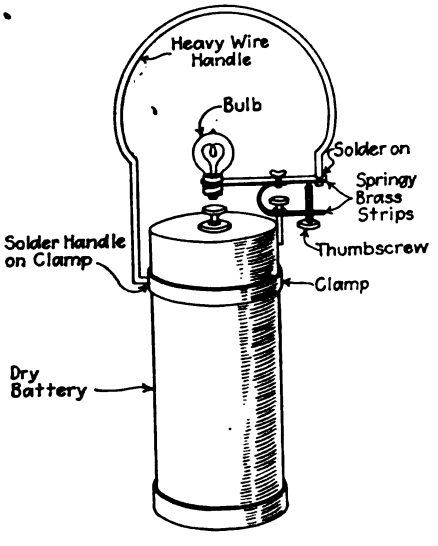
Another valuable feature claimed is that such a hull is unsinkable and therefore safe for ocean traffic. In the relation of weight to strength and carrying capacity, it offers material advantages over former methods of airplane construction. Models have been made but there is no record of full size craft being built to date so until the merits of the new system of construction has been proved by actual experience, one can only accept the report as one of general interest rather than practical value.

Squeaking in the brakes when applied is generally due to mud that has become imbedded in the lining and is forced against the drum when the brakes are operated. Sometimes this dirt may be washed out with kerosene, but if it is so firmly ground in that it refuses to come out, a little rosin mixed with castor oil and applied to the bands is recommended as a cure for the trouble.

Digitized by Google

Electric Lantern That Lights When Lifted by Handle

THE electric lantern shown in the sketch automatically lights itself when it is lifted by the handle, unless the thumbscrew is set to secure steady light in any position. One side of the handle is soldered to a metal clamp fastened around the battery about an inch from the top. The other end is soldered to a strip of springy sheet brass ½ in. wide and 2¾ ins. long. A small bulb is soldered into a hole at the other end of the brass strip. A piece of springy brass strip ½ in. wide is bent as shown in the sketch and screwed under the zinc binding post of the bat-



tery, and then fastened to the brass strip which holds the lamp by a small bolt and nut. The lower end of the brass strip is drilled and threaded to take a thumbscrew. When the lantern is lifted, the strain on the handle pulls against the brass spring, and forces the center of the lamp base into contact with the carbon pole of the battery. As long as the lantern is carried or hung up by the handle it will stay lit, but when put down, the spring forces the lamp out of contact. If the lantern is to remain lit, whether put down or held, the thumbscrew should be screwed till it comes in contact with the brass strip that holds the lamp.

Fine Jewelers' Rouge

SATURATE a solution of sulphate of iron (green vitriol) with a solution of oxalic acid. Filter and dry the resulting precipitate of pale-yellow oxalate of iron; place it in an iron dish and expose it to a moderate heat, whereby the oxalic acid will be decomposed and expelled, and a pure sesquioxide of iron will be left. This is very fine and can be used for producing a very brilliant polish upon the finest jewelers' work.

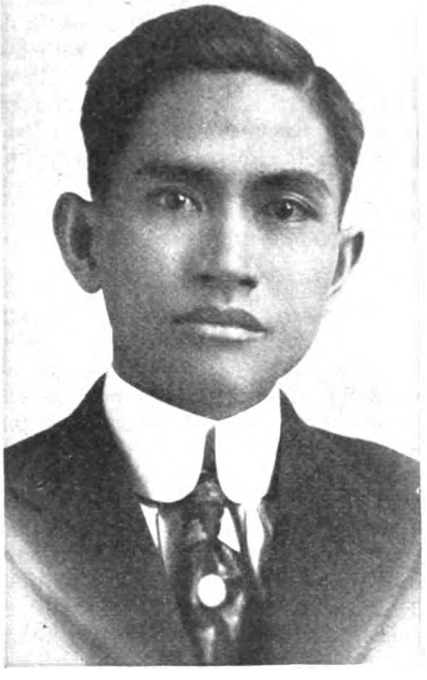
The American Society of Experimental Engineers

Who's Who In The A. S. E. E.

Cesario Tierra

Mr. Cesario Tierra, who is an active member of the American Society of Experimental Engineers, was born in Altimonon, Tay, Philippine Islands, twenty-eight years ago. He arrived in America during the year 1910. Upon reaching America, he immediately took advantage of its educational opportunities by entering a high school in California. He later attended the National University in St. Louis and in 1916 entered Lewis Institute, taking a course in mechanical engineering.

When the United States entered the war, Mr. Tierra was connected with the R. & V. Engineering Co., East Moline,



Ill. This company was engaged in the construction of eight-inch shells and naval guns. Mr. Tierra was engaged as a tool maker with this company. From the above company Mr. Tierra went to the L. Wolfe Mfg. Co. in Chicago, Ill. He was also employed by this company as a tool maker. While being employed as a mechanical draughtsman at the Montague Works, Mr. Tierra invented an auto-condenser compressor. The claims for a patent are now before the Commissioner of Patents, Washington, D. C. Mr. Tierra is now employed by the Nordyke and Marmon Co., Indianapolis, Ind., as tool designer.

Ideas!

Have you an idea which you think would be valuable for the American Society of Experimental Engineers? If you have, please send it in to the Society and if it is feasible it will be brought before the Board of Directors at their next regular meeting. Ideas relative to the Society and its general welfare are particularly welcome and every member is urged to send any idea he has in for attention. Ideas concerning a method of increasing the usefulness of the organization without a great outlay of money are especially welcome. The Society has but one real aim—to give maximum assistance to its membership in their experimental work and study.

What Are You Doing In Your Laboratory?

Are you making some interesting experiments in your laboratory that you think the other members of the Society would like to learn about? Well, why in thunder don't you write them up and send them in for publication in the Bulletin?

Oftentimes experimenters wander into the offices of the Society and tell us of some interesting experiments they have made or of some device they have constructed. Yet it never occurs to them that this is just the kind of material that we are desirous of obtaining for publication in the Bulletin. Furthermore, that it is just exactly the kind of "dope" that their fellow members would be interested in. We feel pretty strongly about this and we earnestly hope that this little protest will do some good.

The A. S. E. E. and Inventions

It is only natural that the American Society of Experimental Engineers should encourage invention. In fact, approximately 9% of its members have obtained patents in the past. How many unpatented inventions have been evolved we have no means of telling.

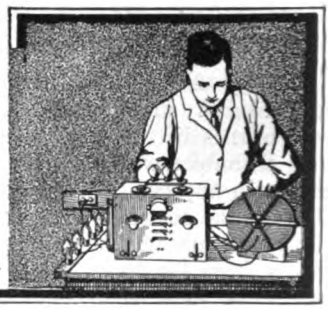
What is the best way the Society can encourage invention? When the membership becomes larger than it is at the present writing, and a great many different inventions will be patented during the year by the members, the A. S. E. E. will give a medal to the originator of the invention possessing most merit. It would seem that this is practical. This is just another one of those things that can be done when the Society grows larger.

If any members have brought out any inventions recently, we would be very glad to receive the details for publication in the BULLETIN.

Digitized by Google



RADIO
TELEPHONE AND TELEGRAPH APPARATUS



The Construction of a Radio Frequency Transformer

A New Field of Experimenting is Open to Those Who Work With Radio Frequency Amplification

RADIO experimenters have been slow to take up experimenting with radio frequency amplification, although it has been used commercially for more than two years. The reason is probably found in the fact that nothing has been written, in the wireless publications, on the construction of high frequency transformers.

This article is confined to the details of a transformer with which preliminary work can be done. Data and circuits will be given in the coming issues of EVERYDAY ENGINEERING.

WHAT THE RADIO FREQUENCY TRANSFORMER DOES

In an audio frequency amplifier, the incoming oscillations are first detected, and the low frequency currents are amplied in the succeeding stages. Therefore, in a set comprising a detector and three-step amplifier, signals can be heard by inserting a pair of telephones in the plate circuit of the detector or any of the amplifier tubes.

On the other hand, a radio frequency amplifier may have three steps of amplification and then a detector. Signals can be heard only in the plate circuit of the detector, for radio frequency currents are flowing in the amplifier tubes.

It has been found that signals below a certain strength cannot be made audible by any number of audio frequency amplifiers. The radio frequency currents, however, can be amplified to the required strength, at which point they will operate a detector and, if desired, audio frequency amplifiers.

There is one disadvantage in the use of radio frequency circuits. That is, radio frequency currents flow in the plate circuits through the transformer. There is a resonance effect due to the inductance of the transformer and the capacity between the plate and the filament of the tube. Consequently, the best results are obtained near the resonant frequency, although the resonance point is not sharp. This particular transformer, with the regular De Forest-Marconi VT, operates from about 1,000 to 5,000 meters.

DESIGN FEATURES

The first radio frequency transformers were made with air cores, the prevalent belief being that the losses in an iron core would be prohibitive at high frequencies. As a matter of fact, this proved to be untrue. Moreover, the distortion of telephone signals is less with an iron core transformer than with the air core type. At the beginning, silicon steel 0.0015 in. thick was considered necessary for the laminations. Steel of such a thickness is practically impossible to obtain, particularly in any quantity. Now, laminations up to 0.01 in. in thickness are used on some transformers.

The greatest difficulty is in the design of the transformer. First of all, following the present methods, a particular wavelength, at which the amplifier will operate at maximum efficiency, is chosen. With the capacity of the tube the primary of the transformer must form a resonant circuit, one in which the natural period will be that of the signals received. Next, at that frequency, the secondary impedance must equal that of the tube. If 3,000 meters is taken as the optimun wavelength, with a corresponding frequency of 100,000 cycles, at 4,000 meters the plate circuit will not be in resonance, and the resultant frequency of 75,000 cycles will give a lower secondary impedance.

Thus it can be seen that the design of a radio frequency transformer, at the present stage of development, is no easy matter. Variations in the steel further complicate matters so that, when the transformer is completed it may not do what was expected of it after all.

It is not proposed in this article to give absolutely accurate details which will produce a given result—that would be out of the question, considering the variations which experimenters are bound to put into their own construction. However, a working basis is provided which will lead to new ideas and developments.

CORE LAMINATIONS

Silicon steel for the core can be from 0.002 to 0.008 in. thick, preferably of the smaller size. Enough is needed to make a pile ⅜ in. thick. Before the steel is cut a template should be made of brass or steel, the exact size of the laminations, as shown in the detail drawing. Then, when the core pieces have been cut with snips to the approximate size, they should be clamped to the template and filed accurately. The dimensions of the two halves of the core are identical. There is an air gap between the parts when they are put together.

Four bakelite strips, marked A, are used to hold the laminations together. Before they are assembled on these strips, one-half of the laminations must be dipped in japan or varnish and hung on wires to dry. Then the plain and japanned laminations are put together alternately. This should make a total thickness, when the core is completed, of 7/16 in.

At this point mounting legs should be cut from a brass strip ⅜ in. wide by 1/16 in. thick.

COIL MOUNTING ASSEMBLY

A cardboard form (Fig. 2), C, is first made to go over the center part of the core. This supports two washers, E, over which a larger paper tube, D, is placed. The progressive assembly in Fig. 2 shows that another set of washers, B, are put over the outer tube. These washers carry the binding posts of the primary and secondary windings.

The tube C is made on a wooden mandrel 13/16 in. square. Bond paper about 8 in. wide is wrapped around it and varnished at the center part with Valspar. Enough sheets are used to make the tube about 3/64 in. thick. When completed the paper should be

Digitized by Google

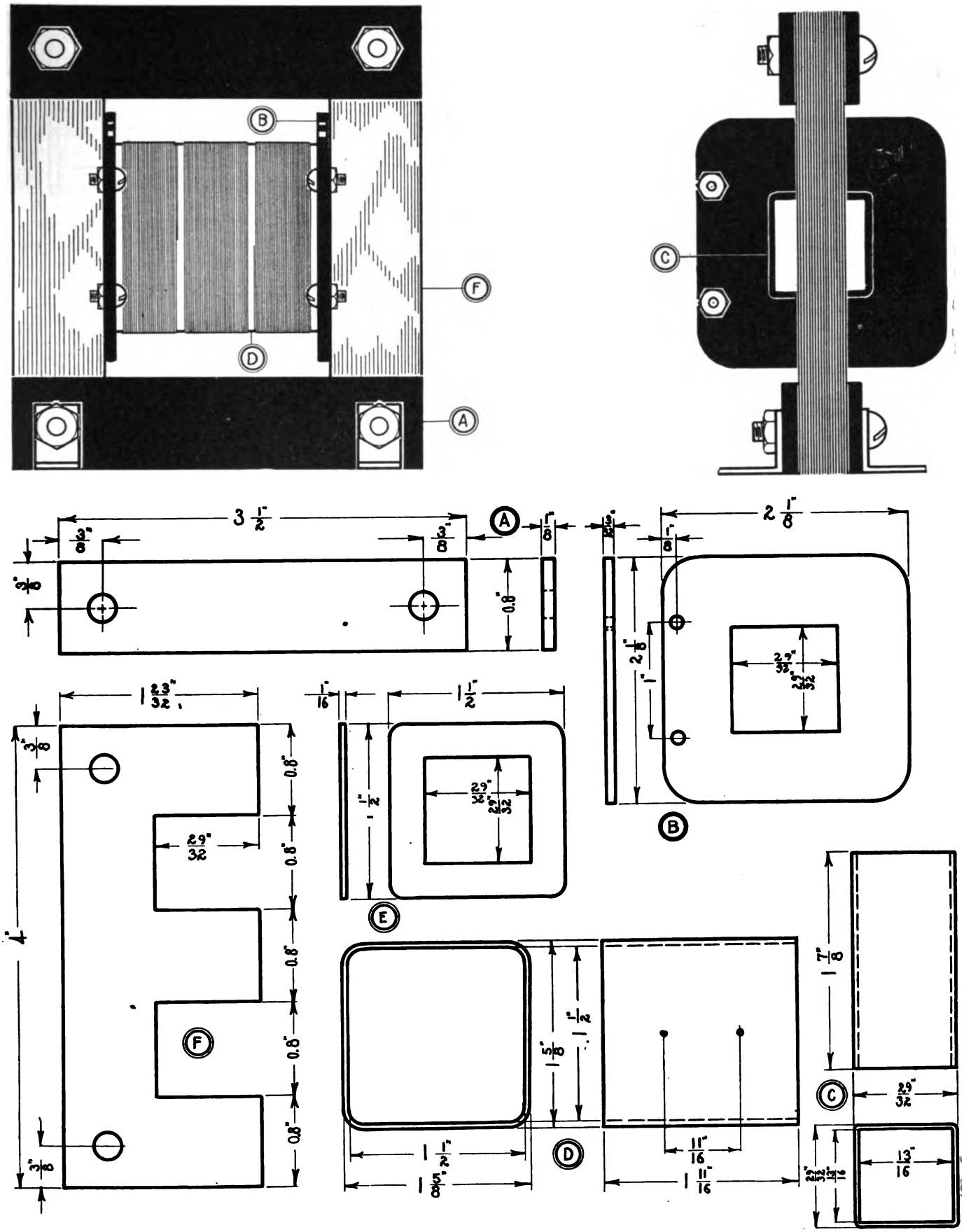


Fig. 1. The letters on the assembly refer to the details. This instrument calls for no difficult construction or expensive parts

Digitized by Google

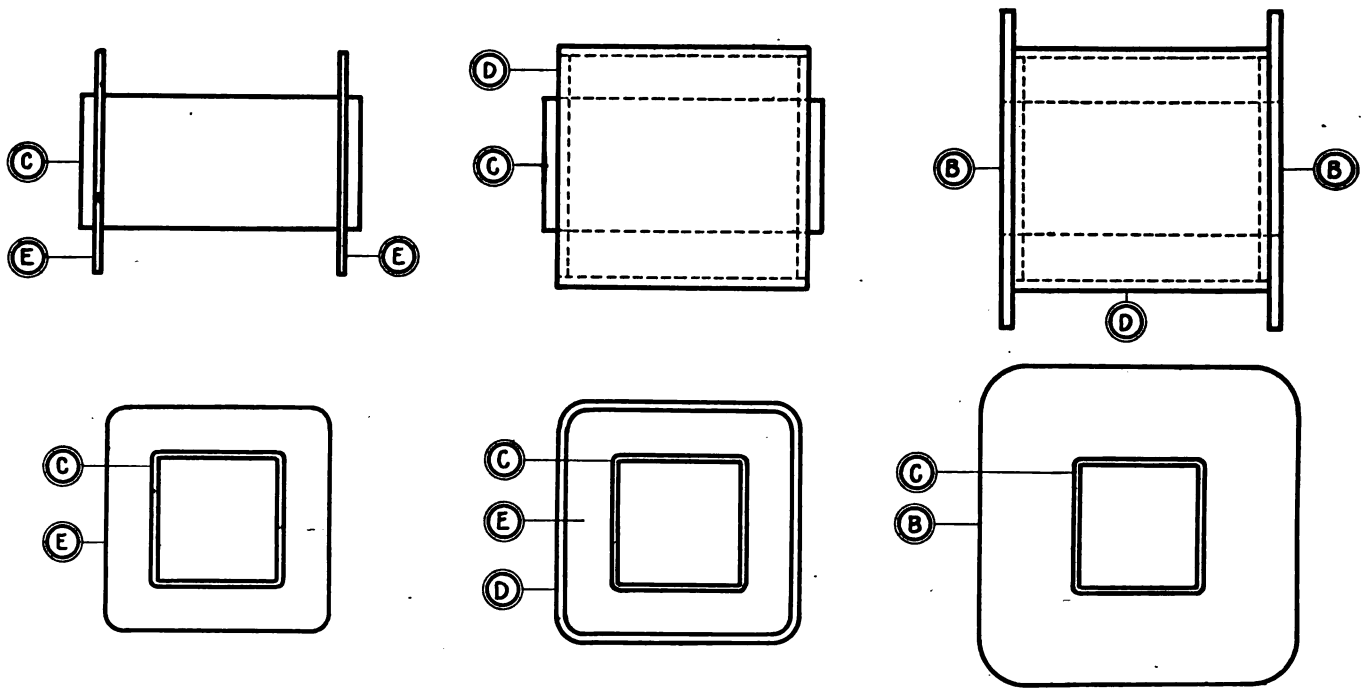


Fig. 2. Progressive steps in assembling the cores and end pieces which support the primary and secondary winding

wrapped with string and the whole outfit put in a warm oven to dry.

Wide paper is called for here because, if the Valspar leaks out at the edges, it will cause the paper to stick to the mandrel, making its removal impossible. After the drying process the tube should be cut to length before it is taken from the mandrel.

The end washers may be cut with a sharp knife from heavy cardboard to the dimensions given in Fig. 1. If cardboard of sufficient thickness cannot be obtained, several layers can be glued together and dried under pressure.

A larger mandrel must be made for the tube D, which carries the winding. This should be treated as explained in the first part of this section.

Primary and Secondary Winding

The assembled view in Fig. 1 shows the primary and secondary winding on the tube D. Two sections are used for the secondary, with the primary at the center. In the matter of winding the radio frequency transformer is much simpler than the audio frequency type.

First, the secondary coils are wound, each section having 90 turns of No. 40 single silk covered wire. The winding is of the ordinary sort secured with Valspar. Connections between the sections should be made inside the tube, and the wires soldered to make a perfect connection. Be sure that both parts of the coil are wound in the same directions, so that they will be equivalent to a continuous winding.

The primary requires 105 turns, also of No. 40 single silk covered wire. When the coils are completed, they should be covered with Valspar and baked dry in a warm—not hot—oven.

Leads can be brought from the coils directly to the binding posts, or pigtails, secured to the tube, can be used instead. The latter methods insures their permanence.

The beginning of the secondary should be brought to a terminal marked Sg, and the corresponding end of the primary to a terminal marked Pp. Thus, the Pp end will go to the plate of the first radio frequency audion, and the Sg end of the secondary will be connected to the grid of the next tube.

Assembly.

When the parts are ready, the tubes and end pieces should be assembled as shown in Fig. 2. An application of Valspar will keep the parts in place. Then the coil system is put on the core, and the end plates tightened until the laminations are clamped closely. If the coil mounting is not tight on the core, put a little Valspar on it and put it away to dry out. This varnish is better than glue for holding light parts, for once dry, it does not soften.

A Loud Speaker

SURPRISING amplification can be obtained with the device described in this article, though it is not intended to compete with expensive manufactured types. The loud speaker consists of a large box of thin wood, such as a cigar box. A regular 2,000 or 3,000 ohm receiver is secured at the center of the bottom, in such a way that the diaphragm faces upward.

Directly above the telephone receiver a hole is cut in the box and a small brass or tin horn fitted into it. The telephone is, of course, connected into the radio set in the usual part of the circuit.

When the telephone is actuated by the incoming signals, the box acts as a resonator, and the signals are conducted out by the horn. Signals of ordinary strength can be heard several feet from the loud speaker.

Cleaning Audion Contacts

The pins of an audion base must be cleaned periodically, as well as the contacts on the socket. There is a tendency for these parts to become oxidized, with the result that the resistance at the contacts becomes high.

Handling Detector Crystals

THOSE amateurs who are not fortunate enough to possess an audion detector should try to get the best results possible from their crystal detector. Few know how to do this.

The first thing to observe about the proper use of crystals is to see that their surfaces are kept absolutely clean. The experimenter cannot hope to do this by continuously handling them, as this will deposit a thin film of greasy matter from the fingers which will greatly interfere with the efficient action of the crystal through its high resistance. To keep crystals in a sensitive condition they should be handled with a small pair of tweezers. When the operator is through with his stations for the day he should remove the crystal from the detector stand and place it in a clean box where it can be kept free from dust and dirt. By following these simple rules the results obtainable with a galena detector will be entirely satisfactory.

Digitized by Google

The Radio Department

DID you ever hear of a "soundmeter", an instrument with a pointer to indicate the strength of a sound? Such an instrument has been invented by a New York man, Mr. McGall, although the operation of the device has not been disclosed because patent specifications have not been filed.

The instrument, outwardly, is just a small wooden box, carrying a glass at the top through which the scale and pointer can be observed. When the soundmeter is put near a buzzer or similar generator of air vibrations, the pointer moves according to the strength of the sound.

It is unfortunate that no manufacturer has offered to take up the production and development of Mr. McGall's soundmeter, since it promises to be a most interesting and useful instrument.

MR. MILLS, of the A. T. & T., would probably feel greatly relieved if someone would invent a method for measuring audibility. At the last meeting of the Institute, he seemed deeply moved in his discussion of the problem. Unfortunately, his was a mole's eye view of the subject rather than the bird's eye. We can thank the war for drawing many of our radio engineers from under their theoretical bushels into the open where their shining candles could glow with a practical and useful light.

DR. GOLDSMITH, at the meeting referred to, spoke of the necessity for considering the operators simultaneously with the development of new equipment. As he pointed out, the operator is the one who has to use the apparatus, and for that reason, it will not do to let the radio art so far outstrip the operators that they will be disgruntled by the new demands made upon them. Since the art must not be retarded, the operators must have the additional instruction necessary to keep them up with the art.

IT might be well for the experimenters to consider the value of the things they are doing. Of course, each one cannot make something better than anyone else, but each experimenter should stop to think whether the apparatus and experiments he is going to make are better or more worth while than anything before.

The construction of small portable receivers seems to hold a fascination for some. One particular enthusiast on such work comes to the Magazine office frequently, each time with a new pocket edition. The series up-to-date numbers ten or twelve kinds of small sets, but they are different only in small details. This man has not yet learned to design the circuits—the sets simply work because almost anything will produce signals from a nearby high powered station. The successive receivers represent no increase in the knowledge or ability of the builder.

A NEW contributor is represented in this issue of EVERYDAY, namely, H. W. Houk, of the International Radio Company. Mr. Houk, during the war, was one of the greatly envied men whose ability won him a place at the Paris laboratories of the A. E. F. His article on antenna period measurement is one of a number which he has promised to give the readers of EVERYDAY.

THERE was quite a flurry in the radio field when, a few months ago, it was announced that a static eliminator had been discovered. Much has been written also, in the less conservative publications, about buried wires which do away with difficulties from static.

Officials in the Bureau of Steam Engineering, the men who finally decide upon the merits of such systems, draw a distinct line between static reducers and static eliminators. While, to be sure, methods for reducing strays have been worked out, the man who has the real thing in static eliminators need not fear that someone else got there first.

Even Professor Pupin, who has probably done more in this direction than any other man, is willing to admit that the discovery of the copper-bound method is still a matter of future development.

A FEW years ago, when there were only a few hundred ship and shore radio stations, the supply of radio operators kept up with the demand. In the past year radio operating has taken its place among professions, but the number of men available has not kept pace with the increasing use of the wireless. Ship stations particularly have gone up and up in number. Land stations, as soon as the Government releases its control, will go up all over the United States, while installations in the South American republics are under construction, or are being planned.

The Post Office, as it increases its facilities for the distribution of mail by airplanes, will need more operators. A survey of the field shows that with these and other extensions in the use of wireless, the industry will, in the next five years, pass the most optimistic prophecies of five years back.

It is interesting to note, in this respect, that a new operators' correspondence school has been opened, offering a course prepared by L. R. Krumm, chief radio inspector, New York, giving prospective operators the benefit of his wide experience in the most effective methods for instructing and training of men for the Signal Corps.

SPRING days will be here soon, and experimenters will feel the call of out-doors. No reason, though, for leaving radio behind. Articles planned for next month include the design of a portable set which can be carried in the hand, or on the bicycle. With warmer weather there are also field tests with loop antennas, sets to be put up on the boat or at the bungalow. Tree climbing will become more popular, and higher antennas will go up.

We are getting ready new articles to suit the season, as well as those of all-year-round interest.

Radio Association

We wish to take this opportunity to call the attention of every radio amateur to the fact that a club under the name of the Ravenswood Radio Association, formed a short time ago in Chicago, has now become one of the strongest amateur radio organizations of its kind in the middle west.

It is composed entirely of commercial licensed operators and is working toward the raising of the amateur standard and the promotion of all legitimate work which will benefit the amateur.

It was decided that any amateur who was sufficiently interested to obtain a commercial license could qualify for membership in the organization. This will have the effect of having more amateur possessors of sufficient technical knowledge to put the amateur radio work out of the plaything class to which the average person not interested has assigned it.

The club has constructed an efficient wavemeter with which all members' apparatus will be tuned. Two of the members will be assigned to the task of tuning amateur sets throughout the city for a slight fee.

Weekly meetings are held at the club headquarters on Tuesdays at which the latest developments are discussed and explained by either members or some radio expert.

All amateurs are cordially invited to attend these meetings and the Secretary would be pleased to hear from all those interested in this organization.

Applications for membership are still open to all those who can qualify for entrance.

THE RAVENSWOOD RADIO ASSOCIATION,
1917 Warner Avenue, Chicago, Illinois.

Digitized by Google

Some Details of a New Condenser

Low Minimum Capacity and Unusual Mechanical Strength Are Outstanding Features of this Condenser

WHEN the condensers shown in Fig. 1 were brought into the office of the MAGAZINE, someone suggested that, if they were really as strong as it was claimed, they should stand two tests—first, that a man could stand on them, and, second, that they should not be injured when dropped at an angle from waist height in such a way as to land on the edge of the bottom end plate.

Another in the group maintained that, while a condenser might be specially built to stand such abuse, no one did it because any radio man with common sense wouldn't try such things on so delicate an instrument as a variable condenser.

But the experimenters' instincts prevailed and a condenser was put on the floor. Then a man weighing about one hundred and fifty pounds stood with both feet on the upper end plate. This was a more severe test than it appears to be at first thought, because the lower bearing extends below the heads of the screws which hold the fixed plates, so that entire weight was supported by the bottom of the lower bearing.

That test showed no ill effects. The plates were not bent, and nothing was loosened or injured. Then the condenser was held four feet from the floor and dropped in such a way that it landed on the edge of the bottom plate. Again the instrument came through no worse for wear.

The reason for this unusual strength is shown in Fig. 1, where a 0.0005 type is disassembled, with a complete 0.001 mfd. condenser at the right. The fixed plates, of 1/32-in. aluminum, are assembled on 10-32 screws, which are threaded into brass end pieces. In this way the fixed plates are assembled into a complete unit, independent of the end plates. This unit, with the heavy plates, washers, and assembly screws, is of great rigidity.

A feature of the variable plates, not found ordinarily in condensers supplied for experimenters, is that they are keyed to the shaft to prevent them from turning independent of the entire unit. Brass washers 5/8 in. in diameter separate the plates. Large and long bearing surfaces insure the perfect alignment of the moving parts.

The end plates are 3¾ ins. in diameter and ¼ in. thick. An adjustable bearing and lock nut are fitted to the lower plate, allowing a variation of the tension and position of the variable plates. If the condenser is mounted on a panel, the screws holding the fixed plates to the upper end plate can be put in from the front of the panel, so that the upper plate will be flushed against the back of the panel.

Fig. 2 gives calibration curves for the two sizes. There are 29 plates in the small size, and 59 plates in the large condenser. The reason for the unusually low minimum capacity is found in the shape of the plates. Instead of being semicircular, they occupy only 165 degrees of a circle. Consequently, in the minimum position the fixed and variable plates are widely separated. This construction is also responsible for the perfectly straight line calibration right up to the maximum, while other condensers drop off at the upper end.

It will be seen that two types have a range of 0.00001 to 0.00058 mfd. and 0.000015 to 0.00115 mfd. Measurements of the capacity were made as follows, using a scale with 100 degrees to a semicircle:

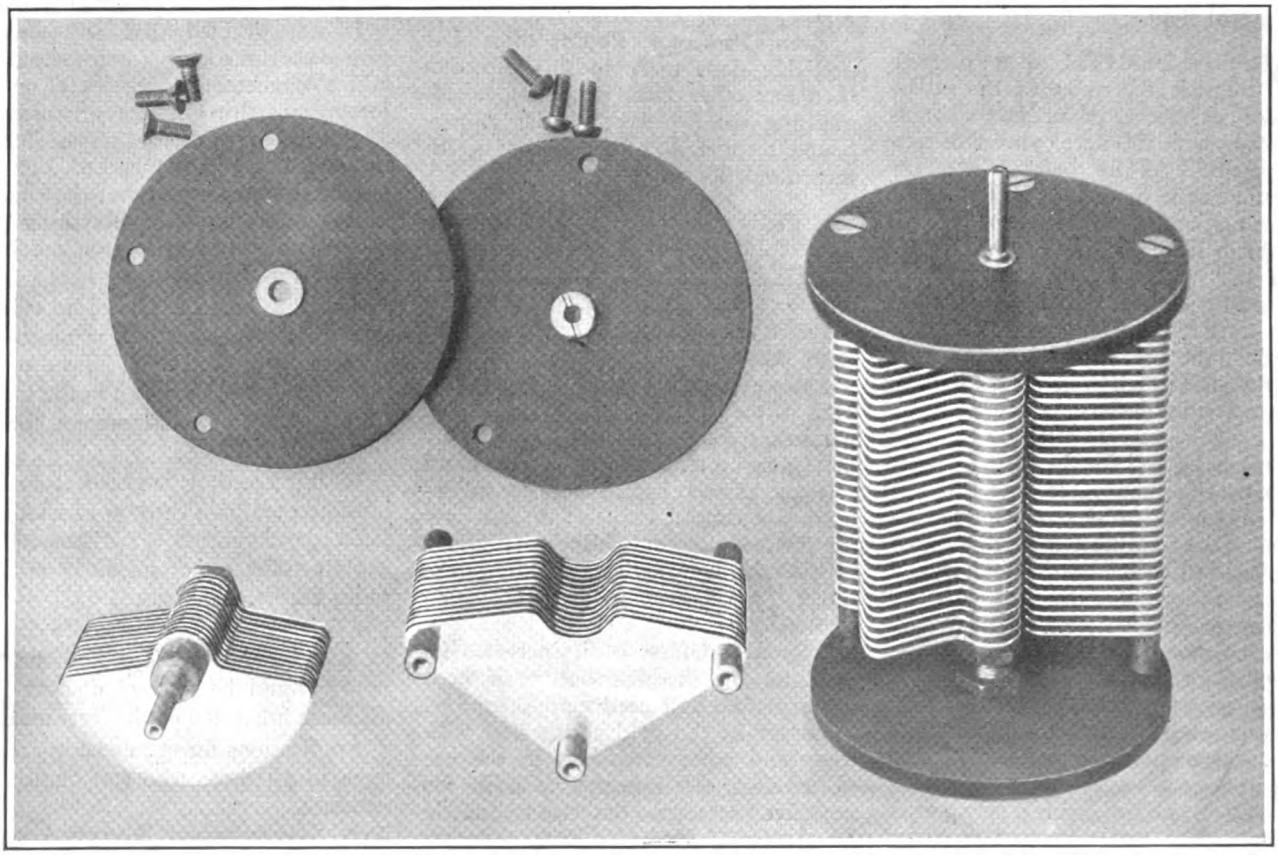


Fig. 1. The fixed and variable plates form complete units of great mechanical strength. End plates of solid bakelite prevent losses even at high frequencies

Digitized by Google

SMALL SIZE		LARGE SIZE	
Degrees	*Capacity*	*Degrees*	*Capacity*
0	0.000010	0	0.000015
10	0.000023	10	0.000050
20	0.000085	20	0.000170
30	0.000150	30	0.000295
40	0.000210	40	0.000415
50	0.000270	50	0.000535
60	0.000335	60	0.000660
70	0.000395	70	0.000780
80	0.000460	90	0.000900
90	0.000520	90	0.001025
100	0.000585	100	0.001150

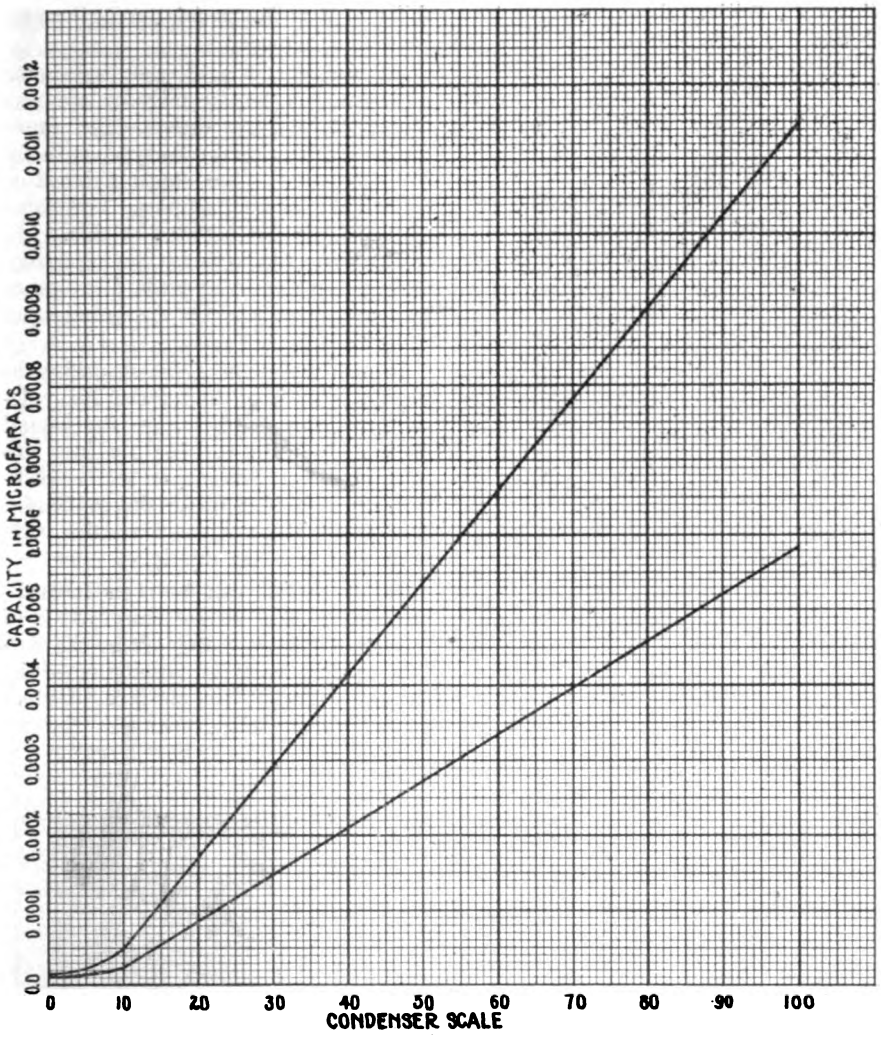


Fig. 2. Calibration curves of the two condensers

Effective Capacity Table

WHEN a series condenser is used for tuning the antenna circuit of a receiving set, the effective capacity is less than the capacity of either the antenna or tuning condenser. The table below gives the effective capacity with different values of antenna and condenser capacity.

To determine the effective capacity—that is, the value to be used with the inductance of the primary coil to determine the wavelength of the circuit—locate the column headed by the value nearest to that of your antenna. Then, in the column headed C, find the value of your tuning condenser. Run across horizontally to the column first found. The figures thus located will give the effective capacity of the circuit.

C	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010
0.0001	0.000050	0.00006	0.00007	0.00008	0.00008	0.00009	0.00009	0.00009	0.00009	0.00009
0.0002	0.000060	0.00010	0.00012	0.00013	0.00014	0.00015	0.00015	0.00016	0.00016	0.00017
0.0003	0.000075	0.00012	0.00015	0.00017	0.00019	0.00020	0.00021	0.00022	0.00023	0.00023
0.0004	0.000080	0.00013	0.00017	0.00020	0.00022	0.00024	0.00025	0.00026	0.00027	0.00028
0.0005	0.000083	0.00014	0.00019	0.00022	0.00025	0.00027	0.00029	0.00030	0.00032	0.00033
0.0006	0.000086	0.00015	0.00020	0.00024	0.00027	0.00030	0.00032	0.00034	0.00036	0.00038
0.0007	0.000088	0.00015	0.00021	0.00025	0.00029	0.00032	0.00035	0.00037	0.00039	0.00041
0.0008	0.000089	0.00016	0.00022	0.00026	0.00031	0.00034	0.00037	0.00040	0.00042	0.00044
0.0009	0.000090	0.00016	0.00023	0.00027	0.00032	0.00036	0.00039	0.00042	0.00045	0.00047
0.0010	0.000091	0.00017	0.00023	0.00028	0.00033	0.00038	0.00041	0.00044	0.00047	0.00050
0.0011	0.000092	0.00017	0.00024	0.00029	0.00034	0.00039	0.00043	0.00046	0.00049	0.00053
0.0012	0.000096	0.00017	0.00024	0.00030	0.00040	0.00040	0.00044	0.00048	0.00051	0.00055
0.0013	0.000093	0.00017	0.00024	0.00031	0.00036	0.00041	0.00045	0.00050	0.00053	0.00057
0.0014	0.000093	0.00018	0.00025	0.00031	0.00037	0.00042	0.00046	0.00051	0.00055	0.00058
0.0015	0.000094	0.00018	0.00025	0.00032	0.00038	0.00043	0.00047	0.00052	0.00057	0.00060
0.0016	0.000094	0.00018	0.00025	0.00032	0.00039	0.00044	0.00048	0.00053	0.00058	0.00061
0.0017	0.000094	0.00018	0.00026	0.00032	0.00039	0.00044	0.00049	0.00054	0.00059	0.00063
0.0018	0.000095	0.00018	0.00026	0.00033	0.00040	0.00045	0.00050	0.00055	0.00060	0.00064
0.0019	0.000095	0.00018	0.00026	0.00033	0.00040	0.00045	0.00051	0.00056	0.00061	0.00065
0.0020	0.000095	0.00018	0.00026	0.00033	0.00040	0.00046	0.00052	0.00057	0.00062	0.00066

The minimum capacity of the tuning must be taken as ½ that of the antenna capacity, but the maximum can be so high as is desired. At a very low minimum the antenna circuit is practically opened.

For example, suppose a condenser of 0.0001 to 0.001 mfd. is in series with an antenna of 0.0004 mfd. At maximum, the effective value will be found in the column headed 0.0004, and across from 0.001 in the C column, giving the result as 0.00028 mfd.

At minimum, the tuning condenser must not be used less than one-half the antenna capacity, or 0.0002 mfd. The answer will be found in the 0.0004 column, opposite 0.0002 in the C column, or 0.00013.

Thus the effective capacity range obtained with the tuning condenser, then, is 0.00013 to 0.00028 mfd., even though the condenser has a range of 0.0002 to 0.001 mfd.

Turning a Thin Brass Disc

IT is out of the question to attempt to turn a thin sheet of brass when it is only held at the center by an arbor, and cutting and filing are nearly as impossible if a smooth job is required. An easy way to accomplish the work is to fasten the brass at the corners to a wooden disc, mounted on a face plate. A sharp tool will cut out a perfect circle in the brass.

Discs made in this way can be used as condenser shields. The disc should be mounted behind the panel, and connected to the ground side of the set. Plenty of space should be allowed between the disc and the condenser parts.

Book Review

STANDARD TABLES AND EQUATIONS IN RADIO TELEGRAPH, by Bertram Hoyle. 155 pages, cloth bound, 8½ x 5½ ins. Published by the Wireless Press, Ltd., Marconi House, Strand, W. C. 2, London, England.

English authors seem to take pleasure in compiling useful books of formulas and data on various subjects. Mr. Hoyle has done radio engineers no small service in preparing for them this book of information.

It is impossible to even attempt to list the subjects covered, for it seems as if everything is included, from definitions of electrical units to thimble sizes for wire ropes.

A complete index gives easy access to the various tables, formulas and definitions.

Digitized by Google

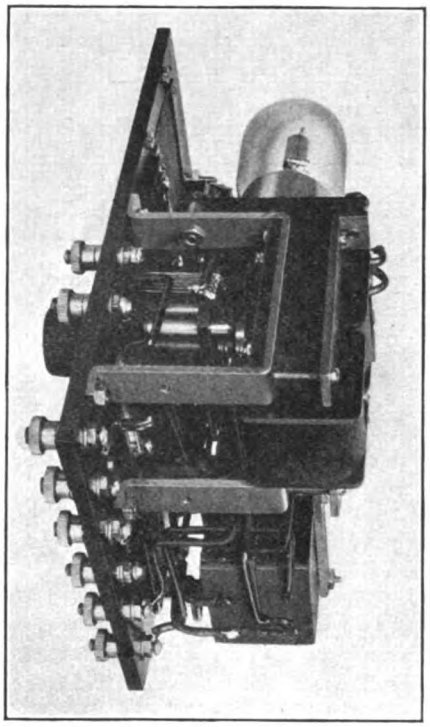
An Interesting Audion Control Box

This Set, from the Wireless Improvement Company, Operates on B Batteries or 110 Volts Direct Current

THE influence of manufacturing apparatus for the Government can be plainly seen in the new experimental equipment, an effect of advantage and credit to both the buildeds and users of the instruments. This audion control box, illustrated in Figs. 1, 2, 3, and 4, is of the regular Navy type with adaptions which made it quite versatile in respect to the important problem of plate voltage supply.

Beginning with the panel mounting, it can be seen that hinges are used, at the bottom, having the pin secured to one-half of the hinge. Therefore, when the panel is down, it can be slipped to one side and the pins pulled out of the other half of the hinges. In the closed position, however, the sides of the case hold the panel in position.

Fig. 1 shows a small thumb screw at the top center of the panel and at Fig. 4 a threaded block inside the case. To lock the panel, the thumb screw is turned tightly into the block. Supports are fastened rigidly onto the panel, Fig. 4, to keep it from falling down. These strips catch on angle pieces inside the case. A little inward pressure releases them so that the panel can be lowered further or removed.



At the rear, Fig. 2, the impedance, audion socket, fixed condenser, ammeter and grid leak are shown. The impedance, of the closed core type, is in the direct current plate supply circuit to smooth out current ripples. The paper condenser is put across the line. The method of supporting the impedance and audion should be studied, as it may present suggestions for designing other equipment.

Fig. 4 shows the rheostat under the socket. This is of the regular Navy design, made up of resistance wire wound back and forth on pins set into two bakelite discs. The carbon sector potentiometer is hidden under the condenser. It controls the voltage from the plate battery or 110-volt supply.

Other details can be seen from illustrations. The circuit employed is of the usual type. Change from the battery to 110 volts is accomplished by an anti-capacity, double-pole, double-throw switch. Experimenters who try

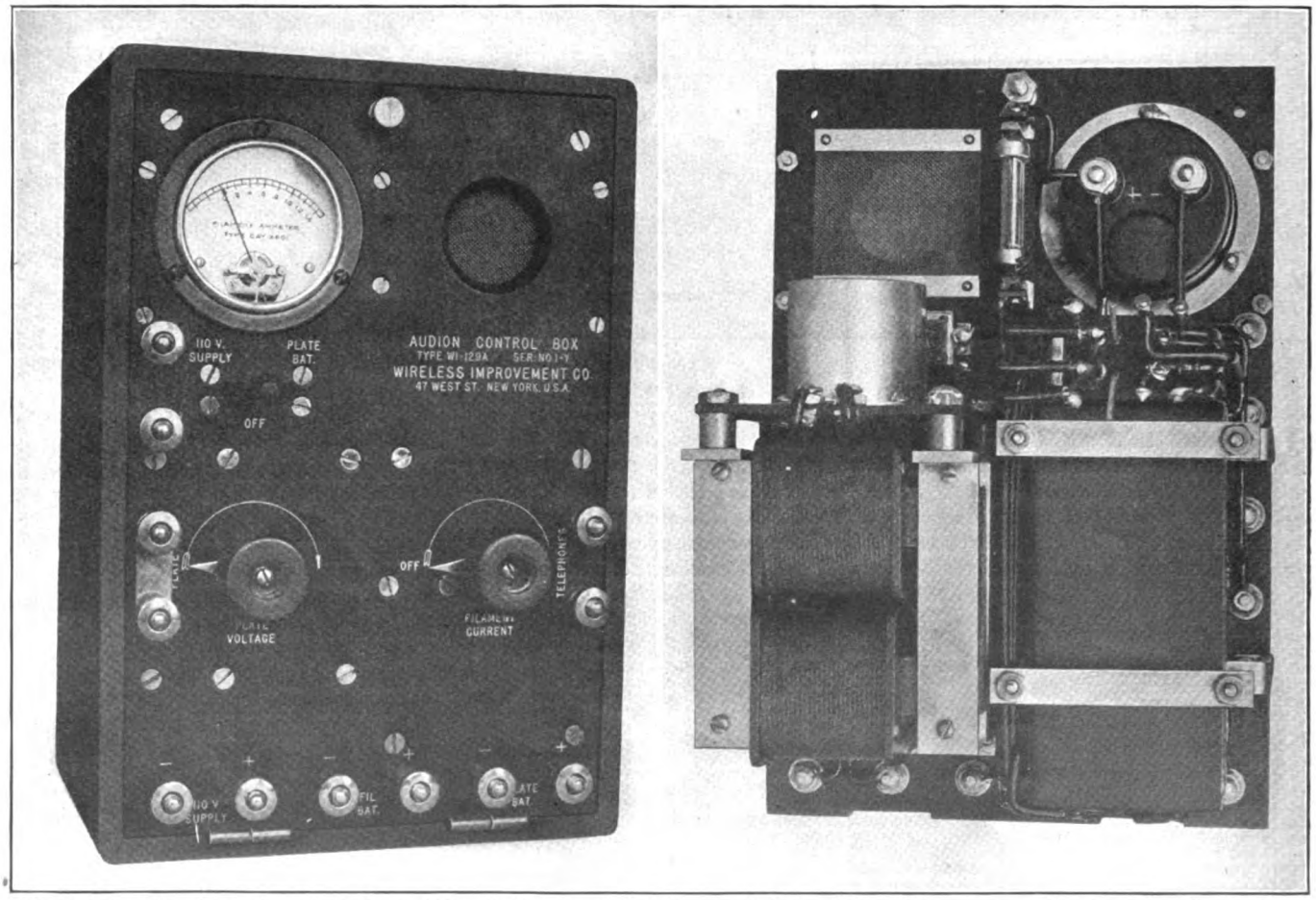


Fig. 1, left. The change from batteries to 110 volts is accomplished by a switch just below the ammeter. Fig. 2, right. A closed core impedance is used to smooth out the 110 volts. Fig. 3, above. Compact design is characteristic of this equipment

Digitized by Google

to run their audions on 110 volts should benefit by the experience of the author, at the laboratory of the magazine. It was a simple matter to set up two iron core chokes with a condenser across them. To prevent any accident, fuses were put in front of the choke coils. When the circuit was closed the fuses blew out. Everything was all right, but the fuses blew a second time. Finally it was suggested that we had a two-phase line in the building and that this circuit must be on the wrong side. It appeared that that must be the trouble, for the polarity of the 110-volt circuit leads were carefully tested, yet the fuses blew when the negative side was grounded.

Finally we called the electric light company and were informed that the installation was an old one and that the positive side was grounded. This will seldom happen at other places, but serves as a suggestion for those who experience any difficulties on this score.

Increasing the Efficiency of Honeycomb Coils

WHEN honeycomb coils were first manufactured for radio work, they were dipped in an insulating varnish to hold the turns together securely without the possibility of damaging them from handling and to protect the insulation on the wire.

It was known, however, that energy losses occurred in the varnish, as it acts as an imperfect dielectric between the turns. Therefore, if the varnish could be removed, except for a thin film, from the interior of the coils, the capacity and high frequency resistance would be reduced.

Of a number of tests to accomplish this result, the last was the simplest, most effective and most economical. The coils were dipped and then put upon a revolving shaft. Centrifugal force threw off the excess varnish and dried them so that the time required for baking was greatly reduced.

Honeycomb coils are all treated in this manner now, with the result that they are much more efficient electrically than before this new method was adopted.

Radio Traffic Association

THE prevalence of inefficient operating was responsible for the organization of the Radio Traffic Association of Brooklyn, N. Y., in January, 1917. It is again preparing to carry out its main objects, which are to minimize unnecessary interference and reduce inefficient operating by the dissemination of practical ideas. It also purposes to promote good fellowship and establish an efficient relay system among the amateurs of Brooklyn.

At present the officers are Ferd. C. W. Thiede, Chairman; Albert R. Heydon, Secretary; Ernest K. Seyd, Financial Secretary, and Clifford J. Goette, Treasurer.

All amateurs of Brooklyn, above the age of eighteen, desirous of connecting with an organization offering obvious advantages are cordially invited to communicate with the Secretary at 486 Decatur Street, Brooklyn, N. Y.

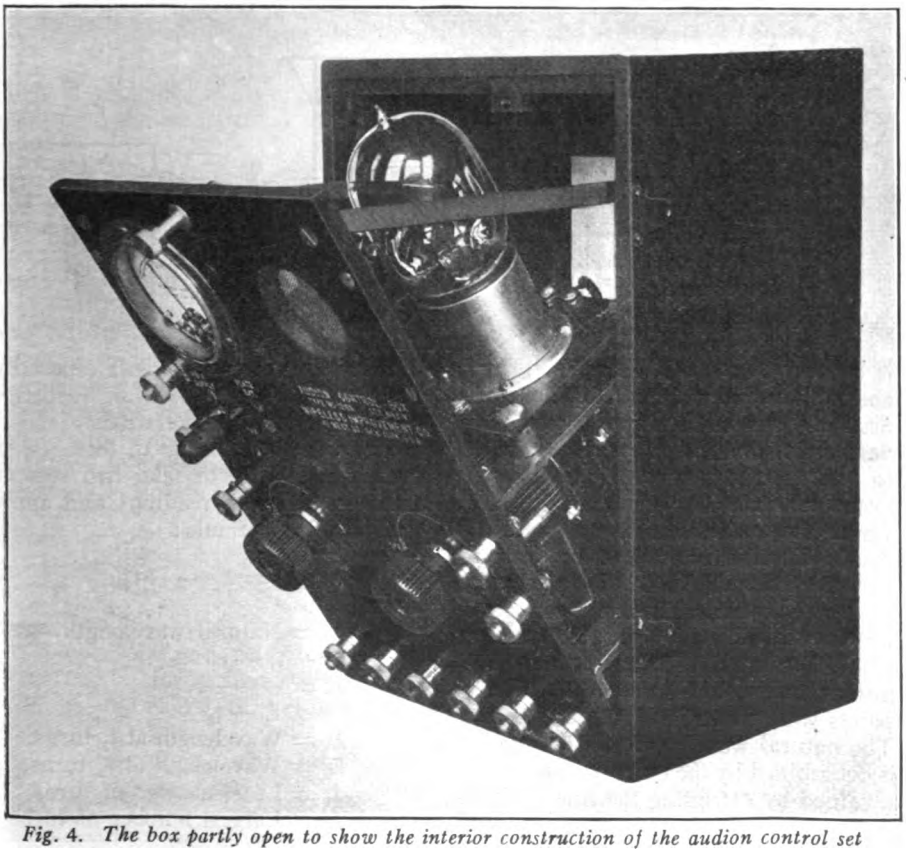
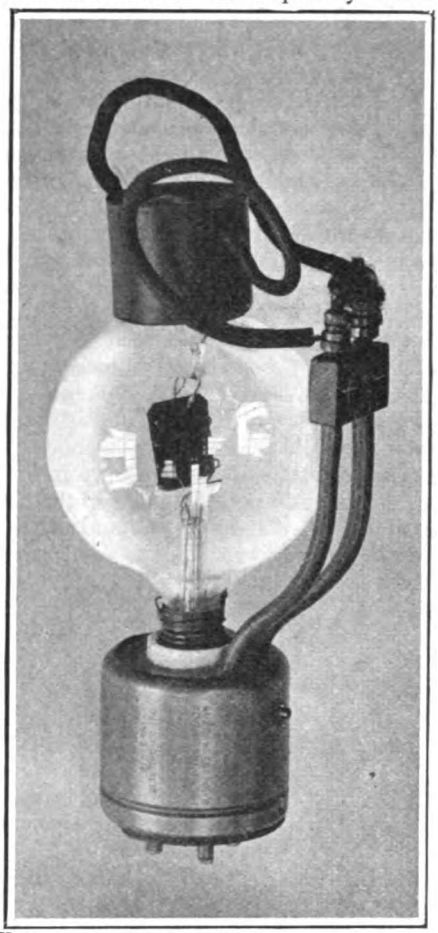


Fig. 4. The box partly open to show the interior construction of the audion control set

An Audion Socket Adapter

THERE is an astoundingly large number of the old style round audions still in use. An adapter by which



How a round bulb is used in a VT socket

the round bulbs can be used in a standard VT socket is shown in the accompanying illustration.

The main base came from a broken Western Electric VT1. To the grid and plate contacts inside the base, two copper wires, covered with empire cloth tubing, were soldered and brought up to a connection block. They take the grid and plates wires from the audion. The cylinder at the top of the tube was made of paper, filled with sealing wax, making an excellent protection for the wires and that end of the bulb.

A small porcelain socket, connected to the filament pins, is held in place by sealing wax. Paraffin is not good for this purpose, because, in a warm room, it becomes too soft to maintain the parts in position.

To use the round audion, it is only necessary to put the adapter in the standard VT socket, screw the bulb in place and fasten the gird and plate wires to the binding posts.

W. H. HOWELL.

Did You

send in your name for the Radio Register? Every engineer and experimenter should be represented. Don't have your name left out.

Digitized by Google

Measuring the Natural Wavelength of an Antenna

Accurate Results Are Obtained With A Simple Method

By H. W. Houck

USUALLY great difficulty is experienced in measuring the natural wavelength of an antenna. The usual methods are shown in Figs. 1, 2, 3, and 4, each of which has the disadvantage of not radiating a sharp wave. In fact, it is very difficult to detect a resonant point and if a resonant point is found it is so broad that accurate measurement cannot be taken. The reason for this broad tuning is due to the high decrement of the circuit. It is possible to get a very sharp resonant point by inserting an inductance in series with the antenna as shown in Fig. 3, because adding inductance in the circuit lowers the decrement and results in sharper tuning. This is easily seen from the equation

$$\delta = \pi R \sqrt{\frac{C}{L}}$$

where

δ = Decrement per cycle,
π = 3.1416,
R = Resistance in Ohms,
C = Capacity in microfarads,
and L = Inductance in microhenrys,

in which the decrement is shown to be inversely proportional to the square root of the inductance. This makes it possible to obtain a sharp resonant point, but the reading is worthless unless the value of the inductance is known and even then it requires a calculation which is difficult due to the correction factor caused by the distributed inductance and capacity of the antenna.

With the circuits shown in Figs. 5 or 6 and by the use of a curve which is easy to plot, it is possible to measure the natural wavelength with reasonable accuracy and little or no difficulty will be experienced in finding the exact resonant point. The inductance L should be a coil of wire whose diameter is small compared with its length, although the error is not great with any shape of inductance. This coil should have about 15 or 20 turns of wire and at least three taps. The method of procedure is as follows:

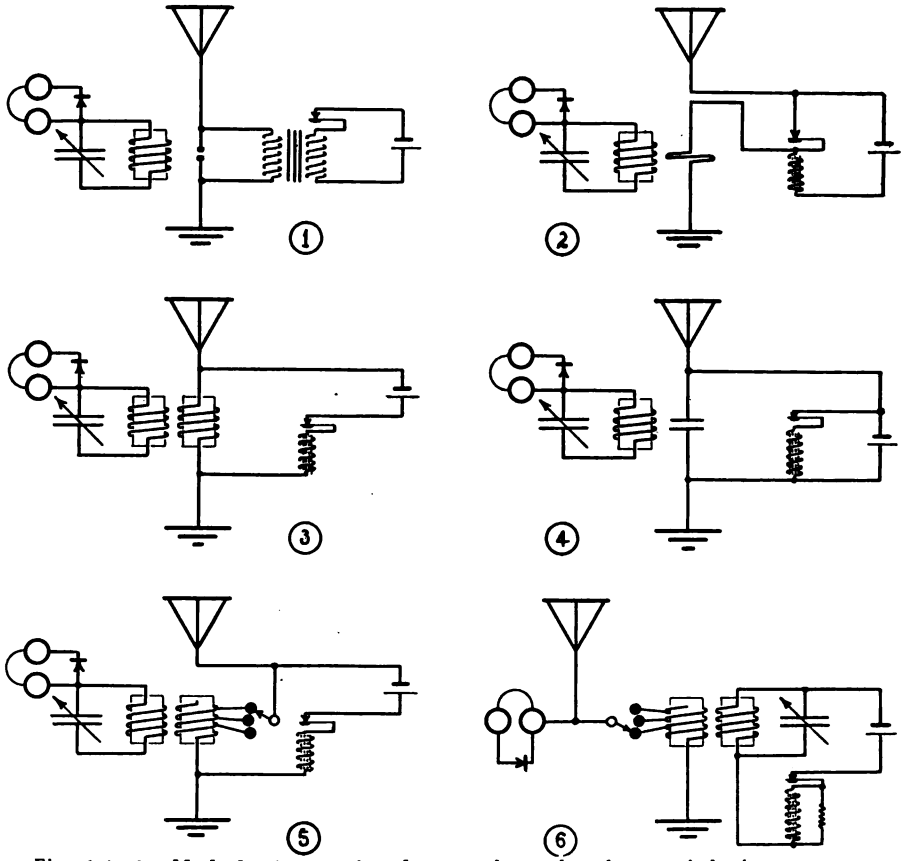
First, insert the inductance in series with the antenna, and provide some method of varying the number of turns of the inductance in the antenna circuit.

Second, excite the antenna as shown in Fig. 5, by connecting a high frequency buzzer and battery in series with the inductance coil L.

Third, place the wave meter near the coil, read the wavelength at different taps and record it together with the number of turns used in each case.

Fourth, on a sheet of cross section paper, with the wavelength on the Y axis and the number of turns on the X axis, plot the points and draw a mean straight line through them. The distance from the origin to the point on the Y axis where the line intercepts determines the natural or fundamental wavelength of the antenna.

If the wave meter is supplied with a buzzer and used as a generator of waves, the circuit shown in Fig. 6 can be used. In this circuit the detector is connected unilaterally to the antenna end of the inductance L. This connection gives a slightly sharper resonant point and is the most desirable to use.



Figs. 1 to 6. Methods of measuring the natural wavelength or period of an antenna

An example is shown in Fig. 7 in which the inductance L was a coil 3 ins. in diameter and 3 ins. long, wound with 24 turns of No. 12 B. & S. gauge bare copper wire. The measured wavelength with 24 turns was 590 meters, with 21 turns 570, with 16 turns 535 meters and with 11 turns 500. These points were plotted and the line drawn. The natural wavelength of the antenna is determined by the point on the Y axis, obtained by extending the line. Hence the natural wavelength was found to be 425 meters. This value checked within 1% of the actual value obtained by an elaborate vacuum tube measurement which involves too great an outlay of apparatus for the average radio experimenter. A similar means of antenna measurement was developed by the French Government during the war, and was used in French Radio Laboratories as well as in the field.

In some cases it is desirable to obtain the natural wavelength of an antenna without going to the trouble of drawing the curves. This is especially true in instances where an inspector has a large number of stations to measure in a limited time. In this case it is only necessary to take two sets of turns—wavelength readings and apply the following formula:

$$\lambda_0 = \lambda_2 - K t_2,$$

where

λ_0 = Natural wavelength,
$K = \frac{t_1 - t_2}{t_1 - t_2}$,
λ_1 = Wavelength at t_1 turns,
λ_2 = Wavelength at t_2 turns,
t_1 = Least number of turns,
and t_2 = Largest number of turns.

Digitized by Google

This formula may be derived from the curve shown in Fig. 7 and is applicable, of course, to any similar case. An example of this method may be taken from data already given. The two sets of readings taken are 590 meters (λ_2) at 24 turns (t_2) and 500 meters (λ_1) at 11 turns (t_1). By substitution in the formula we find:

$$K = \frac{\lambda_2 - \lambda_1}{t_2 - t_1} = \frac{590 - 500}{24 - 11} = 6.92.$$

Then: $\lambda_0 = \lambda_2 - K\,t_2 = 590 - (6.92 \times 24) = 424$ meters,

For instance, if we desire to load the antenna of Fig. 7 to 600 meters, we take two sets of measurements. These are:

$\lambda_2 = 590$ meters $t_2 = 24$ turns
$\lambda_1 = 500$ meters $t_1 = 11$ turns

$$K = \frac{\lambda_2 - \lambda_1}{t_2 - t_1} = \frac{590 - 500}{24 - 11} = 6.92.$$

Then:

$$T = \frac{\lambda_2 - \lambda_0}{K} = \frac{600 - 424}{6.92} = 25.43.$$

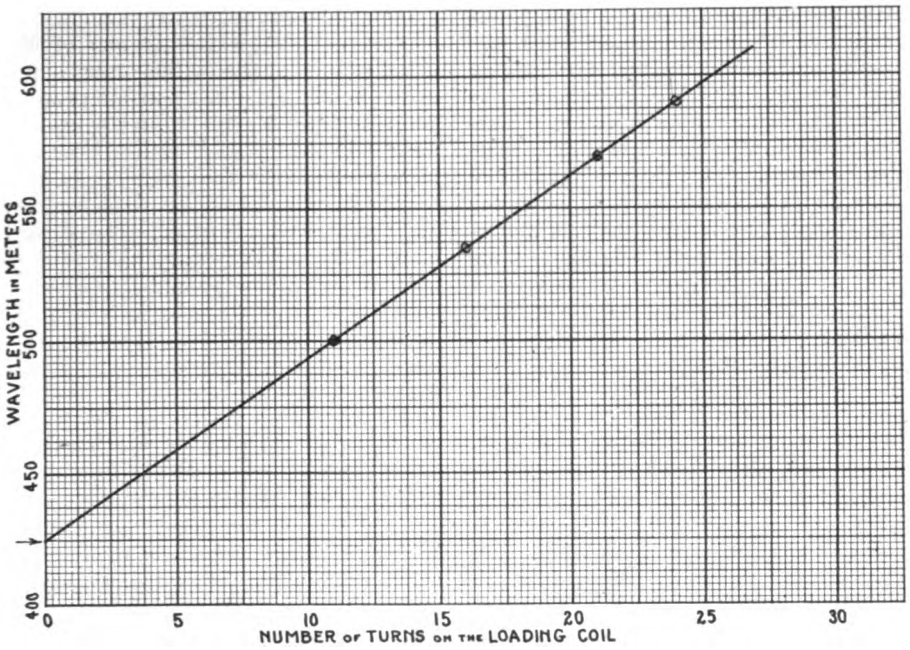


Fig. 7. Results of measurements by which the natural wavelength is obtained

which is probably a little closer than the results obtained by the use of the curve.

Another application of this formula is in the calculation of the exact number of turns necessary to load a given antenna to any wavelength. The coil used in loading the antenna must be of the same diameter and must have the same ratio of diameter to length as the coil used in making the measurement. It is also best to have the greatest wavelength reading at least as great as that which is to be used. The nearer these conditions are obtained, the more accurate the calculation.

$$T = \frac{\lambda_L - \lambda_0}{K},$$

where

λ_0 = Natural wavelength of for desired wavelength,
λ_L = Desired wavelength in meters,
λ_0 = Natural wavelength of antenna,
and K = Same as in the previous case.

Hence, 25.43 turns of the coil used in these calculations would give a wavelength of 600 meters.

From $$T = \frac{\lambda_L - \lambda_0}{K}$$

it is seen that with any number of turns we may readily calculate the corresponding wavelength from

$$\lambda_L = T\,K + \lambda_0,$$

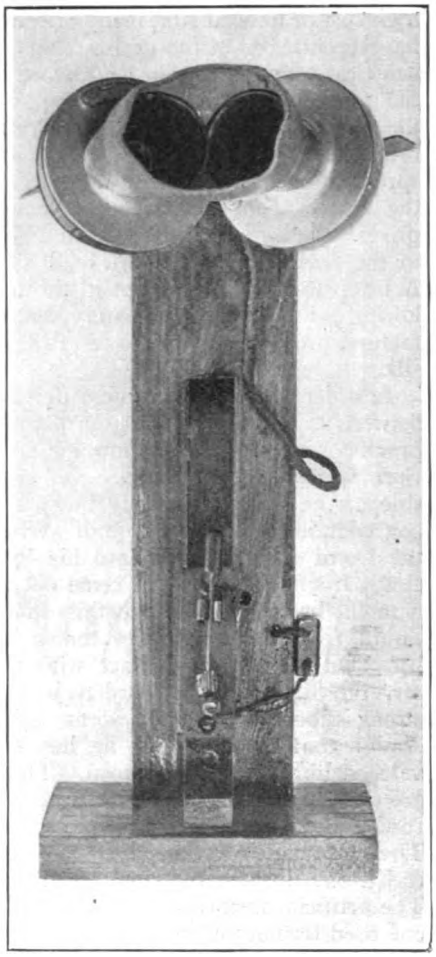
where: λ_2, λ_0, T, and K have the same significance as heretofore.

The principles above set forth may be applied to the measurement of capacities in open or closed oscillators, and is especially valuable in measurements of circuits in which the capacity predominates.

Measurements of this sort give the experimenter data on his station which takes the guesswork out of the design of apparatus.

Mounting Two Transmitters in Parallel

SOME particular experiment may call for a transmitter of extra carrying capacity under circumstances where nothing but the usual type is available. Heavy current transmitters are hard to obtain and expensive. A low resistance transmitter is especially needed for audion telephone sets when the transmitter is in the ground circuit.



Of a number of makes tried the Western Electric proved to have the lease resistance. Because the transmitters had to be mounted at an angle, and because they were fitted at the rear with lugs for the conventional type of support, it was necessary to think out a special type of mounting.

A solution of the problem was accomplished in this way: A bracket was cut from 1/16 in. brass sheet, with a straight center part and angle arms at the ends. The transmitters, with the mounting lugs horizontal, were fastened to the angle arms, while the straight center section was secured to the top of a wooden stand.

Tests show that the modulation was improved by a sound box around the mouthpieces. Accordingly, a piece of light leather was wrapped around them and sewed together at the bottom and between the mouthpieces at the rear.

The switch on the stand is to open or close the battery circuit.

Digitized by Google

The Manufacture of Artificial Silk from Cotton Waste and Wood Cellulose

By Werner A. Schildknecht, A. S. E. E.

THE transformation of cotton and wood cellulose into lustrous silk is one of the triumphs of modern chemical science. On account of the high cost of natural silk, many attempts have been made in the desire to find a substitute for silk. The endeavors of the pioneer experimenters have paved the way to later research, and within a brief space of time a new industry has sprung up which is taking its place in the ranks of modern chemical enterprises. A new material has been added to the textile industry—artificial silk. A brief description is given in the following paragraphs of the history, manufacture, properties and uses of artificial silk.

In order to understand the difference between artificial silk and the natural product we will first see how the silkworm produces the thread. On each side of the silkworm's body there is a bag containing a sticky liquid. When the worm decides to go into his long sleep, from which he will come out as a moth, he begins to force this sticky liquid from two tiny holes under his lip. On coming in contact with the air, the little threads harden into a strong fiber-silk. The worm spins almost continuously until he has enveloped himself with a cocoon. There are usually four hundred yards of this costly fiber on an average sized cocoon. These are collected, boiled, the fiber is reeled off, washed, bleached and dyed. The artificial method is almost like the one used by nature, intricate apparatus taking the place of the silkworm.

The first mention on record of an attempt to make artificial silk dates back to the year 1734. In that year a French scientist, Reaumur, experimented with certain lacks and varnishes, which he forced through small holes in a steel die. The resulting fibers were silklike in appearance, but no commercial use was made of his invention. The subject lay dormant until Andemars, a Swedish chemist, developed a process for making artificial silk in the year 1855. He dissolved wood cellulose, obtained from mulberry trees, in a mixture of alcohol and ether. The threads after having been forced through dies had a silky luster; practically the same process is used to-day, substituting cotton cellulose and a great variety of wood cellulose for that obtained from the mulberry tree. Twenty years later, J. W. Swan, an Englishman, discovered a method. He dissolved guncotton in alcohol and ether, passed the pulp through fine holes, and hardened the threads by passing them through water. This product was very inflammable, however, and Swan's experiments were a failure commercially. Soon after Andemars made his discovery, Count Hilaire de Chardonnet, a Frenchman, began to investigate. He used cheap cotton to make the pulp. After much experimenting a factory was started at Besàncon. He achieved success in making the product and some of the finest artificial silks are at the present time made by his process. Chardonnet lived to see his invention a commercial possibility. In the year 1899 several silk gowns were exhibited at the Paris exhibition made from silk manufactured at Chardonnet's factory. This silk was not only non-explosive but even less inflammable than the natural variety.

The Chardonnet process as practiced to-day is as follows: Bleached cotton waste is converted into nitro-cellulose by treatment with a mixture of sulphuric and nitric acids. This product is dissolved in a mixture of alcohol and ether. The resulting substances is called collodion. It is filtered and placed into a reservoir. From here the collodion is forced through capillary glass tubes, .08-.08 m.m. in diameter, under a pressure of 650 pounds per square inch. It issues in the form of minute threads. This operation is carried on in a warm chamber. The alcohol and ether evaporate, are recovered and thus used over and over. The threads as they issue are conveyed to a spool and ultimately a skein of lustrous silk is formed. In this condition, however, the substance is still more or less explosive and before any other operations are performed it must be denitrated. The threads are passed through a solution of ammonium hydrosulphide. This process renders the silk uninflammable. Then the material is washed and dried and is ready for dyeing. The threads are impregnated with coloring material and are then ready to be woven into cloth. They possess a high luster, great elasticity, and are capable of taking very delicate tints. The above process is used chiefly in France and many tons of the silk are manufactured there annually.

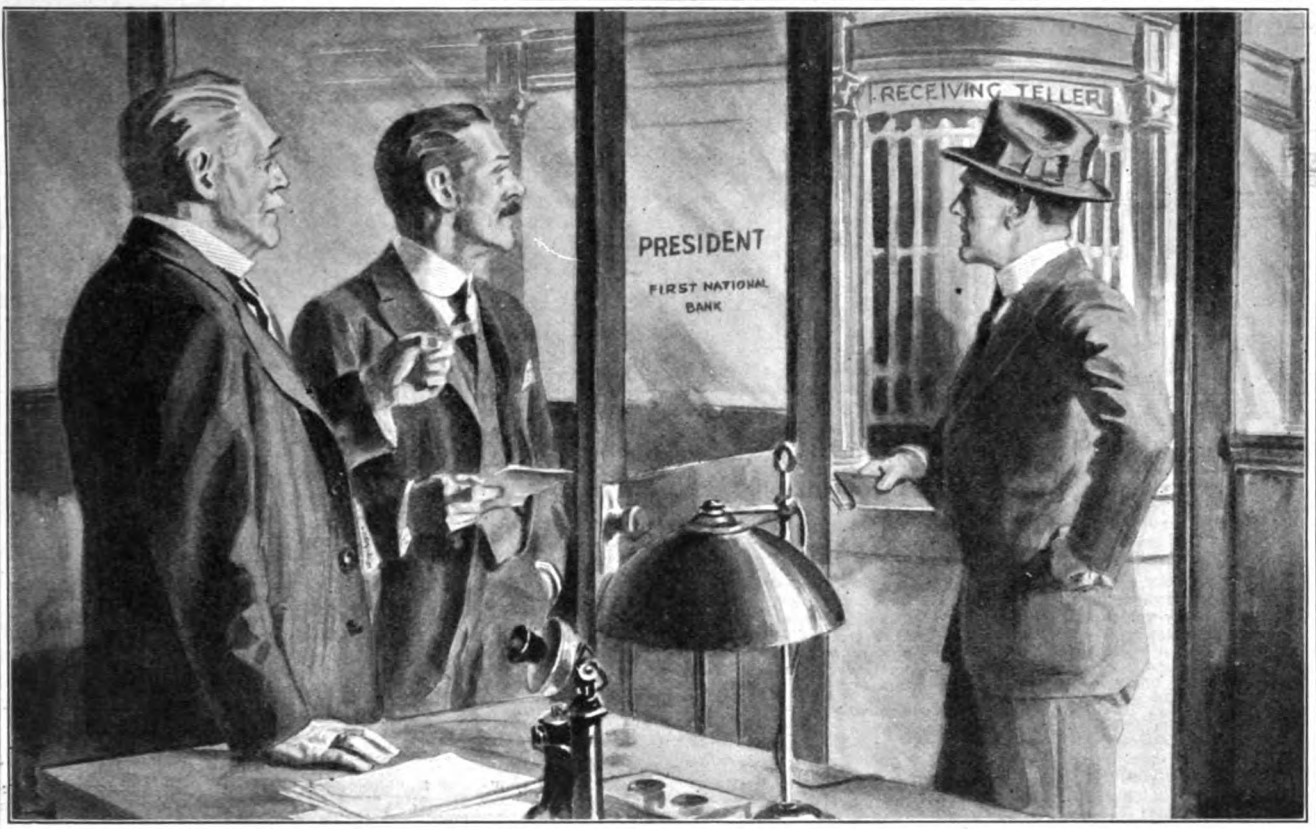
Another process in use is called the cuprammonium process. This consists in dissolving cotton cellulose in Schweitzer's reagent (ammoniacal cupric oxide). The pasty product is compressed in cylinders and the threads are forced out in thin streams. The fibers are hardened by being passed through acetic acid. They are then bleached with chloride of lime, washed and dyed. This silk was manufactured in large quantities before the war at Elberfeld, Germany. It is now being successfully produced in the United States. The annual production of silks made by this process is about 3,000,000 pounds.

The viscose process is one of the latest developments in the manufacture of artificial silk. In this process wood pulp is treated with a strong caustic soda solution. The cellulose thus obtained is treated with carbon disulphide. The resulting mass is called viscose. It is dissolved in water, filtered and exuded through capillary tubes. The threads are at once passed into a fixing solution of either ammonium chloride or ammonium sulphate. Here the filaments harden and are then subjected to heat when they are ready to be bleached and dyed. This variety of silk is one of the most popular of the artificial silks. In luster and tensile strength it compares very nearly with natural silk. Its quality is somewhat better than either the Chardonnet or cuprammonium silks, while the cost of manufacturing it is less. A large factory near Philadelphia, Pa., manufactures this type of silk. It is called wood silk, or pyroxylin silk.

A process which has lately come into use is to spread the pulp over a large flat surface, roll it out thin and engrave the thin sheet of silk with rollers. In this way the material can be given the appearance of having been woven. The resulting fabric is in great demand, as the cost is quite low, while the appearance and service are excellent.

Artificial silk to-day is taking the place of the natural product for making all kinds of ribbons, neckties, and for such trimmings where a high luster is desirable. Large quantities of it are used for covering electric wires. It is estimated that the quantity of artificial silks used in the United States is nearly 20% as great as the quantity of natural silk. Its cost is about one-half that of the natural product. It varies in price from $1.50 to $2.00 per pound. An average spruce or pine tree yields about $50.00 worth of wood pulp, which converted into viscose and spun into silk is worth approximately $5,500.00. Several factories are at the present time engaged in the manufacture of artificial silk and their product compares favorably with the best of European silks.

Digitized by Google



"He Deposits $500 a Month!"

"See that man at the Receiving Teller's window? That's Billy King, Manager for Browning Company. Every month he comes in and deposits $500. I've been watching Billy for a long time—take almost as much interest in him as I do in my own boy.

"Three years ago he started at Browning's at $15 a week. Married, had one child, couldn't save a cent. One day he came in here desperate—wanted to borrow a hundred dollars—wife was sick.

"I said, 'Billy, I'm going to give you something worth more than a loan—some good advice—and if you'll follow it I'll let you have the hundred, too. You don't want to work for $15 a week all your life, do you?' Of course he didn't. 'Well,' I said, 'there's a way to climb out of your job to something better. Take up a course with the International Correspondence Schools in the work you want to advance in, and put in some of your evenings getting special training. The Schools will do wonders for you—I know, we've got several I. C. S. boys right here in the bank.'

"That very night Billy wrote to Scranton and a few days later he had started studying at home. Why, in a few months he had doubled his salary! Next thing I knew he was put in charge of his department, and two months ago they made him Manager. And he's making real money. Owns his own home, has quite a little property beside, and he's a regular at that window every month. It just shows what a man can do in a little spare time."

Employers are begging for men with ambition, men who really want to get ahead in the world and are willing to prove it by training themselves in spare time to do some one thing well.

Prove that *you* are that kind of a man! The International Correspondence Schools are ready and anxious to help you prepare for something better if you'll simply give them the chance. More than two million men and women in the last 28 years have taken the I. C. S. route to more money. Over 100,000 others are getting ready in the same way right now.

Is there any reason why *you* should let others climb over you when you have the same chance they have? Surely the least you can do is to find out just what there is in this proposition for *you*. Here is all we ask: Without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6068-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Toolmaker
- ☐ Machine Shop Practice
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Ship Draftsman
- ☐ Navigator
- ☐ CHEMICAL ENGINEER
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Show Card Writer
- ☐ Outdoor Sign Painter
- ☐ RAILROADER
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ Traffic Management
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ STATIONARY ENGINEER
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE
- ☐ Poultry Raising
- ☐ AUTOMOBILES
- ☐ Spanish
- ☐ French
- ☐ Italian

Name _____

7-25-10

Occupation & Employer _____

Street and No. _____

City _____ State _____

Digitized by Google

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds The Supply

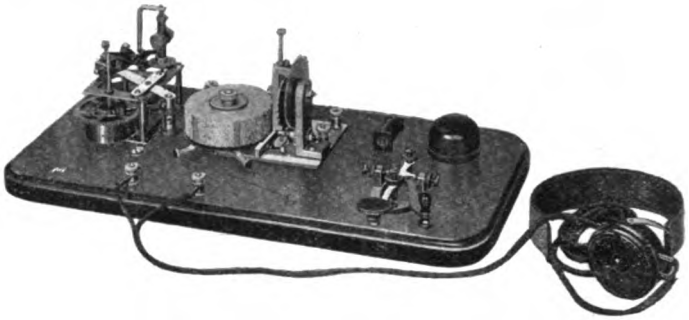
The N. Y. Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Radio Experts. Experts able to impart their practical and technical knowledge to *YOU* in an *easy* to *understand* way. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free*, will make it as easy to learn the Code as it was to learn to talk. *All you will have to do*, is to listen.

BIG SALARIES

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding position as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel The World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* This set is not loaned but *given* to all students completing the Course.

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph*, place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to become an Expert Wireless Operator"—it is free. Mail the coupon attached, or postal or letter—*but do it to-day.*

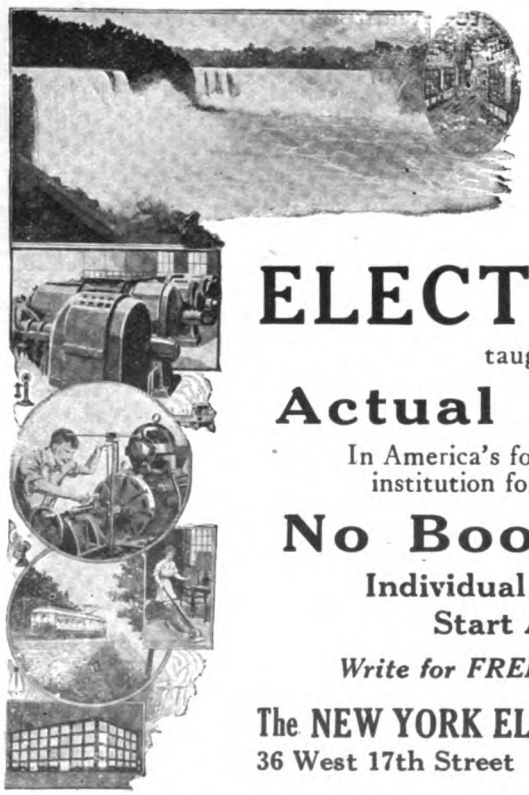
THE N. Y. WIRELESS INSTITUTE
Dept. 21, 258 Broadway, New York City

Send me free of charge, your booklet "How to become an Expert Wireless Operator," containing full particulars of your Course including your *Free Instrument offer.*

Name .....

Address .....

City or Town.....State.....



Learn By Doing

Every phase of all branches of

ELECTRICITY

taught by

Actual Practice

In America's foremost and oldest institution for trade training.

No Books Used

Individual Instruction.
Start Any Day

Write for FREE 64-page catalog

The NEW YORK ELECTRICAL SCHOOL
36 West 17th Street New York City

A CONCENTRATED
ELECTRICAL TRAINING

along all lines of Electrical enterprise assures you a position of importance upon your graduation from the School of Engineering of Milwaukee.

Extensive laboratories, work-shops, drafting rooms and class rooms under direction of large faculty of experienced specialists.

WINTER TERM NOW OPEN

Electrical Engineering, B.S Degree, 3 yrs., Institute of Electrotechnics (1½ to 3 yrs.). One year course in Practical Electricity, also Electrical and Mechanical Drafting, Automotive Electrotechnics (3 mo. to 2 yrs.), Storage Battery Course, Armature Winding, Wireless Telegraphy—Extension Courses.

Frat House, R. O. T. C., Athletics.

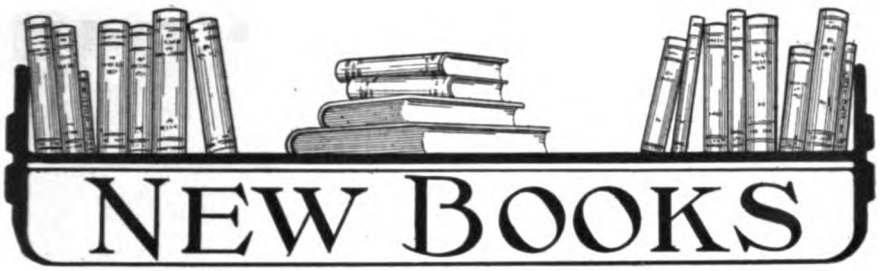
Write now for catalog and full particulars FREE. Mention age, education and course or interest.

School of Engineering
of Milwaukee
160-373 Broadway, Milwaukee, Wis.

HIGH FREQUENCY CABLE—(LITZ)
10-38-20-38-16-2-38-16-3-38 D. S. C. Enameled.
Grey Cardboard Tubes, Bakelite and Rubber panels. Radio call I F J.
Write for circular on Honey comb Coil Mounting. Wholesale and Retail.

A. T. HOVEY
61 Belvidere St., Near Mechanics Bldg.
Boston, 17, Mass. Open Evenings.

Digitized by Google



Behind the Motion Picture Screen, by Austin C. Lescarboura. Size 6¼ x 9 inches; bound in cloth; 420 pages printed on plate paper and illustrated with over 300 half tones. Published by the Scientific American Publishing Company, 233 Broadway, New York City.

Before passing on to the contents of this book, it might be well to inform the reader that its author, Mr. Lescarboura, has been a careful student of the subject it treats for a number of years and he does not write from the standpoint of the man who struggles to fill space with a subject he knows little or nothing about.

"Behind the Motion Picture Screen" is a book that explains every phase of the motion picture industry. Although non-technical in its tone, it thoroughly covers, in carefully selected terminology, all of the interesting work in connection with motion picture production. Not even the smallest detail that would have any interest to the layman seems to have escaped the searching mind of the author. Everything is presented in a delightful way; it is enjoyable reading matter from the first page to the last. The author's smooth, easy style adds tremendously to the information his words impart to the reader.

The book is divided up into the following chapters: I. Working Plans of the Motion Picture, II. The Artist Who Paints the Film Subjects, III. The Real Role of the Picture Actor, IV. The Motion-picture Camera, V. The Cameraman and His Art, VI. In the Land of Make Believe, VII. The Birth-place of the Motion Picture, VIII. The Generals of Shadowland, IX. Tricks of the Screen, X. From the Camera to the Screen, XI. Reporters of the Screen, XII. Putting It on the Screen, XIII. Pictures in Natural Colors, XIV. Filming the World Invisible, XV. Pictures That Talk and Sing, XVI. Cartoons That Move and Sculpture That Lives, XVII. Motion Pictures in Strange Fields, XVIII. Motion Pictures in the Home and Business, XIX. The Present Status of the Motion-picture Art, XX. The Future of the Motion Picture.

The technician will be particularly interested in the latter part of the book which tells of some of the real scientific achievements made possible through the motion picture. For instance, Prof. Bull's experiments with high-speed motion photography at the Marsey Institute in Paris are completely described. Motion picture photography through the microscope is also a very absorbing subject which the author did not forget. Motion picture photography by the aid of X-rays is another phase of the subject which is treated. Natural color photography, cartoon production — all are included in this noteworthy treatment.

Abrasives and Abrasive Wheels, Their Nature, Manufacture and Use. By Fred B. Jacobs. 321 pages, with 175 line cuts and half-tone illustrations. Size 5½ x 8½ ins., bound in cloth. Published by the Norman W. Henley Publishing Co., 2 West 45th Street, New York City.

During the past few years the modern abrasive wheel has assumed a very important part in the industry of the world. Its application has grown to a point where it is absolutely indispensable.

This book completely covers the application of abrasive wheels and abrasive substances to industrial purposes. The treatment is general in every respect and, unlike its forerunners, the book does not specialize on any one abrasive process, but rather contains a complete treatment of them all. The first chapter is devoted to natural abrasive substances and includes a description of sandstone, emery, corundum, diamond, garnet, quartz, flint, tripoli and pumice. The second chapter treats modern artificial abrasives and their physical and chemical properties. Carborundum, Aloxite, Crystolon, Alundum, Bauxite, Boro-carbone, Oxalumina and Adamite are included in the chapter. Not only is the use and nature of such substances given, but also the method of their manufacture. The third chapter is devoted to the manufacture of grinding wheeels and the data set forth will give the reader a very broad education in the general nature of ordinary grinding wheels. Chapter five describes grits and grades and knowledge along this line is absolutely essential to one who is connected with grinding work. To understand the grit and grade of a wheel is to understand its physical nature and what may be expected of it as regards cutting efficiency, etc. The chapter on testing wheels for efficiency gives some very valuable data that will be of extreme value to factory superintendents and managers, as well as purchasing agents. Laboratory tests are described and a chapter is also included on grinding wheels vs. grindstones, but of particular interest is the chapter on the economic advantage of using large wheels. This contains some actual figures that will be of great interest to large users of abrasive wheels. The argument set forth in regard to the advantage of large wheels includes some facts that would ordinarily escape the attention of purchasing agents. Chapter ten is devoted to truing devices for grinding wheels, while chapter eleven describes the process of rebushing grinding wheels. The design of dust collecting systems is treated in detail and many valuable suggestions given, together with photographs of actual collectors. Safeguarding grinding wheels forms an important chapter of the book and safety engineers would do well to examine its contents. It tells

(*Continued on page* 349)

Stop Snuffling



STRONGFORT
the Perfect Man

Sneezing, hawking, spitting and coughing. Why do you have catarrh anyway? You were not born with catarrh — you contracted it. This offensive, unwholesome, disagreeable complaint fastened itself upon you and grew. Nature in trying to prevent more serious consequences due to the congestion in your body, finds an outlet for the accumulated waste, by way of catarrh. You cannot get rid of it the way you are going — sprays, lotions, snuffing powders, drugs and medicines won't stop it. You know catarrh leads to other troubles—serious ones—throat, lungs, stomach, intestines—all become affected. You can never enjoy good health if you have catarrh; you won't be efficient in anything as long as you have catarrh, and it detracts from your personality to be hawking and snuffing around others.

Build Yourself Up

Be Clean — Wholesome — Healthy — Virile. Go at it the right way—Nature's way. No drugs, no medicines. Let me show you how by my method of health building, body developing, called

STRONGFORTISM

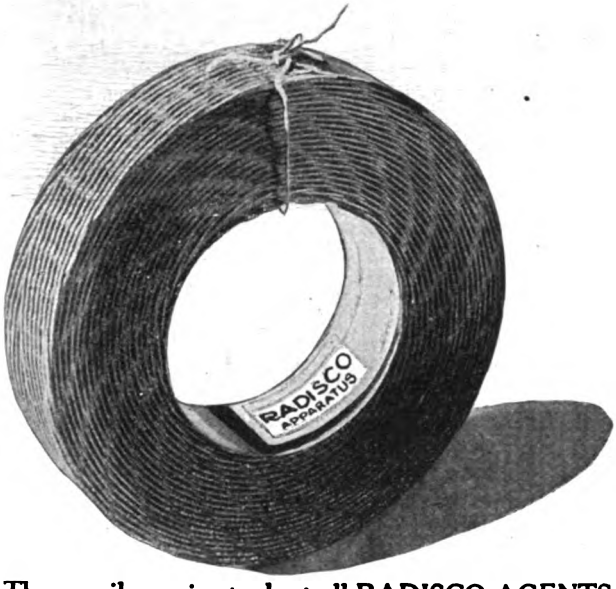
Its practice never fails — it builds new tissue, gives brawn and muscle, it invigorates heart action, strengthens kidneys, and makes the bowels move by their own natural strength, it makes every organ in your body pulsate to health. Under this kind of influence nearly all sorts and kinds of ailments, weaknesses and disorders disappear, for my method helps all your organs function naturally and properly.

If you are too stout or too thin, flat chested, or round shouldered—Strongfortism will alter it. It will make you grow in vigor and virility—and nervous energy—it will restore your vitality and keep your forces vital. No matter what your condition is now, or what habits you contracted or indulged in—I will show that you can renew yourself. You want to be strong, healthy—a virile man—you want to be all that a man ought to be, and I can and will show you how to make yourself the man that is desirable from every standpoint.

Tell me your ailment and send three 2c stamps to cover mailing expenses and I will send you my book **"Promotion and Conservation of Health, Strength and Mental Energy"** written for your interest and welfare.

LIONEL STRONGFORT
Physical and Health Specialist
1224 Strongfort Institute Newark, N. J.

Digitized by Google



CONTRARY to RUMORS

Spread by a Competitor

The Radio Distributing Co. is still manufacturing their unmounted universal wound inductances and will continue to supply their agents these very efficient coils.

That the RADISCO COILS are superior to any similar type of inductances is the opinion of several well known radio men who have received signals from very remote stations.

The RADIO DISTRIBUTING COMPANY will assure all purchasers that they will experience no inconvenience by reason of any action now pending or to be started by reason of patent on coils purchased.

These coils are in stock at all RADISCO AGENTS, who carry only apparatus of proven merit. Look for the RADISCO trade-mark on all coils you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the Universal wound inductances and are our agents for all standard radio apparatus of merit, including our NOW famous Better "B" Battery.

Communicate your wants to them

ALBANY, N. Y.:
E. L. Long,
21 Magnolia Terrace.

ATLANTIC CITY, N. J.:
Independent Radio Supply Co.
118 So. New Jersey Ave.

BEINVILLE, QUEBEC, CANADA:
Canadian Radio Mfg. Co.

BOSTON, MASS.:
Atlantic Radio Co.,
34 Batterymarch St.

BROOKLYN, N. Y.:
Kelly & Phillips Electric Co.,
312 Flatbush Ave.

BRONX, NEW YORK CITY:
Amateur Wireless Equipment Co.
1390 Prospect Ave.

CHICAGO, ILL.:
Chicago Radio Laboratories,
1316 Carmen Ave.

HAMPTON, N. H.
De Lancey Felch & Co.

LOS ANGELES, CALIF.
The Wireless Shop
511 W. Washington St.

McKEESPORT, PA.:
K. & L. Electric Co.,
427 Olive St.

NEW CASTLE, PA.:
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave.

NEWARK, N. J.:
A. H. Corwin & Co.,
4 West Park St.

NEW ORLEANS, LA.:
L. A. Rose,
4323 Magnolia St.

PITTSBURG, PA.:
Radio Electric Co.,
4614 Henry St.

PHILADELPHIA, PA.:
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Sts.

PROVIDENCE, R. I.:
Rhode Island Electric Equipment Co.
45 Washington St.

SCRANTON, PA.:
Shotton Radio Mfg. Co.,
P. O. Box 3,
also at 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.
585 Armory St.,

TORONTO, ONTARIO, CANADA:
The Vimy Supply Co.
585 College St.,

WASHINGTON, D. C.:
National Radio Supply Co.
1405 U St., N. W.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY — Newark, New Jersey

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45th STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for.....years at $1.50 per year (Canada, $1.75; Foreign, $2.00). Please let this start with the..... (Date of issue) issue. I enclose $....., and according to your special offer send me copy of book checked off.

Name .....

Street .....

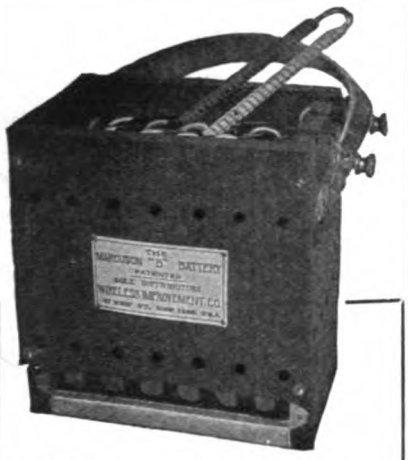
City .....

State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS Check off title desired here		
1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google



The Plate Battery Problem Solved!

The Marcuson "B" Battery

eliminates the use of the inefficient Dry Battery and the old-fashioned expensive Storage Battery

The Marcuson "B" Battery possesses four points of perfection,—it is light, compact, dependable, and inexpensive. The Marcuson "B" Battery can be readily charged from any D. C. lighting circuit.

40 Volts. Over all Dimensions: 6" x 6" x 4". Weight 5 lbs. Price: $12.00. The Marcuson Batteries have been in use for more than ten years by the largest Electrical Manufacturers, Cable Repair Ships, Technical Institutions, etc.

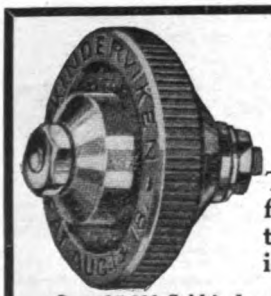
Can be replaced at lower cost than new Dry Batteries can be bought for

We are sole distributors of the Marcuson "B" Batteries.

It is but one of our many Radio products.

Simply drop us a card, and let us send you our Catalogue No. B-5, on plate and filament batteries.

WIRELESS IMPROVEMENT CO.
Radio Engineers
Manufacturers and Distributors
47 West Street New York, U.S.A.



Skinderviken Transmitter Button

The most efficient little transmitter in the world

Over 15,000 Sold in Less Than a Year

Use it on your Phonograph, Wireless, long distance telephone, etc. Hundreds of interesting experiments.

Make your own detectiphone

Send $1.00 for super-sensitive Button. Three booklets free containing circuit diagrams. Order now from

J. SKINDERVIKEN
335 Broadway, New York City
or 154 W. Randolph St., Chicago, Ill.



TRIODE
(Trade Mark)

TWO STEP AMPLIFIER
TYPE B

This amplifier is a compact unit of the resonance low frequency type, and provides a maximum of amplification.

Its compactness, simplicity and efficiency render it an attractive investment to the progressive radio experimenter.

IMMEDIATE DELIVERY
Particulars and price on application.

EATON OSCILLATOR
TYPE C
FOR EXPERIMENTERS

Designed to transform receiving circuits to receive arc and other undamped signals.

It will oscillate over a wave length range of 250-25,000 meters.

Requires no adjustments of any kind. Only one variable, the tuning condenser, is required.

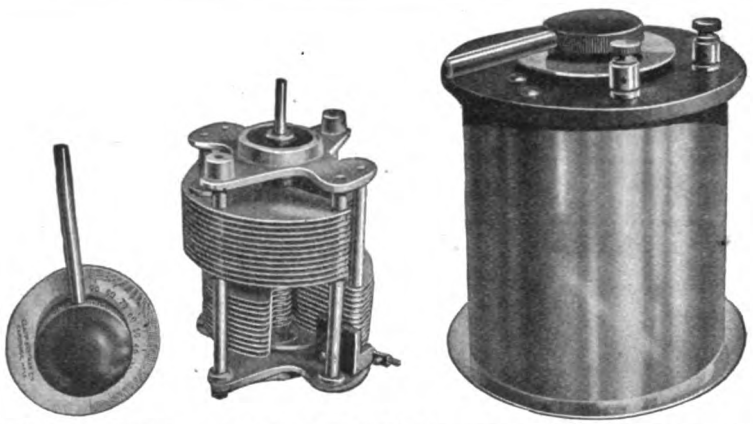
The simplest and cheapest way of receiving undamped signals.

TRIODE
(Trade Mark)



PRICE $14.90. Immediate Delivery.

WIRELESS SPECIALTY APPARATUS COMPANY
Engineers, Designers, Manufacturers **BOSTON, MASS., U. S. A.**



Type 800 BALANCED CONDENSER

Mounted or unmounted. Made in three capacities. Carried by most good dealers, price $7.50 and up. Bulletins Y and Z, sent for 4c stamps, show our complete line of high grade moderately priced apparatus for the modern Radio Laboratory.

CLAPP EASTHAM CO.
131 Main Street -:- Cambridge, Mass.

DO YOU LIKE TO SEE WHAT YOU BUY?

Don't buy blindly. Come to the busiest wireless store in New York City and see what you are getting. It is worth while to wait a day if it isn't convenient to stop in just when you want something. You can see the best apparatus from all the manufacturers, de Forest, Grebe, Arnold, Clapp-Eastham, and others. Complete instruments, parts—everything for the radio experimenter. Be sure to see our transmitting equipment before you buy any new apparatus. If you live away from New York, send 10c, for our new catalog. Our service to distant customers makes mail order buying quick and easy.

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.
235a Fulton Street New York City

Digitized by Google



DUCK'S No. 13 264 Pages
Electrical and Wireless Catalog
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

"MERACO"

A New Line of RADIO EQUIPMENT for EXPERIMENTORS
If You Are Interested in the Latest RADIO APPARATUS
You Will Want to See
The "MERACO" Line Before You Buy Anything Else
"MERACO" Perfect "B" Batteries
POSTPAID, $1.20
Look for our announcement next month.
MERCURY-RADIO APPLIANCE CO.
672-A Broadway, Brooklyn, N. Y.

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS
Official Organ American Radio Relay League

Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work all A. R. R. L. News, Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER
Regular price $1.50 per year, 15 cents per copy. Introductory rate: 9 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

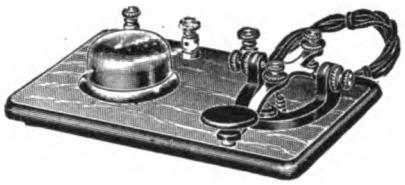
Enclosed find $1; please enter my trial subscription to QST for 9 months.

Name_____

Address_____

Wireless Receiving Ban Raised

MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. — Price
542 Telegraph Practice Set, with Battery and Cord $3.24

Weighs 4 lbs. packed.
Price does not include postage.

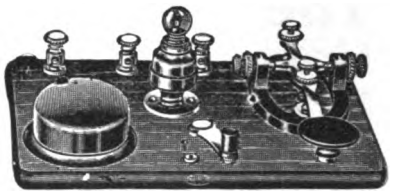
MESCO COMBINATION PRACTICE SET

For Learning the Morse and Continental Visual and Audible Codes

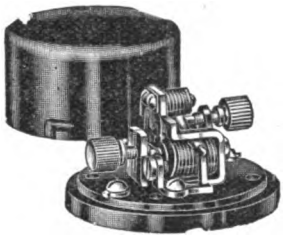
This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord $4.05

Weighs 4 lbs. packed.
Price does not include postage.



MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensite base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a bayonet joint.

List No. — Price
55 Mesco Radio Buzzer $2.05

We carry a large and complete line of Standard Wireless Material recognized by experts as such with competent experienced wireless attendants in charge

Send for the New Edition of Our Catalog K28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarms Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Manhattan Electrical Supply Co., Inc.

NEW YORK: 17 Park Place — BRANCHES: 110 W. 42nd St., 127 W. 125th St.
CHICAGO: 114 S. Wells St. — ST. LOUIS: 1106 Pine St. — San Francisco Office: 604 Mission St.

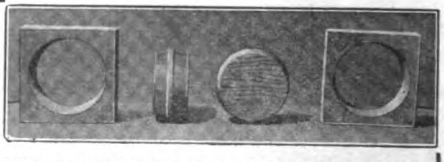
WILCOX PANEL SWITCHES

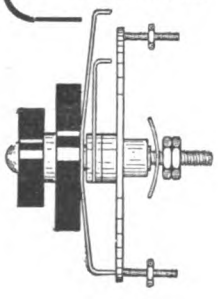
TYPE 101

A beautiful and efficient standardized switch for general use. Furnished in two sizes.
1" Radius, Brass finish....40c Nickel finish....50c
1½" Radius, Brass finish....50c Nickel finish....60c

TYPE 102 (Illustrated)

A compound switch especially suitable for the primary of loose couplers. 1½" outside radius.
Brass finish.....$1.10 Nickel finish.....$1.25







VARIOMETER PARTS

Turned from hardwood. Set as shown consisting of stator (two parts), rotor and form for winding coils.....Postpaid $2.50

Size of stator 5½" sq.
Other sizes made to order

SET NO. TWO contains all parts for the variometer including the above and knob, scale, pointer, shaft, binding posts, wire and instructions for assembly.....Postpaid $5.00

BUILD YOUR OWN APPARATUS

Our standardized parts and materials make it easy to build efficient apparatus that is beautiful and uniform in appearance.

NEW LOOSE LEAF CATALOG READY
Sent for five cents in stamps.

The Wilcox Laboratories
Lansing — Dept. D — Michigan

Digitized by Google



LIBERTY
VACUUM VALVES

Licensed under patents Nos. 841,337 and 879,532. To be used only for amplification in Radio communication, and only for experimental and amateur purposes, and only in Audio frequency circuits. Every Liberty Valve is highly sensitive and carefully tested; any tube that does not prove so we will gladly replace.

Tests have proved the Liberty valves several times more efficient than its competitor.

Liberty Valves are not the only ones you can buy, but they are the best.

Price now—$6.50. Weight 1 lb. Insured Parcel Post Extra

Sold Only by

The Radio Apparatus Co.
Pottstown, Pa.

Are You Satisfied—



with a double-slide tuner, crystal detector. and 80-ohm phones?

If you are, don't waste your time reading this—but if you want to get the maximum range from your set, we have the instruments that will give you this range at all times. Our instruments are real professional quality.

The two step amplifier illustrated, will give the maximum amplification and has "B" Batteries included. It uses standard V. T. Tubes. Further information on request.

Price without tubes—$50.00.

THE PRECISION EQUIPMENT CO., *Manufacturing Engineers*
2437 Gilbert Avenue, Dept. B -:- Cincinnati

MORE THAN A STORE

At F. D. Pitts Company you will find an exposition of radio and experimenters' supplies from the foremost manufacturers of the country. No other store has such a complete line of equipment, nowhere else is such an opportunity to choose from the products of Clapp-Eastham, Grebe, De Forest, General Radio, etc. A feature which will appeal to experimenters is that we keep things in stock! What other stores do not keep, you can get at Pitts'.

SEND 4 CENTS FOR OUR CATALOG. IT HAS JUST COME FROM THE PRESS.

COME IN AND SEE FOR YOURSELF

F. D. PITTS, Dept. F. 12 Park Sq., Boston, Mass.

Readers Workshop Page

(*Continued from page* 293)

mers, saws and many other things.

"I made a lathe on which I use the chuck from the bench drill. I find it very useful in winding coils, transformers and light lathe work.

"I value my shop at about one thousand dollars, and am spending all I make from it for tools and new equipment.

"I am eighteen years old, and for the last four years have been collecting and making apparatus which I now have.

"I obtained most of my material from scrap heaps and the junk yards. This is the second shop I have built and I believe it is nearly complete. A good work-shop at home is the best thing in the world for an industrious young fellow. You will always find a proud boy, with plenty of friends to help him, when he can say 'I made it.'

"His shop can lead him to be an inventor, electrical engineer or contractor, besides merely a 'shop tinker'."

A description of the laboratory shown in the middle of the page follows:

"The electrical power plant of my laboratory is a six-volt, eighty-ampere hour storage battery, located in the lower left-hand cabinet. My main experiments are in electro-chemistry, dye stuffs and explosives.

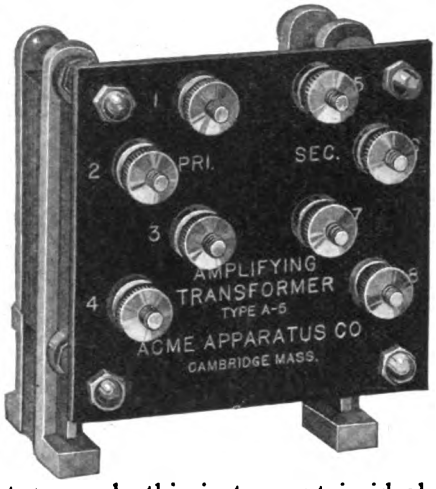
"My equipment is all home made, excepting the glassware. The small gas furnace I made out of 16-gauge iron and lined it with asbestos, three-eighths thick. The cabinets I also made in my small wood-working shop. I could not get a picture of my shop, owing to the nature of the building it is in, but here is a list of what it contains: One speed lathe, jig-saw, rip and cut saw, disc turning machine, emery wheel, and small drill press. My motive power is a 1½ horsepower gas engine."

Writing on Metals

Cover the plate you wish to mark with melted beeswax which can be done by heating the plate slightly and rubbing the surface with wax. When cold write whatever you wish to inscribe plainly with a stylus, taking care to go clean through the wax right down to the metal. Make an etching fluid to the proportions of which put one ounce muriatic acid and 16 ounces of nitric acid by weight. Mix and shake well together; apply the mixed acids with a feather, carefully filling each letter. Let the acid remain in contact with the metal for a period of 1 to 10 hours, according to the depth of the etching desired, then stop the process by washing the plate with water and removing the wax. The design will be found clearly etched on the metal surface.

Digitized by Google

The New Audio Frequency Amplifying Transformer



To meet the demand for an amplifying transformer for tubes of higher impedence than the usual Marconi V. T. and for the experimenter who wishes to try various ratios of transformation, we offer the Type A-5 Laboratory Instrument. Both primary and secondary have three variations of the number of turns. The impedence between taps 1 and 2 on primary and 5 and 6 on the secondary is the same as our well known Type A-2 transformer. The maximum number of turns is between taps 1 to 4 on primary and 5 to 8 on secondary. For laboratory work, this instrument is ideal.

Type A2 Amplifying Transformer completely mounted $7.00
Type A2 Amplifying Transformer without binding posts and panels 5.00
Type A2 Amplifying Transformer without binding posts, panel or castings 4.50
Type A5 completely mounted 11.00
Type A5 without binding posts or panel 7.50
Type A5 without binding posts, panels, or supports..... 7.00

Modulation Tranformers for radio telephony work supplied at same prices as either type of amplifying transformers.

ACME APPARATUS CO., 22 Windsor St., Cambridge, Mass.

Iron Paint

A paint intended for covering damp walls, kettles, or any vessel exposed to the action of the open air and weather is made of pulverized iron and linseed oil varnish. If the article is exposed to frequent changes of temperature, amber varnish and linseed oil varnish should be mixed with the paint intended for the first two coats without the addition of any artificial drying medium. The first coat should be applied rather thin, the second a little thicker and the last in a rather fluid state. The paint is equally adapted as a weatherproofing for stone, iron or wood.

Lacquer for Bright Steel

A cold lacquer that requires no stoving for steel is made as follows: Mastic resin, 8 ounces; camphor, 4 ounces; spirits of wine, 1 quart; sandarach resin, 12 ounces; gum elemi, 4 ounces. Digest, filter and use the lacquer cold. The consistency of the lacquer may be varied by adding more or less alcohol.

Slipping Belts

A piece of beeswax held against a loose, slipping belt will cause it to grip the pulley like a tight belt. The wax is applied while the belt is in motion.

The efficiency and sensitiveness of Vacuum Tubes is retained or increased by repairing or replacing broken or burned out elements.

The establishment of a complete and modern high Vacuum Laboratory enables us to repair all types of tubes manufactured in the United States or abroad.

THE COST OF REPAIRING

MARCONI V. T.
WESTERN ELECTRIC
GENERAL ELECTRIC
DEFOREST
MOORHEAD
} RECEIVING TUBES $4.50

AUDIOTRONS
ELECTRON RELAYS
} $4.00

SMALL TRANSMITTING AND FOREIGN TUBES $7.50
POWER TUBES - - - - - 15.00

Burned out tubes purchased outright at .50 each.

A limited number of repaired tubes on hand, guaranteed money refunded if not satisfactory.

Same as new at $5.00 and $4.50 respectively. **AGENCIES DESIRED**

The Vacuum Tube Repair Co.

511 Perry Building **Oakland, California**

Digitized by Google



RADIO MEN

Make your apparatus up to date. **Indicating dials** now available at a reasonable price.

These dials are of fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. The edge is bevelled. The hole in the center will pass 8-32 screw and there are three holes around the center hole to fasten on knob. (These holes are not shown in cut.) We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted...$1.30 Postpaid

BULLETIN No. 1 describing these parts will be mailed free to all who send in their name and address and they will be put on our mailing list for all future bulletins describing our high-grade Radio Apparatus.

For sale at all Radisco Agencies and by

A. H. Corwin & Co.

4 West Park Street Newark, N. J.

"Ask Anyone Who Has Used It"

"My Brandes Headset Never Gives me a Headache." (Name on Request.)

The fitting and lightness are very important. The Brandes Headset excels in these respects. Special attention has been given to this feature.

BRANDES WIRELESS HEADSET



"Superior", 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. 32 Union Square, Room 822 New York

WIRELESS RECEIVER SPECIALISTS

Licensed by DeForest

AUDIOTRON

The Original Tubular Vacuum Amplifier

The AudioTron vacuum tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos. 841387 and 879532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.

Price $6.00 Each

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

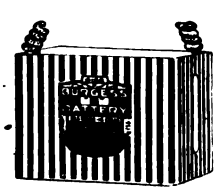
Laminated closed core, two coil type

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO., Lick Bldg., San Francisco, Calif.

BURGESS "B" BATTERIES

Three Sizes -



15 Cells 22½ Volts

BURGESS "B" BATTERIES proved so successful in Government apparatus that they are being used by the progressive amateurs.

They are now available for general use. For further information write to

BURGESS BATTERY COMPANY

Harris Trust Bldg. Chicago

RADIO APPARATUS on the INSTALLMENT PLAN

Full particulars and the RVA BULLETIN each mo sent on receipt of ten cents—stamps or coin.

J. DONALD VANDERCOO

LOMBARD Box 442 ILLINO

Digitized by Google

Useful Books

Complete Practical Machinist
by Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations
Price $3.00

Metal Worker's Handy-Book of Recipes and Processes
By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon. It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations
Price $3.00

Techno-Chemical Receipt Book
Edited with Additions by Wm. T. Brannt and Wm. H. Wahl

This well-known Receipt Book is a mine of accurate information that everyone may work to great advantage. It is encyclopedic in range, yet gives only the best formulas for each preparation or operation, and thorough tests by competent men guarantee their intrinsic merit.

A compact and reliable collection of approved receipts and processes, containing thousands of receipts covering the latest, most important and most useful discoveries in chemical technology and their application in the useful arts and industries. It is indispensable to every practical man and contains 500 pages, closely printed, giving an immense amount of matter on a great variety of subjects. Every care has been taken to select the very best receipts of each kind and there are few persons, no matter in what business or trade they may be engaged, who will not find in this volume something of use and benefit to them. The library of the laboratory, factory or home is not complete without a copy of this handy and useful book of reference.

516 Pages. 78 Illustrations
Price $2.50

Friction, Lubrication, Fats and Oils
By Emil F. Dieterichs

When we realize that it is no figure of speech, but a bald statement of fact, to say that lubrication alone keeps the wheels of industry turning, then we must look respectively upon this as a question of vital importance in this mechanical age. The author, himself a chemist and an inventor and manufacturer of lubricants, wrote this manual for the mechanic and manufacturer of ordinary education, that the busiest man might learn the main facts of friction, the origin and charteristics of fats and oils, their uses, their adulterations, their practical testing and the best ways to make them serve his own particular ends.

Price $1.50

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.
Publishers of Mechanical and Industrial Books
10-116 Nassau St., New York, N. Y.

Supercharging Aviation Engines.

(*Continued from page* 301)

very little weight and head-resistance will be added.

The uses of the supercharger for military service can be divided into, first, for airplanes in which it is desired to reach extreme altitude; second, for airplanes in which it is desired to increase the rate of climb and horizontal speed, and therefore maneuverability at altitudes where it is intended to fight; and, third, for airplanes which carry large loads, such as bombers, which normally are handicapped by having a very low ceiling and whose entire usefulness would, if larger engines were installed to pull them to a higher ceiling, be lost on account of the larger amount of fuel and other material that would have to be carried, thus decreasing their radii of action.

The application of superchargers in commercial airplanes of the future seems assured because superchargers will make possible for more miles per hour and more miles per gallon with a given engine and airplane, and speed is the main advantage of air over other kinds of transportation. It is thought by many qualified judges that by flying at a sufficient height with a supercharged engine and a suitably designed airplane, a speed of 200 m. h. p. can be maintained.

In the heavy load-carrying type of plane which must necessarily cross mountains or perhaps fly above storms and clouds, the necessary height can be reached with smaller, cheaper and more economical engines if they are fitted with superchargers. It is obvious that in really long cross-country flights or trans-continental flights with mail or passengers, the logical course is to fly at 25,000 or 30,000 ft. altitude where the resistance to speed is low and great speed can therefore be attained provided the engine can deliver high power economically, which it can do if equipped with a supercharger.

As a graphic illustration of the advantage of a supercharged engine, it is pointed out that at 25,000 ft. altitude a supercharged 250-hp. engine will deliver as much power as a 1000-hp. engine without a supercharger; and, of course, the former will weigh many hundred pounds less, its fuel and tankage will weigh very much less, the first cost will be much lower and the structure of the airplane can be made much lighter.

EDITORIAL NOTE:—Serious attention was given to this problem in Europe and early in 1915 the French authorities inaugurated a series of experiments to determine a method of maintaining constant atmospheric pressure in the carburetor regardless of altitude. In this country, however, nothing was done on this problem until our entrance into the war made it imperative. This neglect was inevitable because of the lack of interest in aviation matters on the part of the authorities and legislators in this country, so we are really trailing along behind the French, British and Italians in this important development work, just as we are in general aeronautical progress. Each of the nations mentioned have carried out experimental work on supercharging independently of the others. It is a striking indorsement of the turbo-supercharging scheme, as first worked out by Prof. Rateau in France, that at the present time this method is most in favor with all experimenters after other systems have been given exhaustive trials. This applies as well to European development work, which was begun two years before our own. Work in this country has practically all been with the Rateau system, modified mechanically in details but still preserving the same principles of operation as first advanced and tried by Rateau. Suffice it to say here that the Rateau system so far appears to have the most advantages.

Supplementary illustrations at Figs. 6A and B shows the gear drive system at A and a simplified exhaust turbine cycle is shown at B. The original Rateau turbine design is shown at Fig. 7 and it will be apparent that it is the basic type from which other superchargers of the later development have been adapted.

The exhaust-gas turbine offers considerable that is of advantage as it can be connected direct with the exhaust ports of the engine by special pipes replacing the standard manifolds so that all the products of combustion must pass through the exhaust turbine nozzles and give up its energy to the motor and the driven impeller of the into the atmosphere through the discharge passage. In the designs which have been tried thus far, the driving rotor and the driven impeller of the centrifugal compressor are mounted on the same shaft. The building of the turbine and compressor as a unit results in an exceedingly compact machine, which in most instances can be mounted directly on the front of the engine as has been done in the application to the Liberty engine shown at Fig. 3. The possibilities of the supercharged engine opens up a new field for aircraft development, as Major Hallett has so clearly brought out in his paper.—*Victor W. Pagé.*

Digitized by Google

Simple Experiments In Science For Beginners

(*Continued from page* 303)

substances. In the case of liquids, the degree of compressibility is very small compared with solids. For all ordinary pressures, water is absolutely incompressible. This can be shown by the simple device sketched in Fig. 4. A small bottle is clamped between two boards by means of two long bolts. A plunger passes through the top board and fits snugly into the mouth. When the plunger is forced down into the mouth of the bottle with the application of considerable force the bottle will burst.

Another very interesting experiment can be performed by the aid of two small pieces of cloth, one black and one white. It is claimed that white clothes are much cooler in the summer time than black clothes. There is a scientific reason for this assertion. It is known that heat waves can be reflected just as light waves can be reflected. White always reflects heat waves while black absorbs them. Therefore, it is really true that black clothes are warmer than white clothes because they absorb heat waves. This fact can be proven by a very simple experiment. On a cold day, when the sun is shining, the piece of black and white cloth previously mentioned are laid on top of the snow in the sunshine. After a few minutes the snow under the black piece of cloth will be melted while the snow under the white piece of cloth will remain frozen. This proves beyond all reasonable duobt that the black piece of cloth actually absorbed the heat waves and melted the snow underneath, while the white piece reflected the heat waves and protected the snow underneath.

A very interesting experiment can be carried out by melting glass in the flame of a torch and allowing it to drop into a bath of cold water. This will result in the formation of little drops of glass with a long tail. When the end of this tail is pinched with the fingers, the entire piece of glass will be shattered into tiny bits. This results, owing to the state of molecular stress which was caused by the sudden cooling of the molten glass. These drops are called Prince Ruperts Drops.

Origin of "Watch Your Step"

FROM an analysis of nearly ten thousand accidents recently reported by manufacturers, chiefly electrical, in the United States, the highest percentage of those that occurred outside the companies' premises were attributed to slipping, tripping and falling, hence the origin of "Watch Your Step." This means that the greatest danger lying in wait for a man in his hours of leisure is the pavement beneath his feet. The highest percentage of falls came from those occurring on the level, while others came in the following order of seriousness: From elevations, from ladders, over obstructions, on stairs, from poles, into excavations, from temporary supports and from scaffolds.

On the companies' premises, "handling material" comes first. Accidents from electric current—from shock, burns, eye-flash—rank fourth in a list of eighteen classes of accidents. Only .7 per cent of all the accidents reported were due to exhaustion from heat, which seems strange—one imagines that more suffer from heat prostration than is actually recorded.

From a general consideration, injuries to fingers were highest, eyes next, and ears last in a classification of thirty-five anatomical locations. From the standpoint of occupation, linemen ranked first and carpenters lowest.

Perhaps the most interesting classification is that which considered the length of service. Of all the accidents reported, 25.9 per cent, or the highest single percentage, had all been in the employ of the companies less than six months. Those veterans of over twenty years' service contributed only 1.1 per cent to the casualty list.

To determine the seriousness of the various causes of accidents, by consideration of the number only, resulting from each cause, is misleading. While only 8.3 per cent were injured by electric current, these accidents were responsible for over 70 per cent of the total lost time, and 70 per cent of the serious and fatal accidents. The fact is, however, and it is encouraging, that 75 per cent of this class of accidents are preventable when the proper safety devices, such as enclosed switches, rubber gloves, etc., are installed, while falling will continue as long as man fails to "Watch His Step."

Writing on Glass

The glass should be warmed to 120° and not more than 140° F., or until no more vapor is evident. The surface of the hot glass should be bathed with the following varnish, taking care to move the plate just as if applying collodion in photographic work. The varnish is made of 5 grams mastic in sheets, 8 grams dammar and 80 grams of 90% alcohol. The solution is made in a firmly corked bottle then water bathed and filtered. This varnish is very brilliant, hard and transparent. After the varnish is dry, drawings in India ink can be made on the surface, and this method can be followed for marking bottles, making lantern slides or for photographic purposes.

Drilling Job. — Sometimes tapped screw holes require that the lower part of the holes should be larger so that there will be no thread in that part of the hole. It may be impossible to approach that part of the holes from the bottom. Special boring bars are used when the hole is large. If the hole is small, drill the first part of the hole to the required depth that is to be the drill diameter, then take the same drill and grind off one of the cutting sides, throwing the point of the drill out of center. This will increase the diameter of the lower part of the hole in a ratio corresponding to the eccentricity.

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6071-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

Digitized by Google

Is Your Transmitter Really Tuned?



You may think that your transmitter is tuned, but you don't know unless your station is equipped with a reliable Antenna Ammeter.

These Roller-Smith Hot-Wire Ammeters were made for the U. S. Army Air Service for use on fighting planes.

Regularly $13—Our Special Price $7

With the Armistice came a cancellation of contracts and these Ammeters, which had successfully passed the exacting Government tests, were returned to the manufacturers. Each is in perfect condition, packed in its original carton and ready for immediate shipment.

The scale reading is: 0-2.5 Amperes. Shunt giving double or triple this range, 75c extra.

By buying the entire surplus we are able to sell these Ammeters at less than the Government paid for them in lots of one thousand. Better order one today as this may be your last chance. Remit by check or money order.

A. H. GREBE & CO., INC. 71 Van Wyck Blvd., Richmond Hill, N.Y.



INTERNATIONAL RADIO

VACUUM TUBE DETECTOR AND AMPLIFIER AND TWO-STAGE AUDIO FREQUENCY AMPLIFIER

This detector and amplifier unit is one of the series of interchangeable panel units for receiving, which the International Radio Telegraph Company is manufacturing as part of its new line of experimental and laboratory apparatus. The two-stage amplifier will multiply signal strength about 350 times. The units are all of the same size, having 6″ by 6⅜″ panels, and are all fitted to standard well finished cases, so that they may be combined and connected in any way desired. These instruments include detectors, condensers, inductances, amplifiers, etc., as described in our various Experimental Apparatus Bulletins.

The detector-amplifier is priced at $35.00, without tubes, and the two-stage amplifier at $42.50, without tubes. Terms—cash with order, F. O. B. New York City.

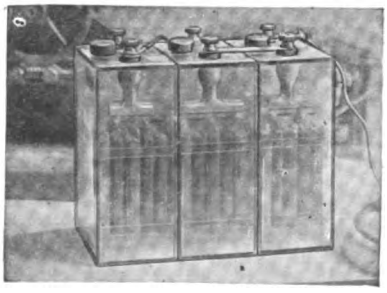
Write to Department 21 for new Experimental Apparatus Bulletins.

INTERNATIONAL RADIO TELEGRAPH COMPANY
326 BROADWAY NEW YORK CITY

POROX STORAGE CELLS FOR

MODELS, ELECTRICAL, AND RADIO APPARATUS

Porox Storage Batteries are made up of separate 2-volt cells in PY-RA-LIN jars, designed for high efficiency, low weight, and long life. They are lighter, more powerful, last longer, and cost less than dry cells. Can be charged at home. Porox Cells are designed for the requirements of the



MODEL MAKER AND EXPERIMENTER

2 volts, 10 amp.-hrs., 3 x 1¾ x 4¼ ins.
2 volts, 15 amp.-hrs., 3 x 2⅜ x 4½ ins.
2 volts, 16 amp.-hrs., 3 x 1¾ x 6 ins.
2 volts, 25 amp.-hrs., 3 x 2⅜ x 6 ins.

Any number of cells put together for any required voltage. Batteries are also furnished in oak cases for ignition and lighting.

ALBERT MULLER,
8758 Queens Boulevard,
JAMAICA, LONG ISLAND, N. Y.

Electric Oven Efficiency

THE *London Electrician* reports some recent tests of electric ovens. They were coated with non-conducting material, and the door fitted in a wedge-like seat or jamb, so as to save all possible waste of heat. It took 28 minutes to get a temperature of 350° F, which was rated as a cooking heat. Then 10½ lbs. of roasting beef were put in, and the oven in the next 12 minutes showed a temperature of 394°. All the switches were now shut off and the meat was left to cook by the heat present, fireless cooker fashion. It was sufficiently cooked without any more current being turned on. In the 35 minutes of heating and cooking 3 kilowatts was the rate of expenditure of electric energy; of course for the actual cooking, as the meat only was acted on by the current for 12 minutes, this reduces to 1¾ kilowatts. The expression "hay-box" is used in the English journal in referring to the insulated construction of the oven—this where we would say fireless cooker.

Electric heating in technology is applied among other uses to japanning, to Sherardizing iron, to core ovens and to the expanding of gun-sections for shrinking. In Sherardizing, iron is bedded in zinc dust and zinc oxide in powder, as usual. The heat is brought up to 700° F. When the metal object in its dust packing is thoroughly heated a lower heat is maintained for two or three hours, when the heating current is cut off. As soon as the temperature falls to 50° the oven is opened and the work is taken out. For gun-shrinking operations a temperature of 700° to 1000° is required.

Electric Hand-Lamp

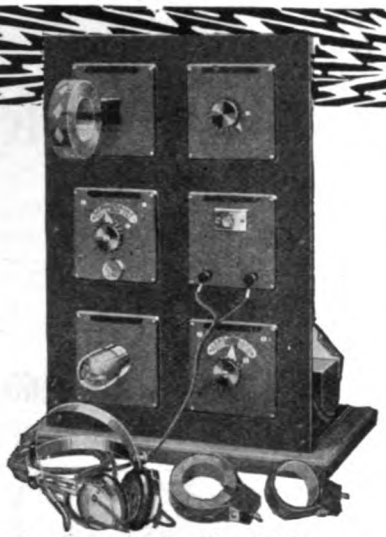
A FOREIGN electrical firm has produced a novel electric hand-lamp, which is claimed to be cheaper to operate than lamps fitted with dry cells or small storage battery. The source of current is a cell with lead superoxide and zinc plates immersed in sulphuric acid, which combination gives 2.45 to 2.5 volts. The body of the lamp is supported on a trunnion so that it can be tipped through 90°. In the position of rest the liquid lies in a protruding chamber, the plates being thus lifted out of the electrolyte. When the lamp is required the body is tilted so that the liquid flows back so as to immerse the plates. When the lead plate is discharged it is replaced by a charged one, which may be kept ready charged in store for a lengthy period. The charging of these plates is carried out very cheaply at depots. They will give 25 hours' burning with one charge and be charged 100 to 150 times. The charging of the lead plates cost about one cent per hour of burning. The lamp will burn about 25 hours on one charge and is very economical.

Digitized by Google

DE FOREST

The Easiest Way to Get a Radio Receiving Station

FOR the Radio beginner, or even for the experienced Amateur, here is the simplest, most satisfactory and least expensive way to secure reliable, efficient and scientific Receiving Apparatus. We have just completed two new Unit-System Receiving Sets, specially designed to give beginners and others complete outfits of the most advanced type, designed for greatest efficiency and offered as complete outfits containing everything required to set up and operate a Radio Receiving Station. Both Sets are part of the de Forest Unit-System and more advanced apparatus may be added at any time without discarding previously purchased units.

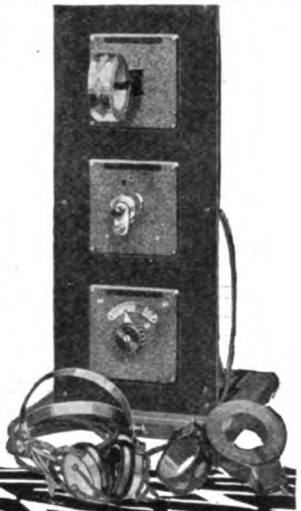


de Forest Audion-Unit Radio Receiving Station
(6-panel set illustrated above)

A larger and wider range Set with Audion Detector and large assortment of "Honey-Comb" Coils, giving wider receptive facilities. 6-panels in all, with all necessary apparatus and supplies, including "B" Battery. Arranged for expansion when the owner desires.

de Forest Simplified Radio Receiving Station
(3-panel set illustrated at right)

Also complete in every detail, including short, medium and long wave-length de Forest "Honey-Comb" Coils, Detector, Condenser, Head Telephones, Antennae Wire—everything needed to set up and operate an efficient Receiving Station. Complete instructions for assembling and operating included.



Send for our new booklet, "How to Set Up and Operate an Amateur Radio Receiving Station," which tells all about these new Sets. Sent Postpaid, for 10 cents in stamps.

DE FOREST RADIO TELEPHONE & TELEGRAPH CO.
Inventors and Manufacturers of Amateur and Commercial Radio Apparatus
1403 SEDGWICK AVENUE NEW YORK CITY

DE FOREST

Send for
HALCUN Radio Catalogue
Full Line of Amateur Requirements
Halcun Radio Co.
San Francisco, Calif.
Formerly Haller Cunningham Elec. Co.

FREE APPARATUS!!

You get a coupon valued at 50 cents for every subscription you receive for "Pacific Radio News." These coupons are as good as cash when presented at radio supply stores.

Your own subscription or extension of your present subscription will be credited with one coupon.

Send for a copy of "Pacific Radio News" today and learn about the FAIR PLAY contest.

15 cents per copy
$1.50 per year.

PACIFIC RADIO PUB. CO.
50 Main St., San Francisco, Cal.

LONG WAVE RECEPTION

These figures show the performance of RADISCO inductances at an amateur station located near Boston. In two hours' time the stations listed were received—using only one audion. The antenna was 40 feet in height and 50 feet in length.

Secondary Calibration, LRD-1200 Coil Coupling Fixed at 2½ Ins.
Primary Condenser, Murdock 0.001 MFD. Max. Secondary Condenser, Clapp-Eastham 0.001 MFD. Max.

Cond. Degrees	Wave-Length	Station
10	4,000	XDA
13	6,000	MFT
14.5	7,400	GB
17	8,400	NPG
20	9,000	UA, NWW
22.5	9,500	LCM
28	10,500	YN
31.5	11,000	IDO, UA, NPM
34.5	11,500	NDD
41	12,200	POZ
45.5	13,000	NPL
51	13,700	NFF
55	14,000	MUU
69	15,200	YN
82.5	16,700	NSS

A set of inductances which will duplicate these results comprise two LRD-1200 Coils and one LRD-550 Coil, for a tickler, cost but

$6.60
Postpaid and Insured

WHY NOT DUPLICATE THIS PERFORMANCE?

Have you tried GRAGAL—the new crystal? It combines the sensitiveness of Galena with the ease of adjustment afforded by Silicon. Experimenters call it "UNIVERSALLY SENSITIVE." We can also supply "ARCO" tested Galena and Silicon crystals.

We endeavor to carry at all times a complete line of high grade Radio Equipment—Complete Receiving and Transmitting Outfits, Regenerative Sets, Radiophones, Vacuum Tubes, Control Panels, small parts, etc.

ATLANTIC RADIO COMPANY
34 Battery March St. Boston, Mass.
Tel. Ft. Hill 1394 Write for Bulletin 10-A

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 33rd St. Valparaiso, Indiana

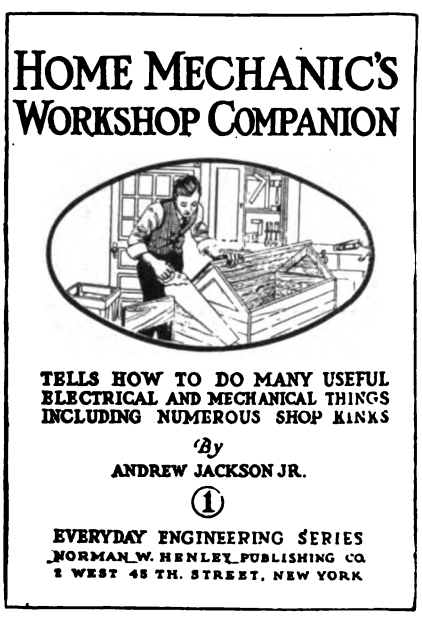
Digitized by Google

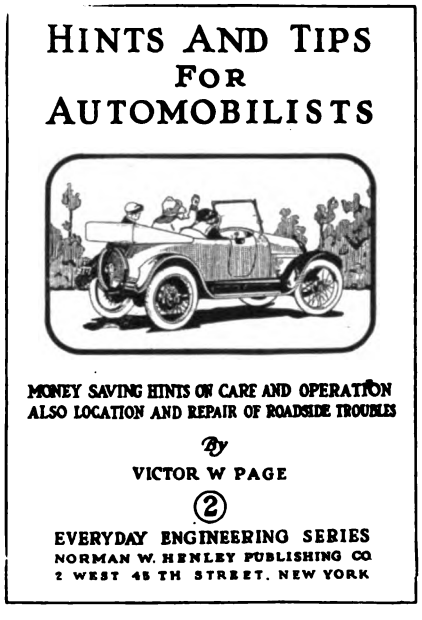
Just Published

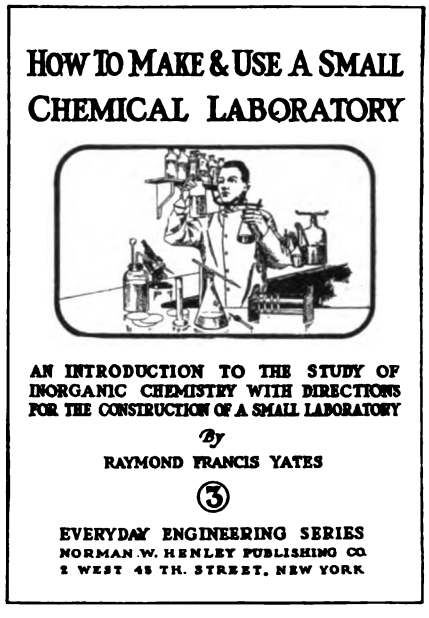
The Everyday Engineering Handbooks

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man—the Mechanic and the Radio Experimenter

ILLUSTRATED BY SPECIAL DRAWINGS AND PHOTOGRAPHS







For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.

This treatise includes a compilation of useful suggestions that cannot fail to interest the handy man, and while it is not intended for mechanical experts or scientists, it will prove to be a veritable store of information for any one who desires to rig up a small shop where odd jobs can be carried on.

The subject matter is divided in five parts as follows:

Chapter 1—The Home Workshop and Its Equipment. Chapter 2—Special Tools and Shop Expedients. Chapter 3—Useful Home Appliances. Chapter 4—How to Do Things Electrical. Chapter 5—Helpful Recipes and Formulae. The illustrations are especially clear and all suggestions are further amplified or made more easy of comprehension by hundreds of thumb nail sketches made by the author.

For the Automobile Owner or Driver

This volume is replete with interesting facts compiled by an expert from a mass of information furnished by the Service Departments of leading automobile makers on operation, upkeep, lubrication, location of troubles and simple repairs of automobile parts. The instructions given are concise and to the point and no information that will help in the everyday operation of automobiles is omitted.

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints and a brief simple exposition of location and remedy of roadside troubles apt to occur under ordinary operating conditions.

The permit of logical presentation, the subject matter is divided into four chapters. Chapter 1 deals with the Control and Operation; Chapter 2, Systematic Inspection and Lubrication; Chapter 3, Power Plant and Auxiliary Groups; Chapter 4, Automobile Care and Maintenance Suggestions.

For the Student Chemist and Experimenter

The treatise covers all of the essentials of elementary chemistry. The law of definite proportions, solutions, crystalloids, colloids, electrolysis, etc., are explained. The second part of the book is devoted to chemical and electro-chemical experiments. Only those experiments that will tend to broaden the readers' knowledge of chemistry in general have been chosen.

The third part of the book describes the construction and fitting out of the home chemical laboratory. Directions for the construction of the many simple pieces of chemical apparatus are given. A chemical balance, ring stand, electric furnace, etc., are described in detail, with working drawings. The manipulation of chemical glassware is also treated.

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.

A SPECIAL OFFER TO READERS OF

ANY ONE OF THE ABOVE VALUABLE BOOKS WILL BE

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOU

Fill Out the Special Blank on Page 324 of this Issue. Check Off the Title Desired and Mail with Your Remittance to

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Just Published

Should be in Every Practical Man's Library

All of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest

RADIO BOOKS CONTAIN MANY WIRING DIAGRAMS

SOLDERING & BRAZING



A USEFUL HANDBOOK FOR MECHANICS

By
RAYMOND FRANCIS YATES

④

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work —something that he may heretofore have forgotten.

Hard soldering, for some reason, is not generally known. Hard soldering, however, is very important and must be used in all cases where soft solder does not possess sufficient strength. Hard soldering and solders are thoroughly covered in the book. Nothing has been omitted that will enable the mechanic to apply hard solder successfully.

Brazing and all of its important ramifications are treated in detail. Brazing, like hard soldering, is a process little understood by many mechanics. The book "Soldering and Brazing" is divided in five parts as follows: Part I—Soft Soldering; Part II—Hard Soldering; Part III—Brazing; Part IV—Heating Devices; Part V—Soldering Notes.

RADIO HOOK-UPS



A BOOK OF THE MOST ADVANCED CIRCUITS OF RECEIVERS AMPLIFIERS AND TRANSMITTERS FOR DAMPED AND UNDAMPED WAVE WORK:

By
M. B. SLEEPER

⑤

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuits for tuning coils, loose couplers, capacity coupling, variometers and other equipment for receiving long and short damped and undamped waves, damped, undamped and modulated wave transmitters using buzzers, spark coils, transformers, arcs and vacuum tubes, telephone transmitters, laboratory oscillators, vacuum tube characteristic measuring circuits, wave-meters, and audibility meters—in short, diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving constructon or operating details. Spaces are also provided for notes on the results obtained with each diagram. This arrangement, coupled with the skillful selection of the circuits, makes Radio Hook-ups an essential to every radio experimenter or operator.

DESIGN DATA FOR RADIO TRANSMITTERS & RECEIVERS



SIMPLE METHODS FOR DESIGNING APPARATUS ACCORDING TO ADVANCED AND APPROVED PRACTICE

By
M B SLEEPER

⑥

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH STREET, NEW YORK

For the Radio Engineer and Student

Far from being a collection of formulas, Design Data takes up in proper sequence the problems encountered in planning all types of receiving sets for short, medium, and long wave work, and spark coil, transformer, and vacuum tube transmitters operating in 200 meters.

Where formulas are difficult, tables have been worked out so that values can be found without the use of mathematics. The few formulas given are so simple that any school boy can solve them. The subjects are so arranged that, having decided upon the type of receiver or transmitter to be built, the reader can locate immediately the problems and solutions required.

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

SENT **FREE** FOR EACH NEW OR RENEWAL SUBSCRIPTION

OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

EVERYDAY ENGINEERING MAGAZINE, 2 W. 45th ST., NEW YORK CITY

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

PATENTS

RECORD your invention, before filing application, by using my form "FIXING THE ESSENTIAL DATES OF INVENTION," sent upon request with full information. Prompt, personal services by an attorney-at-law having over twelve years actual experience. Reasonable prewar charges. B. P. FISHBURNE, 321 McGill Bldg., Washington, D. C.

Making Your Invention a Financial Success
How best to dispose of your invention
What kind of agreements to make for your protection
What kind of offers and mistakes to avoid
Valuable tables and other data
By M. G. Delaney, an experienced Inventor, in
The Inventor's Manual of Valuable Information
$1.50 per copy, postpaid
Additional information and Table of Contents will be mailed on request.
G. L. Perry Co., Publishers, 1328 Broadway, New York

INEXPENSIVE BOOKS FOR THE EVERYDAY PRACTICAL ELECTRICIAN

Wiring a House
By Herbert Pratt. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules; in fact, just the information you need. Directions apply equally to a shop. Fourth edition. Price, 35 cents

Electric Bells
By M. B. Sleeper. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated. Price, 60 cents

NORMAN W. HENLEY PUBLISHING CO.
Dept. EE 2 West 45th Street, New York

PAINTING WITH A GUN

THE modern method of applying various kinds of points and other protective coatings by the use of compressed air is rapidly superseding the old hand-brushing method, not only by reason of the great saving in time and labor, but also due to the fact that better results are obtained.

There is hardly a comparison between pneumatic painting and the old-style way. One handy workman, for instance, can do the work of three to twelve or more skilled painters using hand brushes, depending upon the nature of the work. Uniformly finished coatings free from streaks and brush marks are produced. Rough, irregular surfaces and those inaccessible or difficult to reach with a brush are readily coated. Where single coat work is required, either a lighter or heavier coating can be obtained than is possible with hand brushes. The gun, for such is the usual name of the pneumatic painting device, may be quickly mounted on an extension pole attachment for painting surfaces beyond the reach of the operator. The air-tight material container prevents the formation of paint skins, and makes it impossible to combine dirt with the paint. These are but a few of the leading advantages of the pneumatic system of painting.

Pneumatic painting equipment consists of a container; a flexible, metal-lined hose; a heavy rubber air hose; and the paint gun or nozzle member. Some materials require continuous agitation in order to keep the heavier parts in suspension, and for this purpose an agitating attachment is employed. This device is screwed into the main air port in the bottom of the control head. The agitating is done by air, which, after passing through this attachment and bubbling up through the paint, is allowed to escape through the bleeder valve in the control head. When using certain varnishes and enamels, on the other hand, it has been found that, in order to obtain the best results, the air should be heated before it reaches the gun. If this is done and the material is also heated before being placed in the material container, a perfectly smooth coating can be obtained. For this purpose an electric heating attachment is sometimes used with a pneumatic painting equipment. This attachment may be operated from any ordinary electric light socket. It is so designed that it may be turned on at the same time as the gun trigger is pulled by the natural grip of the hand.

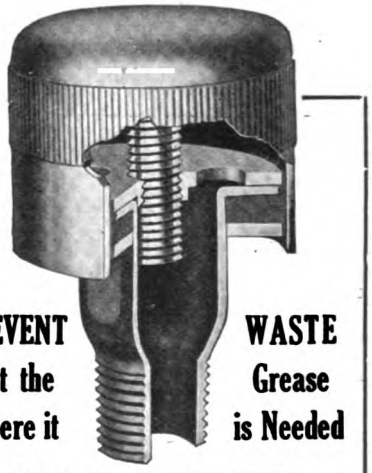
Compressed air for the paint gun is generally supplied by a compressor unit which may serve several paint guns at one time.

Today paint guns are employed to a very wide extent. In many industrial establishments they are employed for all kinds of painting. In the production of explosive shells during our participation in the world war, the old inefficient method of applying protective coatings by dipping, pouring and swabbing, was dropped in favor of pneumatic painting.—*Compressed Air Magazine.*

Genuine Armstrong Stocks and Dies



Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.
Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.
Send direct to us if your dealer cannot supply you.
Descriptive Catalog on Request
The Armstrong Manufacturing Co.
761 Knowlton Street Bridgeport, Conn.



THE BRIDGEPORT
Center Thread Grease Cup
This cup will squirt more grease than any cup of the same size made.
Equip your machine, auto or boat with this new type of grease cup, one that does not leak, that cannot be cross-threaded and that forces the grease to the bearing points.
The cleanest Grease Cup made.
Send for Circular and Price List
THE GARRISON COMPANY
348 George St. Bridgeport, Conn.

Digitized by Google

SOLDERING GASOLINE TANKS

Two fatal accidents due to the explosion of so-called empty drums which had contained petroleum were reported to the Government (British) Inspectors of Explosives during the past year. In one case the drum had but recently been emptied, but in the other steps had been taken to remove all trace of petroleum by thoroughly washing out and rinsing the drum. The victim of the explosion, an experienced chemist, then put a light to the bunghole, either to prove that no inflammable vapor remained or to burn out the residue, and a violent explosion followed. This accident is one more indication of the difficulty of rendering safe a vessel which has contained petroleum spirit, owing to the density of the vapor, which is about two and a half times as heavy as air, and to the very small proportion of vapor required to make an explosive mixture with air.

WATER INJECTION AND ENGINE PERFORMANCE

A SHORT investigation has been conducted at the Bureau of Standards to determine the effect of water injected into the intake manifold of an internal combustion engine. This investigation was carried out on two different engines, truck and automobile, but the results in general are such as to apply airplane engines.

The first series of tests was conducted to determine whether the use of water injected into the intake manifold has any effect on the horsepower output and fuel economy; the second series to determine the effect upon the carbon deposit on the cylinder walls and piston heads.

The data obtained indicate that in an engine of good design there is no appreciable gain in power or fuel economy due to the injection of water, but in a badly carbonized or a poorly designed engine, where hot spots due to improper cooling are present, a slight increase in power may result. If enough water is used, it will remove a small portion of the carbon but will cause at the same time a considerable reduction in the operating efficiency of the engine.

The maximum amount of water used in these tests was limited to that which did not materially interfere with the normal operation of power output of the engine and the results do not indicate the value of much larger quantities of water as injected under special conditions solely as a carbon removing agent.

To cut down the cost per cut

Put on the Weight

If you're cutting with a medium or heavy power machine, start out with a good, full, 45-pound pressure after the first two or three strokes. As the number of cuts progresses, increase your weight. Remember that once the first keenness of the blade is gone, the heavier gauge of the blade the greater the pressure required to make the teeth "bite." Too little weight will ruin a blade almost as quickly as too much.

Follow the Starrett Hack Saw Chart in selecting your blades. Put on the weight and watch the cost per cut go down.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



42-974



THE MIDGET SLIDE RULE will solve any problem in addition, subtraction, multiplication division and proportion. A Log-Log Scale gives any root or power of any number. Gives Logarithms, Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six decimals. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book 16 pages, 12 illustrations, is sent with each rule. Diameter 4 in. Made in two models: Metal (white coated steel), $1.00; White Celluloid $1.25. Leather Case 50c extra. Your money back if you are not satisfied. Send for Catalogue of Slide Rules. Gilson Slide Rule Co., Niles, Mich.

The Service Department of "Everyday Engineering" can help you find any book published on technical or scientific subjects.

HANDY

THAT'S THE WORD TO DESCRIBE THIS NEW utility chest—the handiest, sturdiest, chest for garage or home use, for auto-mechanics, electricians, plumbers, linemen. Its solid oak frame, rigidly held together by lock-cornered joints—twice as strong as dove-tailing—insures tool safety against theft, rust, bangs, knocks or outdoor weather. Get the details about this chest and the other 18 Union sizes and styles. Write for Catalog, prices and name of nearest dealer and guarantee. If no dealer near you, write for special offer. Union Tool Chest Co., Inc., 34 Mill Street, Rochester, New York



UNION TOOL CHESTS



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.
MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.

DO NOT MISS THE
MARCH NUMBER
of
Everyday Engineering Magazine

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Build and Fly One Yourself.



R. C. J. Jr. Sporting Biplane

SPECIFICATIONS

Span	28 Ft.
Chord	4 Ft.
Wind area with ailerons	206 Sq. Ft.
Gap between planes	4 Ft. 3 in.
Overall length	18 Ft. 11 in.
Overall height	8 Ft. 1 in.
Dihedral	3 degrees
Stagger	8 in.
Incidence	4½ degrees
Rudder area	6½ Sq. Ft.
Fin area	2½ Sq. Ft.
Stabilizer area	20 Sq. Ft.
Elevators (2) area each	8 Sq. Ft.
Wing section R A F	No. 6
Engine	35 H. P.
Propeller	6 Ft. 6 in., 3 Ft. Pitch
Weight empty	450 lbs.
Speed	30-85 M.P.H.

PERFORMANCES:

Maximum speed	35 H.P.	85 M.P.H.
	24 H.P.	70 M.P.H.
	18 H.P.	60 M.P.H.
Minimum speed		30 M.P.H.
Maximum Climbing Speed	35 H.P.	820 Ft.
	24 H.P.	530 Ft.
	18 H.P.	330 Ft.
Min. H.P. required for horoz. flight		6 H.P.
Useful load		225 Lbs.

Send $5.50 for the most complete set of working Blue-prints of this simple but wonderful Flyer. Blue-prints contain seven sheets, and each one is brim full running over with instructions and how to build, No. 6 sheet also has latest price sheet, number of parts needed and everything. You get many times the value of your money from these prints.

SEND YOUR ORDER NOW.

JENNINGS MACHINE WORKS

Factory and Office:
R. 33 W. Fayette St.

Flying Field:
U. S. A. Speedway

Uniontown, Pa.

Send for This Book of Model Aeroplanes

Tells how you can build and fly accurate, reduced-scale Models of real Aeroplanes; DE HAVILLAND Battle Plane, NC-4 and others. You can build one easily. Send 10c in stamps NOW and get this 48-page book. Plans for Model Aeroplanes—NC-4, 50c; DE HAVILLAND Battle Plane, Curtiss Military Tractor, Blerlot Monoplane, Nieuport Monoplane, Taube Monoplane, 35c each; Cecil Peoli Champion Racer, 25c. Send for Plans or Book Today.



IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Since 1911
Cor. W. Houston & Wooster Sts.
New York

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 7492 431 S. Dearborn St. CHICAGO



Glide "O" Plane

Learn the principles of Aviation by flying our famous Glide "O" Plane, shipped complete ready to assemble and fly with illustrated flying instructions. PRICE 55 Cents POSTPAID IN U.S.A.

Illustrated instructions from which you may carve an accurate propeller complete with a sample propeller blank. 30 Cents POSTPAID IN U.S.A.

Both the above postpaid in U. S. A. 75 Cents. Send for our catalogue D4. It is free.

HEC Aeroplane Co.
345 East 49th St., New York City

UmakeM **Airplanes** Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 8th Ave., N.Y.

See the "Everyday Engineering" splendid subscription offer on pages 334 and 335.

Digitized by Google

THE CEILING OF AN AIRPLANE

THE power required to sustain an airplane in the air varies inversely as the square root of the density of the air. For instance, at an altitude of 18,100 ft. the density—calling that at sea level 1.00— is only 0.50. Therefore, if the power required to sustain the airplane at sea level is denoted by $1\,00$, that required at 18,100 ft. is $1/\sqrt{0.50} = 1.414$. At the same time that the power required to sustain the plane has increased 41.4 per cent., the maximum power of which the engine is capable has decreased substantially 50 per cent. The ceiling of a plane therefore is limited by the increase in the power required for its support and a decrease in the engine power output with augmented altitude. By means of superchargers it may become possible in the future to eliminate the latter factor to some extent, but there is no known practical expedient for increasing the supporting value of the air under the wings as it becomes thinner. It has been suggested that variable surface aerofoils be used so more wing surface will be available in thin air and be reefed in at lower altitudes where the air is denser.

RESISTANCE OF NOSE RADIATORS

EXPERIMENTS were carried out on a model fuselage 60 in. long, 10 in. wide and 13 in. high, to determine the effect of placing a radiator in the nose of a fuselage as compared with the effect of placing a radiator of the same core construction, having an equivalent cooling capacity, in the free air and streamlining the nose of the fuselage.

The following conclusions were drawn from the experiment:—

(1) The resistance of a fuselage with streamline nose is increased more by removing the streamline nose and substituting a radiator than it is by adding an equivalent free air radiator and retaining the streamline nose.

(2) Between good radiators for each position the increase of resistance due to the nose radiator is roughly double that due to the free air radiator.

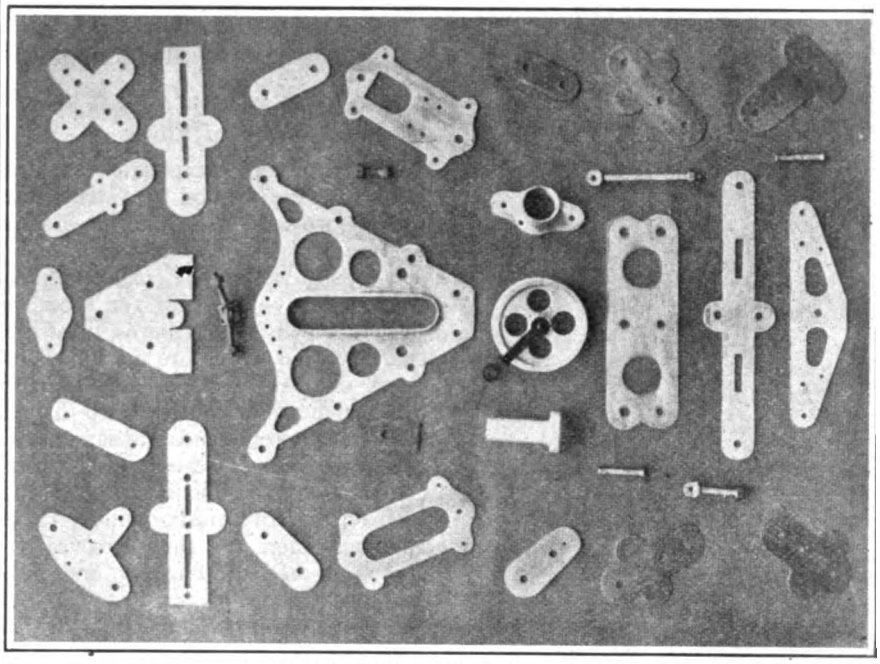
(3) Above a very low mass flow, the nose radiator becomes relatively worse and worse as the mass flow is increased by opening the vents at a constant free air speed. This fact is of great importance, since the space available for a nose radiator is so limited that the highest possible mass flows are used in practice.

(4) It is found that the relative efficiency of the nose radiator and the free air radiator does not change appreciably with free air speed for a given setting of the vents. (*Aerial Age Weekly.*)

R. C. J. AIRPLANE MOTORS, METAL FITTINGS, SUPPLIES AND COMPLETE AIRPLANES

PROMPT SERVICE REASONABLE PRICES
GUARANTEED MATERIAL AND WORKMANSHIP

Amateur airplane builders have been seeking a reliable and dependable supply house that understands their needs for some time. We have a complete line of metal fittings and can furnish cable, turnbuckles, dope, linen, wood members, wheels, shock absorbers; in fact, everything you need to build a safe, practical airplane.



R. C. J. MOTORED AIRPLANE FITTINGS

Our supplies are selected and fittings designed by a mechanical engineer with actual flying experience. Their design is based on actual knowledge, not theory or guess work. GIVE US A TRIAL.

Send 10c in Stamps for Our Catalog and Prices,
They Will Interest You. What Do You Need?

JENNINGS MACHINE WORKS
ESTABLISHED 1910
UNIONTOWN, PA.

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.
Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF II SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.
672-D Broadway Brooklyn, N. Y.

Digitized by Google

Principles of Rotary Engines

(*Continued from page* 269)

secured to the pressed steel carriers of the engine, and runs far enough back so the pilot can crank the engine. The oil tank may be connected with the air-pressure line, so that the suction of the oil lamp is not depended upon to get the oil to the pump. From the bottom of the oil tank a pipe leads to the pump inlet. There are two outlets from the pump, each entering the hollow crankshaft, and there is a branch from each outlet pipe to a circulation indicator convenient to the operator. One of the oil leads feeds to the housing in the thrust plate containing the two rear ball bearings, and the other lead feeds through the crank-pin to the cams, as already explained.

Owing to the effect of centrifugal force and the fact that the oil is not used over again, the oil consumption of a revolving cylinder engine is considerably higher than that of a stationary cylinder engine. Fuel consumption is also somewhat higher, and for this reason the revolving cylinder engine is not so well suited for types of airplanes designed for long trips, as the increased weight of supplies required for such trips, as compared with stationary cylinder type motors, more than offsets the high weight efficiency of the engine itself. But for short trips, and especially where high speed is required, as in single-seated scout and battleplanes or "avions de chasse," as the French say, the revolving cylinder engine has the advantage. The oil consumption of the Gnome engine is as high as 2.4 gallons per hour. Castor oil is used for lubrication because it is not cut by the gasoline mist present in the engine interior as an oil of mineral derivation would be.

The Le Rhone Motor

The Le Rhone motor is a radial revolving cylinder engine that has many of the principles which are incorporated in the Gnome, but which are considered to be an improvement by many foreign aviators. Instead of having but one valve in the cylinder head, as the latest type "monosoupape" Gnome has, the Le Rhone has two valves, one for intake and one for exhaust in each cylinder. By an ingenious rocker arm and tappet rod arrangement it is possible to operate both valves with a single push rod. Inlet pipes communicate with the crankcase at one end and direct the fresh gas to the inlet valve cage at the other. Another peculiarity in the design is the method of holding the cylinders in place. Instead of having a vertically divided crankcase, as the Gnome engine has, and clamping both halves of the case in a groove around the cylinders, the crankcase of the Le Rhone engine is in the form of a cylinder, having nine bosses provided with threaded openings into which the cylinders are screwed. A thread is provided at the base of each cylinder, and when the cylinder has been screwed down the proper amount it is prevented from further rotation about its own axis by a substantial lock nut, which screws down against the threaded boss on the crankcase. The external appearance of the Le Rhone motor is clearly shown at Fig. 1, while the general features of construction are clearly outlined in the sectional views given at Figs. 6 and 8.

Connecting Rod Big Ends Work in Grooved Plates

The two main peculiarities of this motor are the method of valve actuation by two large cams and the distinctive crankshaft and connecting rod big end construction. The connecting rods are provided with "feet" or shoes, on the end which fit the grooves, lined with bearing metal which are machined into crank discs revolving on ball bearings and which are held together so that the connecting rod big ends are sandwiched between them by clamping screws. This construction is a modification of that used on the Anzani six-cylinder radial engine. There are three grooves machined in each crank disc and three connecting rod big ends run in each pair of grooves. The details of this construction can be readily ascertained by reference to explanatory diagrams at Fig. 8A. Three of the rods which work in the groove nearest the crankpin are provided with short shoes. The short shoes are used on the rods employed in cylinders Nos. 1, 4 and 7. The set of connecting rods that work in the central grooves are provided with medium length shoes and actuate the pistons in cylinders Nos. 3, 6 and 9. The three rods that work in the outside grooves have still longer shoes and are employed in cylinders Nos. 2, 5 and 8.

How One Tappet Operates Two Valves

The peculiar profile of the inlet and exhaust cam plates are shown at Fig. 8, while the construction of the wristpin, wristpin bushing and piston are clearly outlined at the sectional view on the same plate. The method of valve actuation is also clearly outlined in an illustration at Fig. 6, which shows an end section through the cam case, and also a partial side elevation showing one of the valve-operating levers, which is fulcrumed at a central point and which has a roller at one end bearing on one cam while the roller or cam follower at the other end bears on the other cam. The valve rocker arm actuating rod is, of course, operated by this simple lever and is attached to it in such a way that it is pulled down to depress the inlet valve and pushed up to open the exhaust valve.

A carburetor of peculiar construction is employed in the Le Rhone engine, this being a very simple type, as outlined at Fig. 7. It is attached to the threaded end of the hollow crankshaft by a right and left coupling. The fuel is pumped to a spray nozzle, the opening in which is controlled by a fuel-regulating needle having a long taper, which is lifted out of the jet opening when the air-regulating slide is moved. The amount of fuel supplied the carburetor is controlled by a special needle valve fitting, which combines a filter screen and which is shown at B. In regulating the speed of the Le Rhone engine, there are two possible means of controlling the mixture, one by altering the position of the air-regulating slide, which also works the metering needle in the jet, and the other by controlling the amount of fuel supplied to the spray nozzle through the special fitting provided for that purpose.

Explanation of Le Rhone Engine Action

In considering the action of this engine one can refer to Fig. 9. The crank O. M. is fixed, while the cylinders can turn about the crankshaft center O and the piston turns around the crank-pin M, because of the eccentricity of the centers of rotation the piston will reciprocate in the cylinders. This distance is at its maximum when the cylinder is above O and at a minimum when it is above M, and the difference between these two positions is equal to the stroke, which is twice the distance of the crank-throw O-M. The explosion pressure resolves itself into the force F exerted along the line of the connecting rod A-M, and also into a force N, which tends to make the cylinders rotate around point O in the direction of the arrow. An odd number of cylinders acting on one crank-pin is desirable to secure equally spaced explosions, as the basic action is the same as the Gnome engine.

The magneto is driven by a gear having 36 teeth attached to crankcase, which meshes with 16-tooth pinion on armature. The magneto turns at 2.25 times crankcase speed. Two cams, one for inlet, one for exhaust, are mounted on a carrying member and act on nine rocker arms, which are capable of giving a push-and-pull motion to the valve-actuating rocker-operating rods. A gear driven by the crankcase meshes with a large member having internal teeth carried by the cam carrier. Each cam has five profiles and is mounted in staggered relation to the other. These give the nine fulcrumed levers the proper motion to open the inlet and exhaust valves at the proper time. The cams are driven at 45/50, or 9/10, of the motor speed.

Digitized by Google

The Colors of Chromium Compounds

THE object the author had in mind in writing this article was solely to show the experimental chemist the various colors which the presence of chromium imparts to its many compounds, and also how he may prepare them himself. Every compound of chromium is exquisitely colored. The element itself is a very lustrous, silvery-gray metal. Its name comes from the Greek word meaning color;. this, of course, refers to its highly colored compounds.

The most important compound is potassium di-chromate ($k_2Cr_4O_7$) and it is the only chromium compound which need be purchased. With this we start out on our display of colors, for it is in beautiful rose colored crystals. When a hot solution of this is treated with a base such as sodium hydroxide the lemon-yellow colored chromate (K_2CrO_4) crystalizes. This solution of potassium chromate will frequently be employed. If, instead of treating the hot solution of potassium di-chromate with a base, an acid be employed; chromic anhydride or the trioxide will crystalize out in the form of dark red needles. With this compound many interesting experiments may be performed. It destroys paper by oxidation. Dry ammonia gas as well as alcohol take fire when brought into contact with it.

Returning to our solution of potassium chromate, we will precipitate several insoluable bodies. The first is silver chromate (Ag_2CrO_4). This is prepared by mixing solutions of silver nitrate with potassium chromate. The silver chromate is thrown down as a beautiful scarlet-red powder. If we use lead nitrate in place of silver nitrate we precipitate a beautiful yellow body which is lead chromate. This is known commercially as chrome yellow. If this chrome yellow is treated with an insufficient quantity of sodium hydroxide to dissolve it, it changes into chrome red, another common pigment. If we take a barium salt, as the chloride, and mix it with the chromate, we have another yellow compound ($BaCrO_4$). This, if mixed with just the right amount of hydrochloric acid, gives one of the finest shades of orange imaginable. Salts of stontium and calcium behave in a similar manner.

There are also chemicals which contain chromium as their principal element, these are called either chromous or chromic compounds according to the valence of the chromium. One of the most important of these is chromic sulphate ($Cr_2[SO_4]_5$). To prepare a little of this, dissolve about one gramme of the potassium di-chromate in 10cc. of water and add one ccm. of ethyl alcohol. Then pour about 5 c.c. of dilute sulphuric acid (1 : 3) on the mixture just made and heat to boiling. We now have a dark green solution containing chromic sulphate. In this manner chromic chloride may be prepared by using hydrochloric instead of sulphuric acid. This solution is also green. If, instead of making it, one were to purchase it, it would come in purple crystals. These dissolve in water, if they are not too pure, to form a violet colored solution. If this is boiled it changes to a green solution from which crystals cannot be obtained. On cooling this solution, the green color reverts to the original blue (rather slowly with the sulphate) and now the sulphate crystalizes out in the original purple crystals which were first dissolved.

If ammonia or other hydroxide is added to a chromic salt the hydroxide Cr $(OH)_3$ is thrown down as a voluminous pale blue precipitate. If this is collected, dissolved in hydrochloric acid allowed to crystalize, and heated in an atmosphere of chlorine, or hydrochloric acid gas, the anhydrous chloride ($CrCl_3$) is formed. This has a beautiful reddish-violet color. This is ordinarily insoluable in water; but if a slight amount of chromous chloride is present, it dissolves very readily. This is thought to be an example of physical catalysis.

The chromous compounds are rather difficult to keep as they readily go over into the chromic state due to atmospheric oxidation. A good way to make chromous compounds is to change a solution of chromic chloride ($CrCl_3$) with zinc and sulphuric acid. Thus the green chromic chloride solution is reduced to a blue solution of chromous chloride ($CrCl_2$). If this be treated with a hydroxide the chromous hydroxide is precipitated (Cr (OH_2) as a brownish-yellow powder.

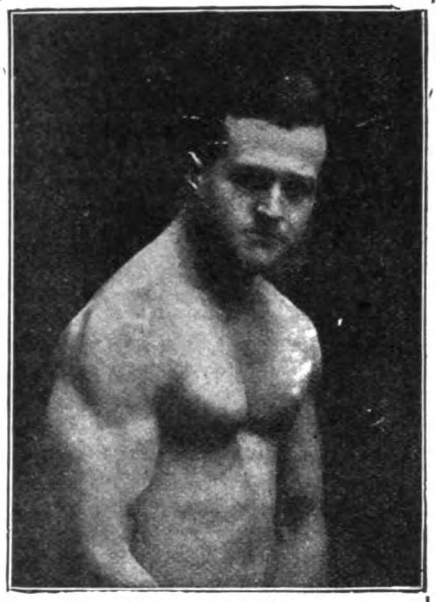
Other bodies containing chromium and of beautiful colors are chrome alums and chromyl chloride which is a dark red liquid closely resembling bromine in that respect. The chrome alums are blackish-purple crystals, which, when large, are delightfully beautiful. There are also browns among this family of color. One of them is chromium chromate; the other is the nitride made by passing ammonia gas over heated chromic chloride.

A very common test for chromic acid follows: Mix a little chromic acid with hydrogen peroxide, and a beautiful coloration is the result. This is due to the temporary production of perchromic acid.

Even nature herself employs chromium when she needs a coloring agent. The ruby, sapphire and garnet would be only clay without traces of chromic to color them. A. S. F.

What Would It Mean *to You* to Have Muscles Like These?

It would mean tremendous strength, putting you in a class above your fellows. It would mean that you could outdo them in feats of strength and be a leader of men. It would mean a strong personality because of your commanding appearance, thereby assuring you of success in both the business and social world. It would mean added lung power, unlimited vitality and perfect health; removing all fears of constipation, indigestion, etc., which undermine the average man and make him old long before his time.



EARLE LIEDERMAN
The Acme of Physical Perfection

All These Things Are Yours

I absolutely guarantee to do all this and more for you. I have found the short cut to physical perfection and applied it on my own body, proving its results. I have personally trained many of the world's strongest men by this same method. Why waste your time and money with old-time worthless methods? If you are desirous of being a real robust man, follow the path of those who have already made a success. Come now, get busy, for every day counts.

Send for MY NEW BOOK
"Muscular Development"

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN
Dept. 707, 203 Broadway, New York

EARLE E. LIEDERMAN,
Dept. 707, 203 Broadway, N. Y. City.

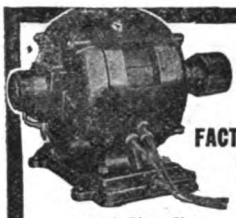
Dear Sir:—I enclose herewith 10c for which you are to send me without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write or print plainly.)

Name .....

Address .....

City .....State .....

Digitized by Google



NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4 H. P., 110 volts, induction, full load start - - $24.50
1/2 H. P., 110-220 volts, induction, full load start - $38.50
1/2 H. P., 110-220 volts, repulsion, for compressor $46.50
1 H. P., 110-220 volts, repulsion, with sliding base - - $67.50
2 H. P., 110-220 volts, repulsion, sliding base $108.50
3 H. P., 110-220 volts, repulsion, sliding base $124.50
5 H. P., 110-220 volts, repulsion, sliding base $164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

6 volts, 10 amp. $16.50
15 volts, 10 amp. $21.00
40 volts, 6 amp. $24.50
110 v, 2½ amp. $24.50
40 volts, 12 amp. $38.50
110 volts, 5 amp. $38.50
40 volts, 25 amp. $58.50
110 volts, 10 amp. $58.50
Moving Picture Arc Generator $85.00

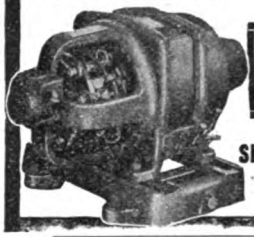
Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 RPM., complete with base and pulley.

½ H. P. - $42.50
1 H. P. - $59.50
2 H. P. - $72.50
3 H. P. - $84.50
5 H. P. - $102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only - $36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt, 24 volts, without switchboard $40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard $68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard - $75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard $85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard $85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard $110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard $125.00

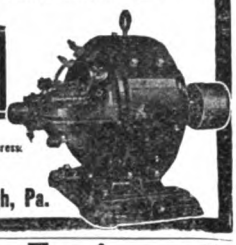
WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL 1/4 H.P. 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $19.75 EACH Reg. Value $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

CHEMIST AMAZING DISCOVERY "MOTOROL"

ONE DOLLAR POSTPAID
25 to 40% more miles per gal.
25 to 35% more power.
Agents Wanted. Starts your engine on a cold day instantly.
Eliminates Carbon Deposits.
Less wear and tear on motor.

AUTO PRODUCTS CO.
Dept. 66 468 West 145th St., N. Y.



SPECIAL KON-VER-TER SLIDE RULE

The original KON-VER-TER slide rule has over 8,000 graduations and over 1,800 letters and figures, will handle anything in Arithmetic, Algebra, Geometry or Trigonometry. Is 5.4 inches in diameter and in use all over the world, is much simpler to operate than others of similar construction. Eventually you will get the KON-VER-TER—get it now and save money. Plain Utility rules $1.00; Special De Luxe white Ivory celluloid $2.50. Leatherette case 50c extra.

J. C. HAMILTON & CO.
Dept. F-7 Water St., Boston, U.S.A.

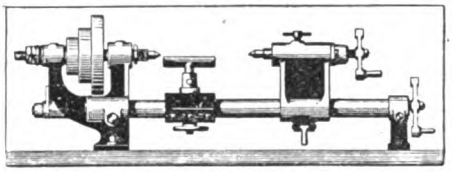
SPEED LATHE $7.00 Complete
Swing 7 inches 24 inch Metal Bed



Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac. Mich.

Model Shop Equipment



6 INCH BENCH LATHE

Castings or finished machine. Also hand power shaper and planer and light drill press. Designs for Model Boats.

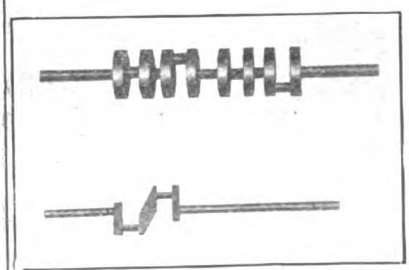
Stamp for catalog.

HUHN MFG. CO., 586 Elm St., Arlington, N. J.

MR. INVENTOR! Let us assist you with that idea that you can't just work out, or let us construct a model of your patent. We develop ideas, and are experts in MODEL and EXPERIMENTAL work. We specialize in designing and building special LABOR SAVING MACHINES. Or perhaps your device is ready for manufacturing. If so, get in touch with us. It would be to our mutual advantages.

ELK MFG. CO., INC.
1926A Broadway, New York

UmakeM Lathe You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $25. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.



CRANK SHAFTS

For Model Steam and Gas Engines Our Specialty—Any type or number of throws to specification. Also needle valves for blow torches. Quotations on receipt of specification.

Send Stamp to

MODEL MACHINE SHOP CO.
415 E. 71st St. New York

A Model Steam Engine

(*Continued from page* 266)

drawing. The piston rod is made of 3/16-in. stock 3¼ ins. long. The piston rod is turned down on each end so that it can be threaded to receive the piston and crosshead. The crosshead is built up out of small scrap brass pieces soldered together. The slide rods are filed to shape from a piece of steel measuring ⅛ x ¼ ins. These are fastened to the projections on the cylinder head on one end and to a bracket attached to the frame on the other. This bracket is bent to shape from ¼ x 1/16 in. cold-rolled steel. The bracket also holds the rocker, which member is filed from a piece of steel ½ in. x ⅛ in. The main rod is filed out of a piece of steel 5½ x ⅛ x ¼ ins. The frame is cut to shape from a piece of steel ½ x ⅛ in. in size. The crankshaft is ¼ in. in diameter and riveted to the crank.

By carefully examining the drawing and the photographs of the finished engine the mechanic will obtain any additional information that may be necessary for the construction of the engine. The writer is aware of the fact that the drawing is not as complete as it should be but he believes that all the necessary dimensions are given and that the builder will have little trouble in understanding the construction of the machine, as it is very simple and anyone having any knowledge of steam engine operation will be able to carry the project out successfully.

Recovery of Platinum from Platinum Solutions

FROM not too large baths precipitation of the platinum with sulphuretted hydrogen is the most suitable method, and preferable to evaporating and reducing the metal from the residue. The process is as follows: Acidulate the platinum solution with hydrochloric acid, and, after warming it, conduct sulphuretted hydrogen into it. The metal (together with any copper present) precipitates as sulphide of platinum. The precipitate is filtered off, dried and glowed in the air, whereby metallic platinum remains behind. From larger baths the platinum may be precipitated by suspending bright sheets of iron in the acidulated bath. In both cases the precipitated platinum is treated with dilute nitric acid in order to dissolve any copper present. After filtering off and washing the pure aluminum it is dissolved in aqua regia; the solution is then evaporated to dryness in the water bath, and the chloride of platinum thus obtained may be used in making a new bath.

Digitized by Google

BULLET-PROOF GLASS

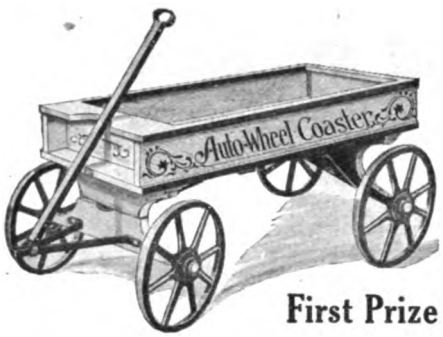
ALMOST interesting experiment with what is said to be a bullet-proof glass was recently made in New York City. A sheet of this glass was subjected to the fire of a .45 caliber automatic pistol at a distance of 12 feet, with the result that although the glass was shattered it stayed in place and resisted the penetrating force of the projectile. The exact nature of this material cannot be divulged at present for obvious reasons.

Great advances have been made in so-called unbreakable glass, the construction of which is in the form of a three-ply sheet of glass and celluloid, the latter being the middle member. Since it is cemented into a solid pane, the glass may shatter in the way glass does but it cannot leave the non-shatterable celluloid to which it is firmly cemented. Glass of this kind is extensively employed for eye-protecting goggles, airplane windows, wind shields, and other similar uses requiring non-breakable glass. From reports of the tests made with the bullet-proof glass, one can judge that the construction is similar to that of the "unbreakable" or triplex glass which has so many applications.

VANADIUM AS AN ALLOYING ELEMENT

VANADIUM has become one of the vital factors in the steel trade, entering into the manufacture of automobiles very extensively. Four pounds of vanadium added to a ton of steel results in an increase of 45 per cent in its strength and at the same time produces an alloy steel which has satisfactory machining qualities. The statement has been made that while the difference in raw material cost between vanadium steel and a carbon steel of approximately the same strength is too small to be of consequence, the difference in machinability makes a finished part of vanadium steel cost $6.50 and of carbon steel $13.00 It becomes evident that an alloy steel may frequently be employed for economic reasons alone, but that is a point much in favor of such alloys as vanadium steel which give us strength at low cost in construction. Some very important work remains to be done in the alloy field as we know all too little of the influence of many of the rarer metals on both ferrous and non-ferrous alloys.

In the Jutland battle the standard range finders used by the British fleet had 9 foot bases. These were only supposed to be accurate at 6,000 yards, and at Jutland some shooting was done at 24,000 yards. One squadron had 15 foot bases. Now 30 foot base range-finders have been introduced, which are accurate to less than 80 yards at a distance of 20,000 yards, or about 12 miles.



First Prize

Won By SCOUT KENNEDY PEIRCE, Tr. 63, Kansas City, Mo.

The judges decided that Scout Peirce's contest letter contained the sixteen best uses for the Auto-Wheel Coaster.

His Prize is the Auto-Wheel Coaster itself.

The Other Prizes Were Awarded as Follows:

2nd. Tent, Henry Jacobs, 37 Watkins St., Brooklyn, N. Y.
3rd. Poncho, Frederick M. Folger, - - - - Easley, S. C.
4th. Fleetwing Racer, Jas. O. Pierce, - West Plains, Mo.
5th Camera, E. B. Roensch, Dooley Bldg., Houston, Tex.
6th. Mess Kit, W. Hayward. 603 Cross St., Ypsilanti, Mich.
7th. Flashlight, Jas. A. Bishop, Route 12, Knoxville, Tenn.
8th. Knife, Arthur Rick, 223 Mariposa St., Syracuse, N.Y.
9th. Scout Axe, Joseph Gerend, Box 76, S. Kaukauna, Wis
10th. Watch, Albert Schulte, - - Box 364, Houghton, Mich.
11th. 3-Coin Bank, Stuart Demarest, - Roselle Park, N. J.
12th. Scout Compass, Charles E. Brady, - - Glen Ellyn, Ill.

There will be several more Auto-Wheel contests this year. Watch for the announcements. Get the Auto-Wheel Booklet now. Send us the names of three local coaster dealers, mentioning which one handles Auto-Wheel. We'll send you a handsome *Felt Pennant FREE*, and our attractive booklet. Ask us about the Auto-Wheel Clubs—how to get special Caps for the members.

BUFFALO SLED COMPANY,
159 Schenck Street,
N. TONAWANDA, N. Y.
In Canada: Preston, Ont.



UmakeM Club You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 19 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.
W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 5th Ave., N.Y.

PROCESSES FOR TESTING RUBBER

THE author of an article on this subject in a German paper outlines the best known processes of testing samples of rubber. These are the "Pontio," the characteristic feature of which is the solution of the rubber, is a particular benzol homologue; the "Marquis and Heim," which is based on the fact that pure rubber in a chloroform solution, when treated with concentrated sulphuric acid, is precipitated as an amorphous substance easily recoverable by filtration; and "Vaubels," in which a chloroform solution of rubber is submitted to the action of potassium bromide.

He rejects Pontio's process as unreliable. The other two he recommended for practical work. For accuracy, there seems to be nothing to choose between them. A long series of tests on a great variety of rubber samples from different sources showed practically identical results.

Earn $35 to $100 a Week
BECOME A PROFESSIONAL PHOTOGRAPHER




Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:
MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free
Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.
N. Y. INSTITUTE of PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.



10 Cents a Day Pays for This Symphonola
Plays all records, Victor, Columbia, Edison, Pathe, Little Wonder, Emerson. Take a year to pay, after 30 days' trial. Compare its tone for clearness, volume, with more costly instruments. Return at our expense if it fails to make good. Ask today for the
Beautifully Illustrated Symphonola Book FREE
Shows this and other Symphonola styles sold on easy payments.
Symphonola Records Get our list of the latest song, dance, popular, clear sounding, full toned disc records. Playable on any Phonograph.
Larkin Co. Desk SEE 220, Buffalo, N. Y.

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



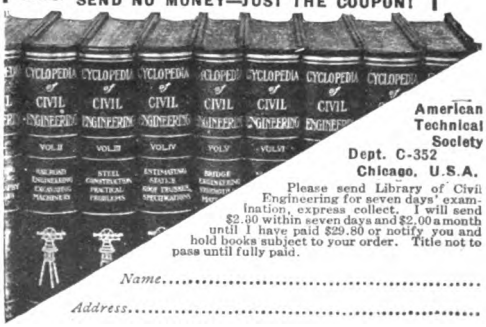
Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46M, E. 12th St., N. Y., U.S.A.

Learn in Spare Time to be a CIVIL ENGINEER

Earn $1500 to $5000 Yearly



Here's your big chance to become a full-fledged Civil Engineer! With this set of books you can fit yourself to make big money, in the greatest outdoor profession on earth! Offer fully explained in coupon. Good only within boundaries of the U. S. and Canada.
Great Books Shipped FREE
50c a Week if you keep them after 7 days' FREE TRIAL.
Nine big leather-bound volumes; 3900 pages, 7x10 inches; 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying; highway construction; railway engineering; earth work; specifications; estimating contracts; bridge engineering; masonry; reinforced concrete; water supply; sewers and drains; water power equipment; irrigation engineering—etc., etc. Written in simple language—every point made plain.
Consulting Service Free
A $12 Consulting Membership solves your difficult problems for a whole year. FREE with the set of books. SEND NO MONEY—JUST THE COUPON!

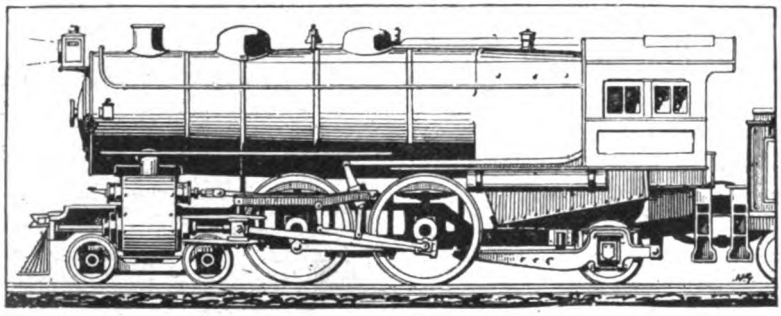


American Technical Society
Dept. C-352
Chicago, U.S.A.
Please send Library of Civil Engineering for seven days' examination, express collect. I will send $2.80 within seven days and $2.00 a month until I have paid $29.80 or notify you and hold books subject to your order. Title not to pass until fully paid.
Name.....
Address.....
Reference.....

Digitized by Google

Model Railroad Materials

Standard parts designed by Mr. Henry Greenley, of W. H. Jubb, Ltd., Sheffield, England, now available for distribution in America.



All the parts mentioned in Mr. Greenley's articles in Everyday Engineering can be supplied.

SPECIAL OFFER

Cylinders ordered before March 1st will be bored and faced without extra charge.

Orders accepted by mail only during the present month.

Look for our new address next month.

F. DEY

American agent for W. H. Jubb, Ltd., Sheffield, England

15 West 45th Street, New York, N. Y.

A Necessity for Every Shop

"The Samson No. 3 Bench Punch," with a powerful leverage of 24 to 1, is intended for work beyond the capacity of the "Samson Hand Punches," and will punch holes from ⅛ to ⅝ in. in soft metal up to 12 Gauge. Extra sets punches and dies size ⅛, 3/16, ¼, 5/16, and ⅜ in. easily inserted and removed. (maximum punching capacity 3/16 in. through 12 gauge soft metal.)



Equipped with 3-16-inch Punch and Die unless Otherwise Specified.

Price $12.50 Delivered

Catalog of Complete Line Sent on Request.

The Machine Appliance Corporation

351 Jay Street, Dept. Eng. BROOKLYN, N. Y.

UmakeM Outfit No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.

N. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

MARCH EVERYDAY ENGINEERING

will be full of good articles on Aviation, Mechanics, Radio, Model Engineering, Automobiles and Chemistry.

Don't Fail to Get Your Copy

Malleable Cast Iron

THE custom among most malleable iron makers is to use such irons only as are quite free from phosphorus and sulphur, for the reason that the process in use is designed especially to eliminate carbon, and after they have driven that out they have no desire to leave anything remaining which will make the metal brittle. By the use and mixture of certain brands of iron they have the means of converting their product into almost pure wrought-iron.

The melting is now done, on the large scale, in reverberating furnaces, and the iron is purified, to a certain extent, while in a molten condition by directing into the heating chamber a current of atmospheric air which mixes with the products of combustion. In its essential principles the method has a resemblance to Berard's process of steel-making, the gaseous currents of air or of the furnace may be used, as occasion requires, alternately, but the tuyeres are not, like his, provided with apparatus for adjustment. The process of removing impurities from the metal must not be carried so far as to detract from its fluidity at the temperature at which it is to be poured. These facts control the operation; the purer the metal is the higher is its melting point, and whatever impurities are allowed to remain must be such as may either be removed by subsequent operations or such as may be allowed to exist in the finished product. The useful function of the impurities is to lower the melting point in the scale of temperature. Small test pieces, of a finger's length, are cast from time to time until the right point is reached, as determined by the appearance of their fracture. The metal is then ready to be poured into the moulds, and as these will hold no large amount the pouring is generally done from hand ladles. After the case pieces are removed from the sand and have the risers, runners and spruce knocked from them, they are rattled in tumbling barrels to remove the adhering sand and scale and to expose the naked surface of the material to the ready access of the chemical agents of decarbonization.

The cast-iron pieces, hard and brittle, are now ready for the process which will alter them in their whole nature without subjecting them to any physical force. The process is one of dissociation of the compound cast-iron, which is carburet of iron the carbon has purposely been made to appear in its combined form and is not visible as graphite; the iron, when broken, exhibits a fine, white appearance of the fractured surface, with a suggested indication of lines radiating from the center.

The pieces are packed in cast-iron boxes with the rust or oxide of iron. These boxes are round or square, according to the shape of the work. If round, they are perhaps 2 ft. in diameter, and, if rectangular, they may be 2 ft. long, 1½ ft. wide and 1 ft. high. When these are filled rims of the same size are placed on them, increasing the height another foot, and when these are filled another rim, and still another is added, until the box is 4 ft. in depth, packed full of castings and oxidizing metal. This material may be wrought-iron turning chips which have been rusted by being spread upon a hot floor, where they are sprinkled with a solution of sal-ammoniac.

Transparent Paint for Glass

A shellac varnish made of bleached shellac can be used with various aniline dyes. The glass should be warm, but the varnish is used cold.

If the whole of the glass is to be coated, the method is to pour the colored varnish on and drain it off at a corner. Another method is to mix 1 part of turpentine with 2 parts of Venice turpentine and rub into this Prussian blue, crimson lake, India yellow or any mixture of these to produce the shade desired. Care should be taken to mix the color and the liquid intimately.

Digitized by Google

HARDWOOD FLOOR EFFECTS WITH SOFT WOOD

SATISFACTORY wood floors, approximating in effect and finish the oak and maple floors found in the best type of homes, can be developed, with the aid of proper finishing methods and materials, in such woods as pine, fir and cypress. These so-called "soft" woods are very durable and possess not a little natural beauty of grain. Hardwood effects are secured on soft woods by staining with an oil wood stain, consisting of a permanent color pigment in an oil vehicle. These stains are particularly adapted to use on the soft woods. The effect is completed by applying a thin coat of shellac and finishing with two coats of prepared wax or floor varnish.

The first step toward obtaining the desired finish is to sandpaper the wood smoothly. The stain should then be applied freely with a brush and, after being allowed to stand for about five or ten minutes, buffed off with a cloth. When the stain has dried for twenty-four hours, the shellac and wax or varnish may be applied as described. A deeper effect than that secured by the method outlined may be obtained by the use of a varnish stain over the oil wood stain. Both should, of course, correspond in color.

CARE OF ALUMINUM WARE

ALUMINUM ware, the kitchen utensils that are so attractive to housekeepers, must be well cared for if one would keep them bright. You may have been told that aluminum ware will not scorch, but if you leave a dry pan over an intense gas flame you will find a hole in the aluminum.

Heat penetrates aluminum twice as rapidly as it does tinplate, and three times as rapidly as it does iron. Not only does it heat more rapidly, but aluminum holds the heat longer. Consequently, the gas need be turned on full only at the beginning. It should be turned lower after the pot is heated.

Any discolorations on aluminum ware are sure to be on the surface only and can be removed by a good cleaning powder. Hot water and soap are enough to keep it in good condition usually, but any white metal polish will keep it bright and shining. Avoid coarse, gritty cleaning powders. Remember that ammonia, potash, lye, soda or strong cleaning powders will stain the inside of your kettles and the stain will be one you can never remove; so be careful. If a kettle or pan needs scraping, use a wooden spoon—not a knife. If so badly scorched that this does not answer, fill it with hot water and cover, then boil for several minutes and scrape with the wooden spoon or a clothespin. A piece of fine sandpaper is also good to brighten scorched spots.

SCRATCHED VS. SMOOTH JOINTS IN GLUING

The common assertion that scratched surfaces make stronger glued joints than smooth surfaces seems hard to prove. Comparative tests made on several occasions by the Forest Products Laboratory all indicate that the strength of these two types of joints are practically the same. The test specimens used by the Forest Products Laboratory were pairs of hard maple blocks, some with smooth and some with toothplaned contact surfaces. These blocks were glued with a high-grade hide glue, allowed to stand for a week, and then sheared apart in an Olsen universal testing machine. Four joints of each type were compared in a single test.

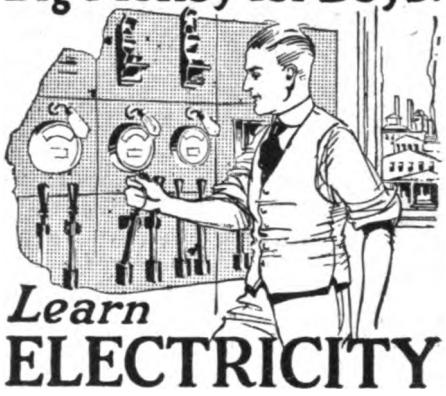
Eleven such tests gave the average results shown in table.

It will be noted that in seven of the eleven tests smooth surfaces gave the better adhesion. Consequently it would seem that there is no advantage in toothplaning wood for gluing purposes.

Comparative Strength of Scratched and Smooth Joints

	Scratched Joints		Smooth Joints	
Test No.	Shear strength Lbs., sq. in.	Wood surface in failure Per Cent	Shear strength Lbs., sq. in.	Wood surface in failure Per Cent
1	1787	25	1855	—
2	1366	—	943	—
3	1976	—	3086	50
4	2409	75	1571	25
5	2298	100	2416	100
6	1947	75	1678	62
7	2310	12	1800	—
8	1835	100	2455	100
9	1425	—	2180	25
10	2330	—	2395	62
11	2180	—	2520	75
Gen. Average	1988	35	2040	47

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into positions just as soon as they are ready. Good salaries are offered to start with splendid chances for rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX6070-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER
☐ Electrician
☐ Electric Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Heavy Electric Traction
☐ Electrical Draftsman
☐ Electric Machine Designer
☐ Telegraph Expert
☐ Practical Telephony
☐ MECHANICAL ENGINEER
☐ Mechanical Draftsman
☐ Ship Draftsman
☐ Machine Shop Practice
☐ Toolmaker
☐ Gas Engineer
☐ CIVIL ENGINEER
☐ Surveying and Mapping
☐ MINE FOREM'N OR ENG'R
☐ ARCHITECT
☐ Architectural Draftsman
☐ PLUMBING AND HEATING
☐ Sheet Metal Worker
☐ Navigator
☐ CHEMICAL ENGINEER
☐ SALESMANSHIP
☐ ADVERTISING MAN
☐ Window Trimmer
☐ Show Card Writer
☐ Outdoor Sign Painter
☐ RAILROADER
☐ ILLUSTRATOR
☐ DESIGNER
☐ BUSINESS MANAGEMENT
☐ Private Secretary
☐ BOOKKEEPER
☐ Stenographer and Typist
☐ Cert. Pub. Accountant
☐ Traffic Management
☐ Commercial Law
☐ GOOD ENGLISH
☐ STATIONARY ENGINEER
☐ CIVIL SERVICE
☐ Railway Mail Clerk
☐ Textile Overseer or Supt.
☐ AGRICULTURE
☐ Poultry Raising
☐ Automobiles
☐ Spanish
☐ French
☐ Italian

Name
Present Occupation
Street and No.
City State
7-26-19

Big Profits in Battery Charging with the HB 32-Battery Charger

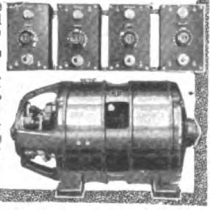
Start Your Battery Business NOW—Make $150 to $350 Every Month

NOW is your opportunity. Make $150 to $350 Clear Profit every month with this HB Charger. Recharges 10c to 15c each. Owner pays 75c to $1.50. Figure 32 6-volt batteries, or equivalent, at one time Cost the profits. You can make BIG PROFITS and build a permanent business. Others are doing it—YOU can, too.

Small Cash Payment Brings You This Money-Maker

Balance on easy monthly terms. Profits easily pay for outfit. Absolute Money Back Guarantee. No expensive repairs or replacements. Runs 24 hours a day. Big, steady, profitable income. Write TODAY for full information.

HOBART BROTHERS COMPANY
Box EE23 Troy, Ohio.
Successful Mfrs. Since 1893



Digitized by Google

An Engineer In Modeldom

A Few Remarks On Efficiency

By Dwight S. Simpson, M. M. E.

WHAT is efficiency? Your dictionary will tell you. The encyclopædia will tell you a lot more, but what is it? In round numbers, the ratio of practice to theory—the equation between things as they are and things as they ought to but never will be. The expression of the reason why many minds that have tackled the problem of perpetual motion, have not achieved it. And it is queer that while we always speak of "efficiency" it is ever the lack of it that really interests us. And the lack of it is usually spent in heat. The average statesman, so called—saying little, though talking much—lacks it in great quantities.

To borrow from something I've read somewhere (we are seldom original) it is theoretically possible to fill a pail brimming full of water at the well and to carry it to the house without spilling a drop. As to the water—that is 100 per cent efficient. But, we stumble and spill a little, the pail swings and we spill a little more. We arrive with the pail only partly full and the ratio between what is in it and what it held when full, or when we started, is the measure of efficiency, which is always expressed as a percentage.

Suppose the pail had a hole in it so that all the water ran out and we arrive with it empty. Efficiency = zero per cent. We plug the hole partly so that the pail is just half full when we arrive. Efficiency = 50 per cent. A little better plug and by saving three-quarters of the water we have reached 75 per cent efficiency. The great aim of all engineers is to always keep fitting a little better plug.

Let us mend the leak and we come immediately to another phase of the question. Tom, the clodhopper goes to the well, and in returning falls all over himself and arrives with the pail half full. Brother Jack, quick on his feet, brings in his pail filled to the top. We know that the pail will hold the water, therefore Tom must have been only 50 per cent efficient, while Jack is perhaps 90 or 95 per cent.

This human side of the question has of late years engaged the attention of engineers, managers and even doctors, with the result of many piece rate and bonus systems of pay in factories and many beneficial changes of method in working. As an example, a laborer used to travel around with the same shovel day after day and all day long. Now a shovel can hold only a certain bulk, so friend laborer would for a time be lifting say sixty pounds of ore and in a few moments be exerting himself with a shovel full of perhaps three pounds of shavings. Nowadays in a well regulated plant it is the job and not the man that has the shovel. He shovels shaving with a fork that holds so many pounds. He shovels coal with a shovel that holds the same number of pounds. Ore with a smaller shovel that holds the same weight. As a result of lifting the same weight every time he does more work in the day with an expenditure of less actual energy (sometimes he doesn't feel that way about it). In other words, his output is greater for the same or less input. His efficiency is higher, just as Tom's in bringing in the full pail.

Let us look at it in another way. suppose we hire a man for fifty cents an hour (it is still possible to persuade a few men to work for that sum) and he drives fifty rivets in an hour, that being a popular sport these days. That costs us a cent a rivet so we will make a new arrangement and pay him not by the hour, but a cent for every rivet he drives. He can now be reasonably expected to drive about seventy-five rivets an hour. Let us revise the schedule again—offer him a cent a rivet for the first seventy-five in each hour and a cent and a half for each one over. He is liable to make it ninety or even a hundred. Now that man was not shirking in the first place. He doubtless thought he was giving a full hour's work. The added incentive of the extra pay simply urged him to extend his muscles a little further. Possibly he shortened the swing of his hammer, making the blows a little harder and quicker. Possibly he rearranged his forge or his holder on so that rivets would come faster and stay put. In other words, he has increased his efficiency. Unfortunately, we cannot figure in the human element and say just what 100 per cent efficiency is; all we can say is that figuring from the first output he has increased his efficiency by 100 or 150 per cent. He may still be only 30, 50, 70, or perhaps 95 per cent efficient. We cannot tell how far he can do.

These figures are not excessive. It has been proved that one can do two or even three times a normal day's work, and under proper arrangement, keep it up indefinitely without detriment.

Now that we have some idea of the ratio between theory, possibility and actual achievement, let us see where it gets us in our model engineering work, and go back to our first dry subject of water.

But first let me say to you who have some knowledge of engineering, don't let the glowing descriptions of 90 per cent machines get your hopes too high. Friction, radiation, magnetic, and electrical losses do not diminish in proportion to dimensional reduction of a machine. A thousandth of an inch is a thousandth of an inch whether it is on a three-inch bearing or a three-eighths-inch bearing and while it is but one three-thousandth of the larger, it is one three hundred and seventy-fifth of the smaller. Small machines and models, as a rule, are not more than two-thirds as efficient as their larger cousins.

Pumps

The first requisite in the design of a pump, model or not, is the amount of water required (in cubic inches) and the number of revolutions it is convenient to run it. The novice then arrives at a piston diameter and stroke so arranged that area of piston times stroke times revolutions (or number of strokes per minute) equals the cubic inches of water required. Some time afterward he is much peeved and surprised because he isn't getting water enough. Let's see why.

Of course, water is incompressible and all that, but valves have to move up and down, reversing their direction twice every stroke, and the water itself has to be reversed in movement through the pump. This takes an appreciable moment of time, which is fully grasped by the water and some of it slips back under the suction valve to the pipe. More slips back into the pump through the delivery valve, leaving less room for water on the next intake stroke. Our pump therefore draws less water than it should and delivers less water than it draws. This loss amounts to about 15 per cent normally, but may be increased by poorly fitted or too small valves, or pipe that is too small or has too many, or too sharp bends.

If the pump is run at more than 350 revolutions, more trouble will develop. I am fully aware that plunger pumps on the cheaper gasoline engines are run at 700 or a 1000 R.P.M., but they are much larger than the capacity required, arrived at by trial and failure and probably operate at about 25 to 40 per cent efficiency.

All these figures are referring to the water end alone and no account is taken

(*Continued on page* 348)

Digitized by Google

Genuine Gold Bronze

LEAF gold is ground with honey upon a stone until the leaves are broken up and minutely divided. The mixture is then removed from the stone by a spatula and stirred up in a basin of water, whereby the honey is melted and the gold set free; the basin is then left undisturbed until the gold subsides; the water is poured off and fresh quantities added until the honey is entirely washed away. The gold is finally collected on filtering paper and dried for use. Gold bronze occurs in various shades of colors—red, reddish, pale, or dark yellow, as well as grennish—the color depending on the varying content of gold or the different mixture of gold with silver and copper. By boiling with various salt solutions or acidulated masses various tones may also be imparted to gold bronze. It acquires a vivid yellow color by boiling in water containing nitric, sulphuric or hydrochloric acid, a reddish color by boiling in a solution of crystallized verdigris or blue vitriol, while other shades are obtained by boiling in solutions of common salt, tartar, green vitriol or saltpetre in water.

Metallic gold powder is also obtained by dissolving pure gold in aqua regia and precipitating it again by an electropositive metal, such as iron or zinc, which in the form of rods is placed in the fluid. The gold is thereby entirely separated. The rods used for precipitation must be scoured perfectly clean and bright. The lustre of the gold bronze may be heightened by rubbing after drying.

To Bronze Tin

PREPARE two solutions, one of one part ferrous sulphate (green vitriol), one part cupric sulphate (blue vitriol) and twenty parts of distilled water; and the other of four parts verdigris and sixteen parts vinegar. Thoroughly cleanse the article by means of a clean brush dipped in fine earth and water, and after throughly drying apply to both sides a light coat of the first solution by means of a brush. After drying, the article presents a blackish appearance. The second solution is then applied with a brush until the article acquires a dark copper-red color. It is now allowed to dry one hour, and then polished with a soft brush and finely elutriated bloodstone, the surface being frequently breathed upon so as to make the bloodstone adhere. In conclusion it is polished with the brush alone, which is from time to time drawn over the palm of the hand. To protect the bronze against moisture, cover it with a very thing layer of gold lacquer.

NOW 35cts EACH

MODEL LIBRARY SERIES

1. The Study of Electricity for Beginners.
2. Dry Batteries. How to Make Them.
3. Electrical Circuits and Diagrams. Part 1.
4. Electric Bells, Annunciators and Alarms.
5. Modern Primary Batteries.
6. Experimenting with Induction Coils.
7. Electric Gas Igniting Apparatus.
8. Small Accumulators, How to Make and Use.
9. Model Steam Engine Design.
10. Practical Electrics.
11. Insulators, How to Protect and Soil Them.
12. Woodwork Joints, How to Make and Use.
13. The Fireman's Guide to the Care of Boilers.
14. The Slide Valve Simply Explained.
15. The Magneto Telephone.
16. The Corliss Engine and its Management.
17. Making Wireless Outfits.
18. Wireless Telephone Construction.
19. The Wimshurst Machine, How to Make It.
20. Simple Experiments in Static Electricity.
21. Small Electrical Measuring Instruments.
22. Electrical Circuits and Diagrams, Part 2.
23. Induction Coils, How to Make Them.
24. Model Vaudeville Theatres.
25. Alternating Currents, Simply Explained.
26. How to Build a 20 foot Bi-plane Glider.
27. A B C of the Steam Engine.
28. Simple Soldering, Hard and Soft.
29. Telegraphy for Beginners.
30. Low Voltage Lighting with Storage Batteries.
31. Gas and Oil Engines.
33. House Wiring for Electric Light.
34. Magnets and Magnetism.
36. Small Windmills and How to Make Them.
37. Collin's Wireless Plans, Part 1.
38. Collin's Wireless Plans, Part 2.

In paper covers, Price 35c each post paid.

SPON & CHAMBERLAIN
120-E Liberty NEW YORK

SEE
Special Subscription Offer on pages 334 and 335
Valuable Books on Radio, Automobiles, Chemistry and Mechanics given FREE.



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-352 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-352
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid

Name .....
Address .....
Reference .....

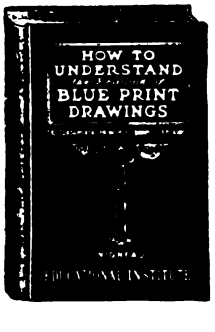
96-Page Book Catalogue Sent Free

WE have just issued a 96-page Book Catalogue listing about 2,500 of the most recent Scientific and Technical books. This is all the more welcome by reason of the fact that both the publishing and importing of books have been very much upset by the war, and many books can only be supplied with great difficulty. This catalogue will be sent to any address in the world, free on request.

Manuscripts Considered for Publication

The Book Publishing Department of the SCIENTIFIC AMERICAN will be glad to give an examination of any manuscript of Scientific or Technical nature. Submit as much of matter as possible, including illustrative material. There was never a better field for books of this nature than at the present time.

Scientific-American Publishing Company
Woolworth Building 235 Broadway, New York



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr.,
U. S. Rubber Co.'s Mech. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE, YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
160 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 133 Rowland Bldg., Detroit, Michigan

Digitized by Google

AN ENGINEER IN MODELDOM

(*Continued from page* 346)

of friction and head losses or the power required to drive the pump.

In general, then, it is necessary to gear our pump down to about 300 or 350 strokes per minute and to design it for a capacity of 115 per cent to 125 per cent of the amount of water required. Another time we will consider some of the details of design.

Centrifugal, gear and rotary pumps are not suitable for boiler feed and have been so little dealt with in the model field that it is hard to find what their efficiency might be. As their working depends largely on the closeness of fit, and as above explained a close fit is not so close, comparatively, in model work; it is probable that their efficiency is not more than half that of the reciprocating pump.

Dynamos and Motors

These being so nearly alike in their characteristics it is safe to consider them together for model purposes.

As in model work we rarely deal with powers greater than a horsepower, I believe it would be much better to rate all our machines by watts instead of fractional horsepower. Small dynamos and motors should be bought and sold this way, as ten watt, twenty watt machines, etc., and as the only satisfactory way of testing a small engine of any type is by an electric dynometer, why not use the watt to measure their power, too?

Large electrical machines operate normally on an efficiency percentage of 80 to 90 and even 95 per cent. In our small machines, friction surfaces are proportionately larger. Magnetic air gaps while actually the same may be proportionately as much as fifty times greater. Dead wire on the ends of armature coils is nearly as much as the effective wire between. It is therefore impossible to expect an efficiency of two-thirds more than 50 per cent.

That is to say, it is necessary to provide twice the mechanical power to drive a dynamo for any required output, and twice the electric power for the motor for the power wanted at its shaft. The other half the power is mostly heat.

Boilers

From the model standpoint, it is scarcely worth while going into the efficiency of boilers, as it is largely a discussion of water evaporated per pound of fuel, and the amount of fuel burned in a small boiler is of no great consequence. It is therefore sufficient to say that a model boiler of average type and construction will evaporate from 1 to 3 cubic inches of water per 100 sq. inches of heating surface. The former for pot boilers and the latter for the best water tube outfits. In all cases, it should be arranged to burn about a half pint of gasoline per hour for each hundred inches of heating surface.

This corresponds to an evaporation of 3 to 10 lbs. per sq. ft. per hour and for comparison it may be noticed that large boilers have evaporated as much as 17 to 20 lbs.

For high speed engines, having practically no cut off and expansion, about thirty feet of 5/16 in. tubing is required per horsepower. For this it is necessary to burn nearly a pint and a half of fuel per hour. The actual efficiency from a fuel standpoint is very low, probably about 7 per cent of the latent heat of the fuel being turned into power.

Engines

So much depends on the design of the machine, whether low or high speed reciprocating or turbine engine, that it is impossible here to say much about it. We will reserve the priceless information until some time when the Editor will let us have another page or so. Suffice for the moment to say that for small turbines of the De Laval type an efficiency of 40 per cent is all that can be expected, figuring from the latent energy of the steam before entering the nozzle. Doubtless about 30 or 35 per cent will be more common.

For large reciprocating engines, a mechanical efficiency of 80 per cent is fair practice. For our models, after all calculations for pressure, cutoff, etc., are made, 60 per cent should be deducted for friction and radiation losses. For the extreme high speed, racing engines, probably not more than 30 per cent of the calculated I.H.P. will be applied to the propeller.

Small internal combustion engines will probably operate at about 60 per cent of their figured power.

Propellers

Many scientific and painstaking experiments have demonstrated that for maximum efficiency a propeller should work with a 20 per cent slip, and that the greatest efficiency to be obtained is only 75. Now, in a model boat it is about impossible to tell at what revolutions the engine is running, and therefore at what slip the propeller is working. It is likely to be around 40 or 50 (we are always hoping for more speed than we get and design accordingly). This added to the necessarily large sections of the small blade reduces the theoretical efficiency to probably 40.

Storage Batteries

In the laboratory, the storage battery is most efficient, about 98 per cent of the current put in having been taken out. In our small one in actual use we will do well to figure about 60 per cent or possibly 70 per cent. This takes no account of damage to the plates or the fact that it is never wise to completely discharge the cell. It is no affair of mine if you mistreat them, but just as a tip, if you are willing to stand the expense or trouble, and if you want a little extra speed in that boat some day, you may wreck the battery, but you can get pretty near that 98 per cent—once.

Gearing

Spur gears are the most efficient and durable and if properly cut and fitted there seems to be no difference whether they are small or large. Efficiency is better at the higher speeds, running from about 90 per cent at a pitchline speed of three feet per minute to 98 per cent at a two hundred foot speed.

The same thing applies to worm gears with the added attraction that the efficiency falls off rapidly as the worm angle is changed from 45 degrees. Maximum possible efficiency about 92 per cent.

Belting

Efficiency figures of belting mean nothing. The following rules by F. W. Taylor will help to solve any problem of this nature:

A double leather or 6-ply rubber belt with an arc of contact of 180 degrees will give a pull on the face of pulley of thirty pounds per inch width of belt.

Eleven hundred feet of one inch belt passing around a pulley per minute will transmit one horsepower.

A single belt will do about 60 per cent of this.

Tackles

We all know that a rope and pulley will help lift a greater load than we make without it. How much? The good old fashioned rule for finding the weight required on the hauling end is to add 10 per cent to the load for every pulley in the tackle and divide the total by the number of parts sustaining the load.

In conclusion, don't reduce your own efficiency by trying to remember all this. Make a note on your card index or in your note book that all good engineers should have, as to the issue and page number and then when you do want any of these figures you will know where to find them and have them correct. This will be much better than misremembering the quantities and will possibly save me some "cursing out."

A careful study of these fact will probably remind "Mr. Average Experimenter" how really inefficient and careless he is in designing and constructing his apparatus. Only the very first principles of machine efficients have been treated in this article, but it is hoped that it will awaken a desire to carry the study further.

Digitized by Google

Book Reviews

(*Continued from page 323*)

how accidents are caused through careless mounting and guarding of wheels and how these accidents can be overcome by proper precautions. Abrasive cloths, papers, their manufacture, nature and use are fully described in Chapter Fifteen. The latter part of the book is a complete exposition of the actual shop use of grinding wheels in surface grinding, cylindrical grinding, internal grinding, special grinding operations, cutter sharpening and saw sharpening. This material is compiled with a special view to educating the reader regarding the actual application of abrasives in the machine shop.

We feel very safe in giving this book a thorough endorsement and we feel sure that all those who read it will feel amply repaid for their time and trouble.

BOILER FEED WATER, Its Effects, Treatment and Analysis, by Percy G. Jackson, F. I. C. Size 5 x 7½ inches; 100 pages. Published by J. B. Lippincott Company, Philadelphia, Pa.

The author of this volume had extensive experience as a chemist for a boiler insurance company. This position brought him in contact with all the problems that can arise in boiler operation. Cases of feed water trouble are so common that this information will be generally helpful to engineers and chemists. An expert chemist is often not immediately obtainable in an emergency and a knowledge of the principles and methods of application controlling the underlying causes of these troubles will present a large percentage of loss and delay in the operation of any boiler plant.

The contents include mineral constituents, corrosion, softening, selection of softening, priming; scale, grease, and overheating, methods of analysis, analysis of scale, control tests for water softening, sampling and solutions. The appendix gives some valuable tables and factors of atomic weights and Clark's table of hardnesses .

ANALYSIS OF BABBITT, by James Brakes. Size 5½ x 7 inches; 169 pages; bound in cloth. Published by the Allen Book & Printing Company, Troy, N. Y.

This book treats the analysis and manufacture of the alloy, babbitt. It is especially prepared for mining, civil, electrical and mechanical engineers who use this important alloy in their profession. It is also an important guide to manufacturing establishments that find use for babbitt in their work.

The book will also be found to be a valuable one for the young chemist who desires information on this particular subject.

The contents cover the properties, qualitative, volumetric and electrolytic analysis of babbitt compound. Antimony, tin, lead and copper are treated.

PRINCE ALBERT *the national joy smoke*

Our exclusive patented process cuts out bite and parch.

Telegraph Pictures
BY ELECTRICITY

A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.
L. J. LEISHMAN CO. Dept. L, Ogden, Utah



SEND $1. TODAY

For One Hundred Successful Circular Letters. No two copies alike. Letters that pulled business in 100 different lines of business. This is not a book that tells "How to Write Letters," but gives the complete copies of each letter. Worth their weight in gold. Special letters prepared on every subject, $5. each. Three follow-up letters, $15.00. These letters are endorsed by advertising agencies and the press.
Established Reputation (25th Year)
ROSENBLUM ADVERTISING EXPERT
1482 Broadway, New York City

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY



Small Investors Wanted
To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.
For full particulars address
Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit, and low price.
At Drug Stores or sent direct $1.00
Send for booklet of other styles and prices
J. C. SCHNOTER CO.
523 SIXTH AVE. *Dept. E* N. Y. CITY

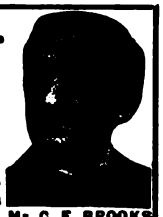
Your Prospective Customers
are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.
Send Them Sales Letters
You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"
Ross-Gould Mailing Lists St. Louis

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 905 Bogue Bldg., Indianapolis



Dickson School of Memory, 1740 Hearst Bldg., Chicago, Ill.

Don't Wear a Truss



Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.
Mr. C. E. BROOKS
Brooks' Rupture Appliance
Has automatic Air Cushions, Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.
Brooks Appliance Co., 264A State St., Marshall, Mich.

Mathematics Made Easy



The Arenascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.
Dept. U, L. J. LEISHMAN CO., Ogden, Utah

DRAFTING
Inventions and Ideas Developed!
Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE
A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

KLEANE-Z-SUSPENSORY
FORM FITTING FOR ALL MEN
LINEN (MESH) $1.50



PRICES ALL SIZES
Balbriggan $1.25
Linen (Mesh) $1.50
Fine Glove Silk $2.00
Heavy Silk (Mesh) $2.50
One Extra Sack
At your dealers or sent postpaid on receipt of price.
A. R. CHISHOLM CO., New York, N. Y.
Suite 597 1328 BROADWAY

Digitized by Google

Adjusting Bracing Wires Scientifically

IT has been necessary in the past to depend upon the judgment of the mechanics assembling an airplane for securing the correct initial tension of the landing and flying wires, interplane or incidence bracing and drift cables, through adjustment of the turnbuckles. They secured what they considered the proper uniform tension by the "feel" of the wire or by listening to its vibrant sound when plucked with the finger. Either of these methods is crude and inaccurate, owing, among other things, to the widely varying diameter and length of the wires. Some experiments have shown that wires thus adjusted for equal tension have really varied by several hundred per cent. A dangerous condition may thus be developed by causing overloading of airplane members, such as struts, wing spars and fuselage compression members, through adjustment of initial tension. This emphasizes the need of an apparatus to determine accurately the load in a flexible tensile stressed member.

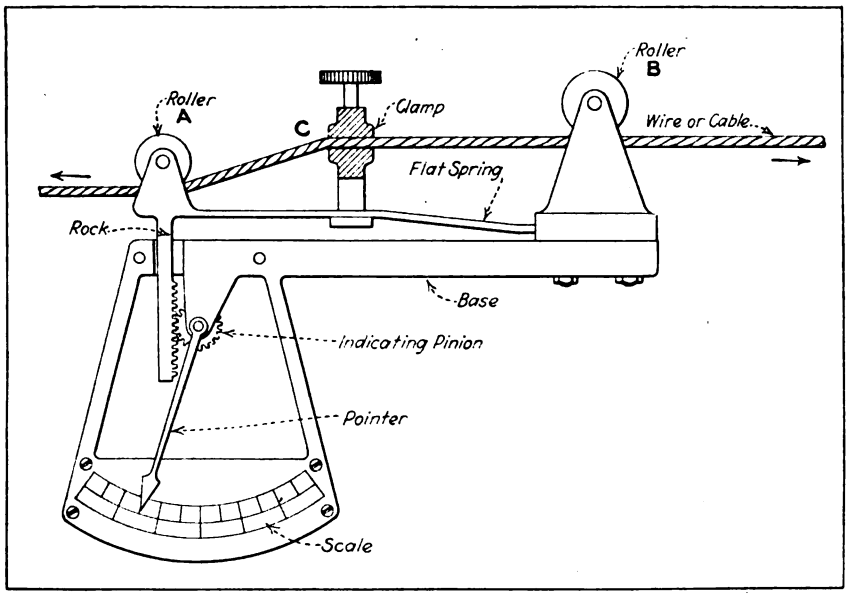


Diagram showing tensiometer for gauging tension of airplane bracing cable

These parts of an airplane are subjected not only to the stresses imposed by the flying load, but also to the initial stresses, caused by the tension in the bracing and drift wires. An appreciable initial stress in these wires is necessary to maintain the alignment of the machine and in many cases the initial stresses have been found to form too large a proportion of the total load. Failure of the structure in service has sometimes resulted from an improper adjustment of the turnbuckles in cables.

A simple device, known as the Tensiometer has recently been described in Bulletin No. 32 of the National Advisory Committee for Aeronautics that eliminates all guesswork from wire adjustment and makes it possible to have the tension of opposing or co-acting bracing cables uniform to an error of less than 10 pounds.

The instrument consists, essentially, of a frame with supports spaced 10 inches apart, between which a section of the wire or cable is adjusted. Midway between these supports, and operated by hand grips, is a plunger which deflects the wire 0.1 inch from its normal position. The operation of deflecting the wire compresses a calibrated spring. A dial indicator measures the deformation of the spring and thus the load on the wire. One revolution of the indicator pointer corresponds to a load of 1,000 pounds, and the smallest dial division, to a 10-pound load.

The theory upon which the instrument is based is very simple. If a wire, under tensile stress, is supported at two points and loaded at the middle of the span thus formed, a system of three forces in equilibrium is established. If the span and deflection are kept constant, as in this instrument, the deflecting force is a constant fraction of the tension in the wire.

The Tensiometer is made direct reading by graduating the indicator dial upon the loading spring so as to read tension in the wire instead of load upon the spring. A second dial indicator allows the simultaneous determination of the deflection to the nearest 0.001 inch. The use of these two sensitive indicators for accurately determining the position and load upon the wire is, in a great measure, the reason why accurate results are obtained with the Tensiometer. In use it is advised to attach the Tensiometer to the wire. It is simply put into place and the grips are brought together until the proper deflection is obtained. The tension in the wire is then read from the other dial, which gives the value directly in pounds of stress.

A diagram given herewith shows the principle of a simple instrument of this nature used in England. The principle of this appliance is that if a wire is stretched between two fixed points, a pull is required to deflect or bend it and the amount of pull varies directly as the tautness of the wire and can be taken as a measure of the stretching force. For this purpose the guy wire to be tested rests on two rollers, A and B, and is clamped at C. The two rollers and clamp are not in a straight line, therefore the stiff spring to which one of the rollers is attached is deflected and the amount is transferred by a rack and pinion movement and indicated on a scale graduated in pounds by a suitable pointer.

Concrete Floats for Ship Salvage

THE first of a new type of "mystery ship" has been completed near Brighton, England. It has taken some months to construct and the cost approaches $5,000,000 for each ship. Altogether six are to be built. Unlike the ships built during the war, these are not intended for destruction, but for salvaging merchant vessels sunk by submarines around the British coasts. The position of these merchantmen have been ascertained and divers have reported that many can be raised and again fitted for service. The new salvage ships look like segmented towers, with broad ship-shaped bases. They rise tier on tier like a welding cake, each tier diminishing in size to the top one, which is over 100 feet above the base. Each tier is made of numerous blocks of concrete, honey-combed to withstand external pressure but otherwise hollow. Water-tight doors are provided by which the blocks can be filled with water and pumps by which the water can be forced out and replaced by air. These concrete towerships have no motive power and are to be towed in pairs to the neighborhood of sunken merchantmen. On a calm day the interior will be flooded and the ships will be sunk on each side of the wreck. Divers will lash them to the wreck with steel chains and cables, the water will be pumped out, and if all functions as intended the tower-ships will rise, bringing the wreck to the surface. The construction of these ships has provided a new industry for Brighton. Many hundreds of men have been employed and shipyards constructed where only mudflats and waste land was found.

Digitized by Google

ALUMINUM IN THE MOTOR CAR

By H. A. Tarantous, Member S. A. E.

JUST before the country entered the war the automobile industry was beginning to use aluminum alloys in a way that predicted the coming of the light car era, but just as all big movements have their obstacles so did the use of aluminum. Its price became prohibitive and then again all sorts of restrictions were put on the car manufacturers so that the whole movement was halted. But not for long. The car makers are again on the right track and aluminum alloys are going to be used in more cars and in a great number of units of those cars.

It is not speaking very well for our industry to say that it has had the opportunity to use aluminum alloys for many years past and has not taken advantage of the numerous advantages of it, especially its lightness in weight. Weight reductions must be made in our cars if they are to reach a point of efficiency comparable with other machinery we have been using. Automobiles are wasteful of fuel, oil and tires and cost so much to keep in repair because the cars are admittedly too heavy. Aluminum is perhaps the lightest metal we have and its alloys are not only lighter than most metals but equally as strong and in many cases stronger. Aluminum is easy to machine, it does not rust like iron or steel, it takes paint easier and it looks better. It is a great conductor of heat and thus runs cooler than other parts.

I doubt very much whether the average reader has ever seen a real aluminum car or ever dreamed that we would see aluminum wheels, aluminum body, engine and dozens of other parts made of this material. There is such a car in existence and its weight is so low that its fuel consumption is something like fifty miles per gallon and it runs about 1200 miles on a gallon of oil. Experimentally it has run upward of 50,000 miles and the repair cost has been one-third of that of an ordinary vehicle of today.

Light weight must be used in many parts which now are unnecessarily heavy. Following are some parts in the modern automobile which can be made of aluminum and made to give better service than the heavier car. Many of these are already in extensive use. Cylinders, crankcase, fan, water pump, mountings for auxiliary engine parts, spark and throttle connections, pistons, oil pump housings, all brackets, radiator core and shell, hood, fenders, running boards, body, windshield supports, clutch housing, many clutch parts, transmission case, rear axle housings, brake drums, wheels, hub caps, small parts, fittings and brackets, such as door handles, floorboards, certain bolts and nuts, mouldings, etc. Think of the steering system parts which could be made of aluminum.

It can readily be seen that if aluminum alloy is substituted for many of the iron and steel parts that the whole car would be considerably lighter in weight, and we all know that the lighter the car the less gasoline it uses, and the easier it is on tires. Above all, if the car is designed scientifically and the aluminum is used in the proper places, the engine can be made smaller and the same performance had as before. In other words, as you lighten you can reduce the size of the working parts and thus effect a still greater saving in weight.

It might be a surprise to many to learn that experiments have been made with practically every part of a car made of aluminum, including rims, propeller shafts, and other such parts. While it may not be possible to get aluminum to do all sorts of work, it certainly is clear that it can be made to do a great deal that now is being done by heavier parts.

It is possible by the use of aluminum to get a large car, which weighs considerably less than a smaller one of other materials, and have that larger car perform better than the smaller and be more economical. This can be done by the proper use of aluminum and scientific design, by getting the sprung and unsprung weights correct and by getting the correct spring suspension. Present owners know that when they drive along a road that is not very smooth the rear wheels leave the ground. If it were possible to keep the four wheels on the ground all the time the average car would give over 15,000 miles on a set of tires. That is just what one will get in a light car with a light axle, because there will be no grinding away of tread, but simple natural wear due to friction of the tire against the road surface. This is a small fraction of the wear a tire gets because it leaves the ground, spins rapidly in the air and then strikes the ground spinning. It is no different from holding that tire against a grindstone.

The reason the wheels leave the ground is obvious. The wheels, rim and the axle are so heavy that when the wheels strike a bump or a rut the whole unit moves upward and the springs cannot stop it from bounding up and down until the stored up energy is expended. The spring in order to prevent that bouncing would have to be stiff, and so soon as you make them stiff you bring about hard riding. The light weight will overcome this tendency, and coupled with a proper spring suspension will give a light vehicle that will hold the road at any speed in its range.



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6069-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name_____

Present Occupation_____ 7-20-19

Street and No._____

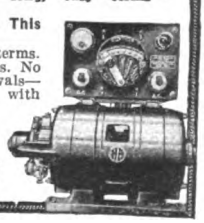
City_____ State_____

HB BATTERY CHARGING PAYS BIG PROFITS

You Can Make $100 to $200 Clear Extra Profit Each Month—This HB 500 watt outfit recharges 1 to 8 6-volt batteries at once for 10c to 15c each. Owner pays 75c to $1.50. Figure those profits! You can build a big, profitable business in battery charging. No mechanical knowledge required. Small investment—long, easy terms—BIG PROFITS.

Small Cash Payment Puts This HB Outfit in Your Shop

Balance on easy monthly terms. Profits easily carry payments. No burnouts, no expensive renewals—steady, dependable service, with BIG PROFITS. Absolute Money-Back Guarantee. Tear out this ad and mail TODAY for information.



HOBART BROTHERS COMPANY
Box EE21 Troy, Ohio
Successful Mfrs. Since 1893

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

AGENTS—Something different! Our Eradium (Luminous) Crucifix actually Shines in the Dark. Startling! Mysterious! Wonderful enthusiasm follows every demonstration. 150% profit on every sale. Sole manufacturers. The Pioneer Corporation, 1265 W. 63rd Street, Chicago.

SCIENCE CREATES NEW AUTO WONDER; solves puzzling problem; no more rain or snow blurred windshields; mystic cloth works like magic; deposits invisible chemical film; one rub keeps glass clear 24 hours; one agent sold 5,000. Security Mfg. Co., Dept. 255, Toledo, Ohio.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

FORMULAS FOR GASOLINE PEP TONIC, carbon remover, polish for automobiles, furniture, or floors, tire cements, antifreez mixtures. Save money. All sent for $1.00. Baker Dist. Co., Box 928, Atlanta, Ga.

MORE Power, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

Automobile Schools

HAVE YOU A TRADE?—Why not learn the Automobile Business—actual practice under expert instructors qualifies you in a few weeks' time to repair or drive any make of car, truck or tractor. There are always plenty of good positions open for trained men. Write today for particulars to Buffalo Auto School, Dept. 84, Buffalo, N. Y.

Aviation

BUILD YOUR OWN AEROPLANE; materials on installments, in the rough or cut to fit ready to assemble. Also machines completed. J. Angeles, Centralia, Wash.

THE VERY LATEST IN MONOPLANES. THE ARMITAGE TRACTOR. Rises from the ground by its own power. Length 21 in. Wing spread 20 in. Chord, 4 in. Has rubber tired disc wheels. Detachable running gear. Indestructible propeller. Aluminum trimmings. Get yours now while they last. Immediate delivery. Positively guaranteed to fly. Send your order now. We will ship C. O. D. Price packed $3.50. Armitage Engineering & Aeroplane Co., New Orleans, La. Dept B-2.

WANT TO SELL small, uncompleted airplane, with motor, or will exchange for motorcycle. BRUBAKER, 522 East 78th St., New York.

BUILD THE SIMMONS BIPLANE, flies with motorcycle engine. Pricelist. Complete drawings and building instructions so simple you can't go wrong. $1.00. Particulars free. Simmons & Lawrence, Fairfield, Ill.

Books

GAMBLING EXPOSED. Sensational book exposing secret systems, tricks, schemes and devices gamblers use with cards, dice, etc. You may need this book for your own protection. Particulars free. United Sales Co., Springfield, Ill.

RARE BOOKS. Three miscellaneous catalogues, etc., for stamps. Sovereign Company, 160 Sycamore, Buffalo, N. Y.

BOOKS FOR MEN. Also "Classy" pictures. Catalogue free. United Sales Co., Springfield, Ill.

BOOKS ON SEX. For men and women. Catalogue free. United Sales Co., Springfield, Ill.

Business Opportunities

QUARTER FOR AGENTS' RATE BOOK, ETC., on magazine subscriptions. Supplies furnished. Wilson Agency, Middletown, Ohio.

MONEY IN LIST COMPILING. Complete course on compiling and selling names by mail to advertisers. Description free. Globe Publishing Co., 176 Syracuse, N. Y.

MONEY SAVED—All kinds used correspondence courses sold. (Also courses bought.) Write Lea Mountain, Pisgah, Ala.

Chemicals

MICROSCOPES. Balances, Experimental Laboratories. Buy through our easy Payment Plan. No red tape. Write for Booklet 24-E. Chemical and apparatus supplied for all Chemistry articles appearing in Everyday Engineering. Perform their experiments with our equipment. Lions Scientific Institute, Bausman Street, Mt. Oliver, Pittsburgh, Penna.

EXPERIMENTERS—This Ad pays for itself because Everyday Engineering Readers are our regular customers. Our chemicals, apparatus, and supplies outfit their laboratories. Why not yours? Ask for free price list and free service card. Lions Scientific Institute, Mt. Oliver, Pittsburgh, Pa.

Experimenters

EVERY EXPERIMENTER should have one of our handsome wooden test-tube racks. Holds thirteen tubes. Has draining pegs. Price 85c. David Altman, 225 East 110th Street, N. Y.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

MOLASSES BEER, it's delicious, like the good old fashioned. Very easy to make. Absolutely pure. A real chance for agents. Formula for making sixty gallons, one dollar by mail. Oriental Laboratories, 2314 E. Albert, Philadelphia, Pa.

GET my formula for making paste resembling the diamond. Price 25c postpaid. Barber, 523 Tully St., Syracuse, N. Y.

For Sale

"BEST OFFER OVER $75 takes latest type Drummond 4 inch screw cutting and milling lathe, imported direct from maker and never unpacked. William Cawley, R. D. 3, Milton, Pa.

FOR SALE—Goodell Pratt Amateur bench lathe complete, 1st class condition. U. B. Scheiner, 64 Wyckoff Ave., Brooklyn, N. Y.

Help Wanted

WANTED—Railway Mail Clerks. Men-women. Commence $110 month. Experience unnecessary. Common education sufficient. Last positions open—free. Write immediately. Franklin Institute, Dept. P 99, Rochester, N. Y.

MODEL MAKERS—Splendid opportunity in marine model shop for several young men who have decided taste and inclination in this line of work in both wood and metal. Write fully stating age, experience, where had, and wages expected. Address Model Maker, Everyday Engineering Magazine, 2 West 45th Street, New York.

Instructions

CRYSTAL GAZING—The craze. Send self-addressed stamped envelope right now for free instructions. Zancig's, Box 556, Asbury Park, N. J.

Inventors

INVENTOR'S MANUAL, HOW TO MAKE A PATENT PAY is a work of special interest to inventors in perfecting their inventions, taking out their patents, and disposing of them. It is not in any sense a Patent Solicitor's circular nor a Patent Broker's advertisement. No advertisements of any description appear in the work. It is a book containing a quarter of a century's experience of a successful inventor, together with notes based upon the experiences of many other inventors. 120 pages. Price $1.25 postpaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

TWO VOLUMES on MECHANICAL MOVEMENTS by G. D. Hiscox are works every inventor should have for it is illustrated in these volumes. If it hasn't been reference. If the thing you want has been invented, invented, then you'll find in it the nearest things to what you want, some movement or device that will apply in your case, perhaps; or which will give you a key from which to work. No books ever published are of more real value to the inventor, draftsman or practical mechanic than this set of books. Price per volume each $3.00 prepaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

INVENTORS. In all matters concerning Patents, The National Institute of Inventors, 118 Fulton St., New York City, a co-operative society of 2500 will help you protect, develop and market your inventions. Annual dues $10.00. Booklet on request.

INVENTORS—We do experimental Model, Tool, Die and Jig work. Light manufacturing. Miller & O'Brien Mfg. Co., North Saint Paul, Minn.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS; $110.00 a month to start and expenses; travel if desired; unlimited advancement. No age limit. Three months home study. Situation arranged. Prepare for permanent position. Write for Booklet CM-36. STANDARD BUSINESS TRAINING INSTITUTE, Buffalo, N. Y.

FIREMEN, BRAKEMEN, BAGGAGEMEN, $140-$200. Colored porters, by railroads everywhere. Experience unnecessary. 898 Ry. Bureau, East St. Louis, Ill.

Miscellaneous

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

SPORTSMEN — Trained beagles, rabbit, fox, coon, skunk, squirrel, and opossum dogs, bird dogs, pet and farm dogs, swine, rabbits, pigeons, pheasants, goats.—100 Varieties blooded stock. Circulars 10c. VIOLET HILL KENNELS, YORK, PA.

ADDRESSOGRAPHS, multigraphs, multicolors, folders, sealers and duplicators. Guaranteed. Office Device Company, 156 F North La Salle, Chicago.

DETECTIVES EARN BIG MONEY. Travel. Experience unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

SHAWNEE, OKLAHOMA, a growing city. Write Board of Commerce, Shawnee, Oklahoma.

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

Miscellaneous—Cont'd

TRIGONOMETRIC ENTERTAINMENT, 10c. Postage, 2c. E. Lennert, 305 E. 76th St., New York City.

RECHARGE YOUR OLD DRY CELLS for almost nothing. Directions, ten cents silver. Gilbert, 28 Chestnut, St., Binghamton, N. Y.

PYTHAGORAS BALL GAME, 10c. Postage, 2c. E. Lennert, 305 E. 76th St., New York, N. Y.

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

SONG WRITERS! Our plan brings quick results from publishers. New York Musical Bureau, 411-U, 1545 Broadway, N. Y.

MYSTERIOUS. Wonder Shavings, new Japanese novelties; when dropped into water turn into babies, flowers, fish. Dozen in pretty package, 15c; three, 35c. Excellent dinner party favors; they create talk. Twelve packages, $1.00. George D. Heinemann, 1424 Rosemont, Chicago.

Photography

DO YOU TAKE PICTURES? Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 406 Pope Building, Boston, Mass.

Motion Picture Plays & Supplies

$25-$300 paid anyone for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

Patents

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS — Herbert Jenner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

DON'T LOSE your rights to patent protection. Before disclosing your invention to anyone, send for blank form "Evidence of Conception," to be signed and witnessed. Form and information concerning patents free. Lancaster & Allwine, 237 Ouray Building, Washington, D. C., "Originators of the Form 'Evidence of Conception.'"

Patents and Trade Marks

WE HAVE recently associated with us three examiners from the U. S. Patent Office. Mason, Fenwick & Lawrence, Lawyers, 600 F St., Washington, D. C.—220 Broadway, N. Y. City—111 West Monroe St., Chicago, Ill. Established over half a century.

INVENTIONS PATENTED, Trade-marks registered, labels, prints, publications copyrighted, prompt service, reasonable fees, plain advice, request detailed information before placing your business. Jaynes & Jaynes, 804 Kellogg, Washington, D. C.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York. 625 F Street, Washington, Tower Building, Chicago, Hobart Bldg., 582 Market Street, San Francisco, Calif.

PATENTS—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years' actual experience; full information upon request. B. P. Fishburne, 822 McGill Bldg., Washington, D. C.

PATENT OWNERS—We positively create a market for your patent rights. Write, requesting sound proposition. Glassford Company, Redfern Avenue, Montreal. Not an agency.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Established 1882. "Inventor's Guide" FREE. Franklin H. Hough, 510 Loan & Trust Bldg., Washington, D. C.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

FREE PREMIUM with 4 Belgium German occupation, for 10c. Jos. Gallant, Hempstead, N. Y.

Tricks

1,000 STAGE TRICKS with 500 illustrations. Catalogue 15c. Small Catalogue Free. Hornmann Magic Co., Station S, 304 West 34th St., New York.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¼" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotoy Electric, Charlotte, N. C.

WIRELESS AMATEURS, you can build things better from working drawings. Send $1.00 today for set of blueprints of an amateur wireless receiving set. Northwestern Blueprint Co., Portland, Oregon, Box 331.

WIRELESS OPERATORS IN GREAT DEMAND—Learn wireless telegraphy at home. Complete course and practice set $15.00. We answer all questions free afterwards. We maintain a **DESIGNING BUREAU** and design apparatus. Anything wireless. Write immediately. Radio Intelligence Bureau, Dept. D., 864 Roosevelt Place, New Orleans, La.

Digitized by Google

CONTENTS

Vol. 8 MARCH, 1920 No. 6

A Sixteen-Foot Shallow Draft Power Boat 361
By A. C. Leitch

The Story of Artificial Abrasives..... 366
By Raymond Francis Yates

The Heat Treatment of Tool Steel..... 369
By Warren S. Dunlap

Makeshift Crankshaft Repairs for Obsolete Engines 370

Building a Two-Passenger Seaplane..... 372

Making Cable and Hard Wire Terminals by Machinery 375

The Kitchen Reversing Rudder..... 376

Adjusting Planetary Transmission..... 378

The Everyday Motorist..... 379

The Design and Construction of Model Locomotives 382

A 2500-Watt Step-down Transformer for Arc Welding 384
By E. F. Tuttle, Jr.

Complete Enclosure for Passengers the Feature of New Airplanes..... 386

New Fittings for Motor Boats..... 388

Models Made by a Reader..... 389

The Standardization of Gauge Design..... 390
By Walter J. Oldroyd

Electrical Progress Digest..... 393

The American Society of Experimental Engineers 394

Motor Sleds for Winter Sports..... 395

Compressed Air Motor for Model Airplane Propulsion 396
By H. C. Ellis

A Practical Small Airplane..... 397

The Construction of a Chanute Glider... 399
By Percy Pierce

Shop Practice 401

Our Readers' Workshops Page..... 403

The Junior Experimenter..... 404

The Chemistry of the Common Metals... 405
By Henry L. Havens

Everyday Science Notes..... 406

Construction of a Portable Receiver, B-C Wavelength Range 408
By M. B. Sleeper

A Radio Frequency Amplifier Without Transformers 414

Making an Audion Socket..... 416

Radio Buzzer Construction..... 417

Commercial Stations Released by the Government 419

Benzol-Alcohol Fuel Mixtures for Internal Combustion Motors..... 420
By Kenneth Alton

New Foreign Auto Body Designs..... 439

Book Review..... 441

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

Editor RAYMOND F. YATES
Managing Editor VICTOR W. PAGÉ
Radio Editor M. B. SLEEPER

Contributing Editor
PROF. T. O'CONOR SLOANE

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Office
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, INC.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechancis Co., Inc.

THE VIBRATING WORLD

EVERYTHING vibrates; everything is eternally busy. The air vibrates, the ether vibrates, molecules and atoms vibrate. Nothing is still, nothing dead. True, many of the vibrations are quite beyond our senses, but science assures us that the whole world is a mass of vibrating particles.

SOUND waves, wireless waves, heat waves, light waves, visible and invisible, are made up of vibrations. Vibrations produced in air we call sound waves. In the ether the properties exhibited by waves depend upon their length. The real long waves are called Hertizan or wireless waves. The next shortest are heat waves, the next infra-red waves, and from this point they develop into visible red light with a frequency of vibration in the neighborhood of two billion per second. As the waves become shorter and shorter the sensations of orange, yellow, green, blue, etc., are produced until the zone of the invisible is approached. Beyond this point, our senses fail us, and we must rely upon instruments to tell us of the presence of such rapid etheral vibrations as those necessary for the production of ultra-violet and X-rays. There may be many other invisible rays in the "ultra" zone of the spectrum. Present-day scientists claim that but a small part of the invisible spectrum has been discovered. What the future holds for those working in this promising field of investigation no one knows. One thing remains certain: We must increase our knowledge of vibration before the great problems that confront us today will be solved. The problem of atomic energy, heat, electricity, mental telepathy—all are wrapped up in the Mystery of vibration.

RAYMOND FRANCIS YATES, Editor.

Price of Everyday Engineering Increased

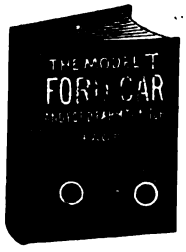
BEGINNING with this number, the price of EVERYDAY ENGINEERING MAGAZINE will be increased to 20 cents per copy and to $2.00 for the yearly subscription. However regrettable this step is, it has become necessary through the increased cost to us of paper, engravings, press work, drawings, binding, etc., etc. During the last few months EVERYDAY has been increased greatly in volume. The space devoted to editorial matter has been increased through the well-deserved support the magazine has received from its readers and the publishers feel that the new price, which is strictly a matter of necessity, will not interfere with the development and progress of the only periodical in its field that closely adheres to a policy of practicability in the dissemination of information for those interested in mechanics, electricity, radio, aviation, automobiles and model engineering.

Digitized by Google

EVERY PRACTICAL MAN'S LIBRARY SHOULD CONTAIN THE FOLLOWING BOOKS

The Modern Gasoline Automobile, Its Design, Construction, Operation.

By Victor W. Pagé, M.S.A.E. This is the most complete, practical and up-to-date treatise on gasoline automobiles and their component parts ever published. In the new revised and enlarged 1920 edition, all phases of automobile construction, operation and maintenance are fully and completely described and in language anyone can understand. 1,000 pages. 1,000 illustrations. **Price, $4.00**



The Model T Ford Car, Its Construction, Operation and Repair, Including the Fordson Farm Tractor. The F. A. Starting and Lighting System and the Worm Drive 1-Ton Truck.

By Victor W. Pagé. This is the most complete and practical instruction book ever published on the Ford car and the Fordson Tractor. Illustrated by specially made drawings and photographs. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and operating principle made clear to everyone. 425 pages, 150 illustrations. **Price, $1.50**

How to Run an Automobile.

By Victor W. Pagé. This treatise gives concise instructions for starting and running all makes of gasoline automobiles, how to care for them, and give distinctive features of control. Describes every step for shifting gears, controlling engines. 178 pages. 72 illustrations. **Price, $1.25**

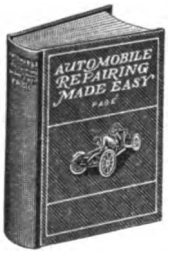
Automobile Welding with the Oxy-Acetylene Flame.

By M. Keith Dunham. Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understanable by everyone. 167 pages, fully illustrated. **Price, $1.50**

Abrasives and Abrasive Wheels.

By Fred B. Jacobs. A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantage in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering. 340 pages, 200 illustrations. This is an indispensable book for every machinist. **Price, $3.00**

Automobile Repairing Made Easy.



By Victor W. Pagé. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism. Written in a thorough but non-technical manner. This book also contains Special Instructions on Electric Starting, Lighting and Ignition Systems, Tire Repairing and Rebuilding. Autogenous Welding, Brazing and Soldering, Heat Treatment of Steel, Latest Timing Practice, Eight and Twelve-Cylinder Motors, etc., etc. You will never "Get Stuck" on a Job if you own this book. 1,000 specially made engravings on 500 plates. 1,056 pages (5½x8). 11 folding plates. **Price, $4.00**

Machine Shop Arithmetic.

By Colvin-Cheney. Most popular book for shop men. Shows how all shop problems are worked out and "why." Includes change gears for cutting any threads; drills, taps, shrink and force fits; metric system of measurements and threads. Used by all classes of mechanics and for instruction in Y. M. C. A. and other schools. Seventh edition. 131 pages. **Price 60c**

Steel: Its Selection, Annealing, Hardening and Tempering.

By E. R. Markham. This work was formerly known as "The American Steel Worker," but on the publication of the new, revised edition, the publishers deemed it advisable to change its title to a more suitable one. This is the standard work on hardening, tempering, and annealing steel of all kinds. This book tells how to select, and how to work, temper, harden, and anneal steel for everything on earth. It is the standard book on selecting, hardening, and tempering all grades of steel. 400 pages. Very fully illustrated. Fourth edition. **Price, $3.00**

Saw Filing and Management of Saws.

By Robert Grimshaw. A practical hand book on filing, gumming, swaging, hammering and the brazing of band saws, the speed, work, and power to run circular saws, etc. A handy book for those who have charge of saws, or for those mechanics who do their own filing, as it deals with the proper shape and pitches of saw teeth of all kinds and gives many useful hints and rules for gumming, setting, and filing, and is a practical aid to those who use saws for any purpose. Third edition, revised and enlarged. Illustrated. **Price, $1.25**

Brazing and Soldering.

By James F. Hobart. The only book that shows you just how to handle any job of brazing or soldering that comes along; it tells you what mixture to use, how to make a furnace if you need one. Full of valuable kinks. The fifth edition of this book has just been published, and to it much new matter and a large number of tested formulas for all kinds of solders and fluxes have been added. **Price, 35c**

Drafting of Cams.

By Louis Rouillion. The laying out of cams is a serious problem unless you know how to go at it right. This puts you on the right road for practically any kind of cam you are likely to run up against. Third edition. **Price, 35c**

House Wiring.

By Thomas W. Poppe. Describing and illustrating up-to-date methods of installing electric light wiring. Intended for the electrician, helper and apprentice. Contains just the information needed for successful wiring of a building. 125 pages, fully illustrated, flexible cloth. **Price, 75c**

Electric Wiring, Diagrams and Switchboards.

By Newton Harrison, with additions by Thomas Poppe. This is the only complete work issued showing and telling you what you should know about direct and alternating current wiring. It is a ready reference. The work is free from advanced technicalities and mathematics, arithmetic being used throughout. It is in every respect a handy, well-written, instructive, comprehensive volume on wiring for the wire-man, foreman, contractor or electrician. Second revised edition. 303 pages, 130 illustrations. Cloth. **Price, $2.00**

High Frequency Apparatus, Its Construction and Practical Application.

By Thomas Stanley Curtis. The most comprehensive and thorough work on this interesting subject ever produced. The book is essentially practical in its treatment and it constitutes an accurate record of the researches of its author over a period of several years, during which time dozens of coils were built and experimented with. 248 pages. Fully illustrated. **Price, $2.50**

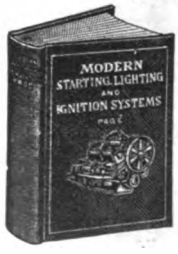
The Lathe—Its Design, Construction and Operation, With Practical Examples of Lathe Work.

By Oscar E. Perrigo. A new revised edition, and the only complete American work on the subject, written by a man who knows not only how work ought to be done, but who also knows how to do it, and how to convey this knowledge to others. It is strictly up-to-date in its descriptions and illustrations. A number of difficult machining operations are described at length and illustrated. The new edition has nearly 500 pages and 350 illustrations. **Price, $3.00**

Henley's Twentieth Century Book of Recipes, Formulas and Processes.

Edited by Gardner D. Hiscox. The most valuable techno-chemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work. New edition. Cloth. **Price, $4.00**

Starting, Lighting, and Ignition Systems.



By Victor W. Pagé. A practical treatise on modern starting and ignition system practice. This practical volume has been written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. It can be understood by anyone even without electrical knowledge. Nearly 500 pages. 297 specially made engravings. New Edition. **Price, $2.50**

☞ Any of these books sent prepaid on receipt of price. FREE—Our new 1920 Catalog of Practical Books sent free on request

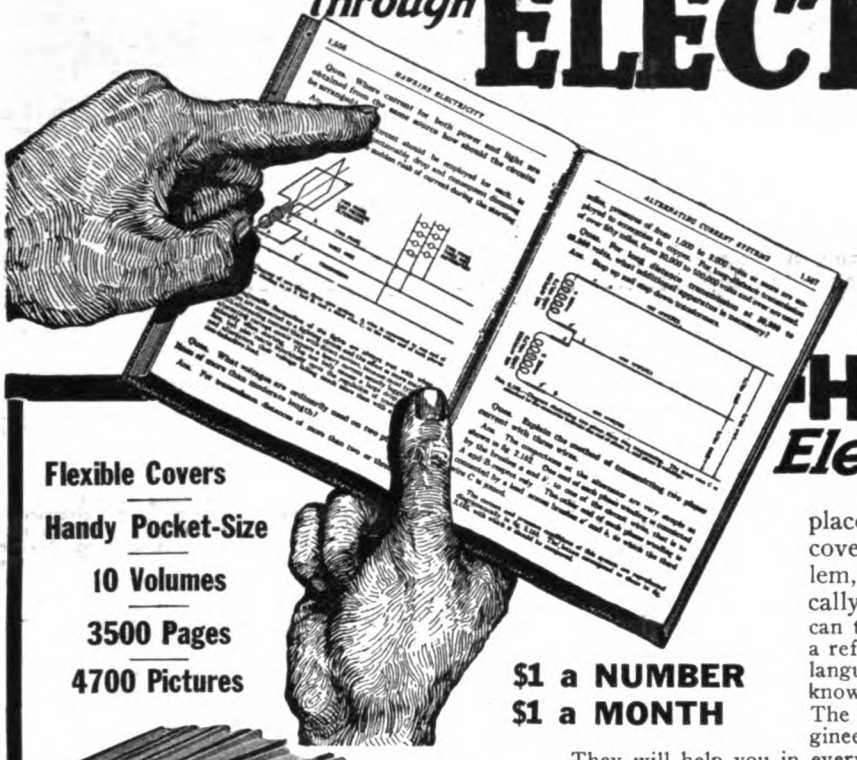
THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. **2 West 45th Street, New York**

Please mention Everyday Engineering Magazine

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent
Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved
The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.
The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.
Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry
The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....
Occupation .....
Employed by .....
Residence .....
Reference ..... Mar.

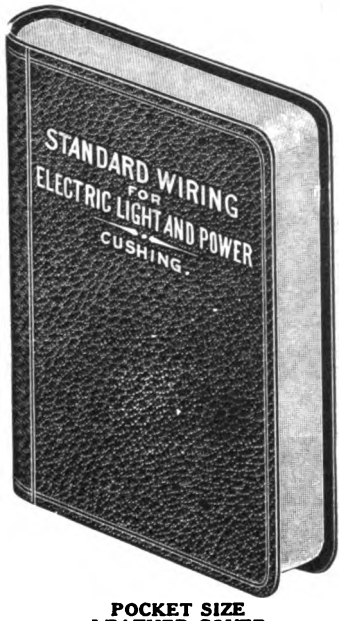
SEND NO MONEY - USE THE COUPON

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

LEARN WIRING

Earn $50.00 to $75.00 a Week



POCKET SIZE
LEATHER COVER
GILT EDGES

THE NEW EDITION **1920** COMPLETELY REVISED

"STANDARD WIRING"

Will Make You an Expert Wireman

GENERATORS—How to install them, care for them and operate them; all their troubles and how to prevent and cure them; all diagrams showing connections for compound, series and shunt wound machines. How to operate them in parallel or in series. How to protect them and wire them in accordance with the underwriters' requirements.

MOTORS—How to install them, how to protect and operate them. The required amperes, volts or horse power when any two factors are known. How to take care of hot boxes, sparking commutators and other troubles. How to change the direction of rotation when desired. How to start and stop any kind of motor in any class of service. All diagrams of motor wiring. How to find the proper size of wire for any motor for direct current or for A. C. single, two or three-phase.

OUTSIDE WIRING—Pole line construction, line wires, service wires, roof structures, poles and their dimensions and weights, and how to erect and protect them and wires they carry. Insulators, guard arms, guy anchors. Tree wiring, splicing, service and entrance wiring. How to install Lightning arresters. Transformers with diagrams and instructions.

INSIDE WIRING—When and where to use rubber covered, slow burning and weatherproof wire. How to find the proper size of wire to use for lamps, motors or heating devices for any current, voltage and drop, either by formula or by the many tables that are given in this section of the book. How to wire for two-wire or three-wire systems. Direct current, two-phase and three-phase with formulae and tables, with examples worked out for each system and in a simple manner that anyone can understand and use. How to run wires on walls, ceilings, floors, through partitions and walls and in concealed places, damp places and where dangerous surroundings exist. When and where to install Switches, Cut-outs and Circuit Breakers and just how to do it. How to wire for high and low voltage systems and the precautions to be taken. The proper way to install Knife and Snap Switches, Cabinets and Cut-out Boxes, Outlet, Junction and Switch Boxes, Panel Boards, Wooden and Metal Raceways. How to install complete interior conduit jobs either for rigid metal, flexible metal or flexible non-metallic conduit. Concealed knob and tube work or armored cable. How and where to install and wire electric and combination lighting fixtures. How and where to use flexible cord and where not to use it. How to install arc lamps and gas filled lamps and the fixtures and rules required.

LIGHT AND ILLUMINATION—What is meant by proper and efficient illumination, the latest data on Mazda and gas filled lamps of every candle power and wattage. Direct, indirect and semi-indirect illumination and where each should be used. Illumination required for various classes of service from show window lighting to public halls and from factories to small residences.

SPECIAL SECTIONS—House and residence wiring with diagrams; how to wire garages; how to wire theatres and moving picture houses; electric organs; marine wiring for ships and vessels; how to install and care for watt-hour meters; electric ranges, etc.

STORAGE BATTERIES—Both lead and Edison types and how to install, charge, discharge and care for them to get the best results.

250 ELECTRICAL AND MECHANICAL TERMS AND UNITS—Giving their definition, values and what they mean in your work together with the complete metric system of weights and measures.

TABLES—Fifty-two tables giving every dimension, carrying capacity, resistance, weight and strength of every size of wire and cable of copper, steel and iron. All the necessary dimensions, capacities, weights, and other data on conduits, fuses, insulators, lamp sockets, motor efficiencies, current per horse power of motors. Proper size of wire for all classes of power, light and heating installations. The proper symbols to use to indicate on plans just what is wanted from a motor to a small snap switch with all necessary diagrams.

APPARATUS AND SUPPLIES—A classified list of the leading manufacturers of officially approved wires and wiring devices. Engines, generators, motors, appliances, fixtures and all supplies necessary for any complete installation from a Central Station to a small cottage.

The only complete and accurate Book on Wiring and Construction published. Over twice the useful information ever contained in any previous edition.

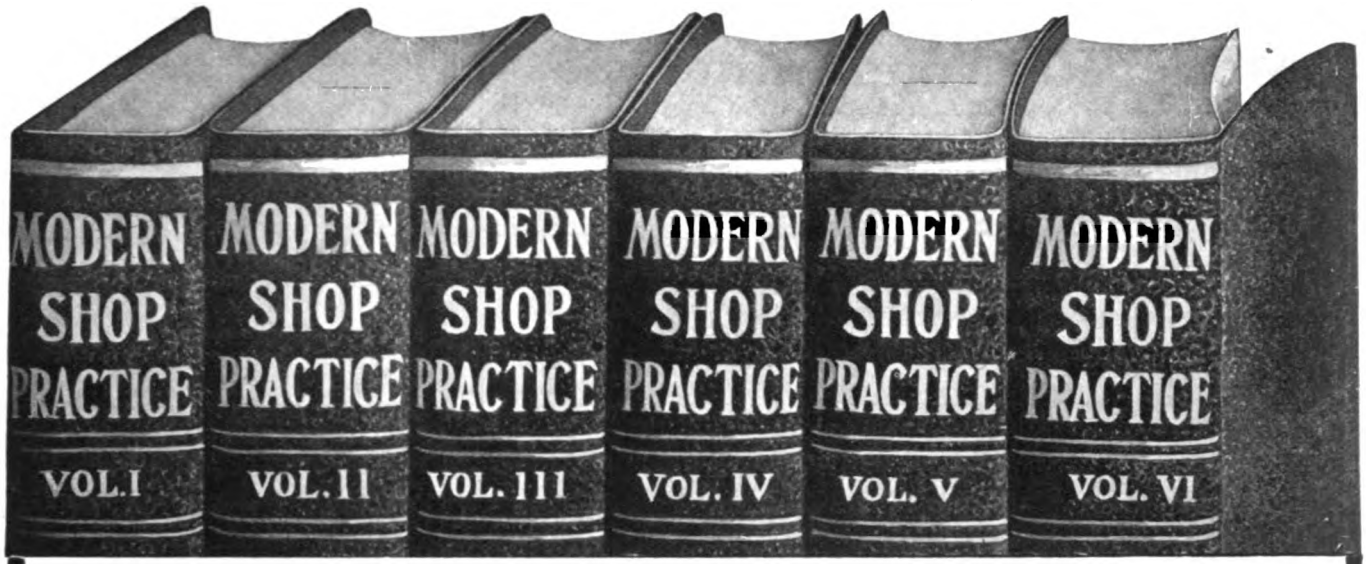
440 PAGES - LEATHER COVER - GILT EDGES - POCKET SIZE, $3.00

Sent Postpaid to Any Address on Receipt of Price by

H. C. CUSHING, Jr., 6 West 40th Street, New York

Every Electrical Inspector in the United States will approve your work if done in accordance with the simple rules given in "Standard Wiring"

Digitized by Google



Can You Answer these Questions on Shop Work?

Test Yourself NOW

A surface of Cast iron is to be finished in one cut on a milling machine. The casting is 8 inches long and 5 inches wide. The milling cutter has a diameter of 3 inches and a width of 2 inches. How long will it take to do the work? Assume a feed of 2½ inches.

For what purpose is a magnetic chuck used?

How many processes for cutting gear teeth?

How do you determine the ratio of two gears, when the numbers of teeth are given?

The lead screw has a pitch of ¼ inch. What is the ratio of gears to be used to cut a screw with 18 threads per inch?

What determines the cutting speed in a milling machine?

Give a short description of the thermit-welding process.

What is essentially the first step in making any tool from a tool-maker's standpoint?

Why is it advisable to cut the threads of an adjustable tap somewhat smaller than the desired size for the tap to cut?

Under what circumstances would you consider it advisable to use a counter-bore, rather than a drill, when enlarging a hole? Why?

Why should undue accuracy never be indulged in when making drill jigs and similar tools?

What is the practical way to test the temper of molding sand?

How does the riser on a steel casting differ from one for iron?

What are some of the precautions necessary in pouring a mold in order to obtain the best results?

How are the sides of deep molds vented when a flask is used?

What point carbon steel should be used for machine tools, milling cutters, drills, and taps?

Why is it necessary to reheat large pieces after they have been hardened?

What must be the outside diameter of the original wooden pattern for the rim of a pulley with six arms, the diameter of the finished pulley to be 30 inches and the width of face 9 inches?

What are the allowances for shrinkage in the construction of a wooden pattern of a shaft hanger bearing cap?

THE skilled mechanic today is a specialist. He has no opportunity to build a complete machine or even a small part of one. His active work is carried along rather limited lines. But to make the best success in his work—to secure promotion to more responsible duties or to go into business for himself—it is absolutely necessary that he have a broad and comprehensive knowledge of machine work and shop practice. There is only one really feasible way for the mechanic to familiarize himself with other shop lines outside his own individual work—and that is to have specialists in all lines give him all they have learned in a form that will be readily accessible. There you have the reason for the famous standard reference work, called "Modern Shop Practice."

Thousands of Dollars' Worth of Shop Information

"Modern Shop Practice" is a wonderful reference work in Machine Shop Practice and Management, Production Manufacturing, Metallurgy, Welding, Tool Making, Tool Design, Die Making, and Metal Stamping, Foundry Work, Forging, Pattern Making, Mechanical Drawing, etc. It has been tested through six editions, bought by thousands of mechanics, consulting engineers, shop superintendents and owners, production managers, etc.

New Edition Only 7c a Day

Six magnificent volumes, flexibly bound in American Morocco, gold stamped. 2,300 pages. 2,500 illustrations—photographs, drawing, explanatory diagrams, tables, etc. Here you have at your finger tips up to date labor-saving methods that big manufacturers have spent thousands of dollars to develop. Facts that you can use in your everyday work. Information that fits you to earn bigger pay. All this is now yours in the new 6 volume set of "Modern Shop Practice," on payments so easy as to average only 50c a week or only 7c a day!

SHIPPED FREE

No money in advance. Not a cent. See the books in your own home or shop absolutely free at our risk. Read them, examine them, study them for 7 whole days before you need decide whether you want to keep them or not. Send no money to get the books for free examination. Make no deposit. Assume no obligation. Simply sign and mail the coupon herewith and the books will be promptly shipped to you for 7 days' free examination. If you are not more than delighted with the books and do not consider them a wonderful investment, just send them back to us, and you won't owe us a cent.

If you prize the books and consider them worth many times their price to you, send only $2.80 within 7 days and then $2 a month until the special introductory price of $21.80 has been paid.

Extra Feature Free

To those who order promptly, we will give free a consulting membership in the American Technical Society for one year. This gives you the right to ask our experts any question regarding shop practice for an entire year. You may ask as many questions as you please.

A Few of the Subjects Treated

- Machine Shop Practice
- Machine Shop Management
- Production Manufacturing
- Metallurgy
- Welding
- Tool Making
- Tool Design
- Die Making
- Metal Stamping
- Foundry Work
- Forging
- Pattern Making
- Mechanical Drawing, etc.

SEND NO MONEY

Merely sign and mail the coupon and the books will be shipped to you at our risk. Get the coupon in the mail at once, before this special offer is withdrawn. Send it today—NOW!

American Technical Society
Dept. M-353
Chicago, U. S. A.

Please send me set of Modern Shop Practice for seven days' free examination, shipping charges collect. If I decide to buy, I will send $2.80 within seven days and the balance at $2.00 a month until $21.80 has been paid. Then you send me a receipt showing that the set of books and $12.00 consulting membership are mine, and fully paid for. If I think that I can get along without the books after the seven days' trial, I will return them at your expense.

Name.....

Address.....

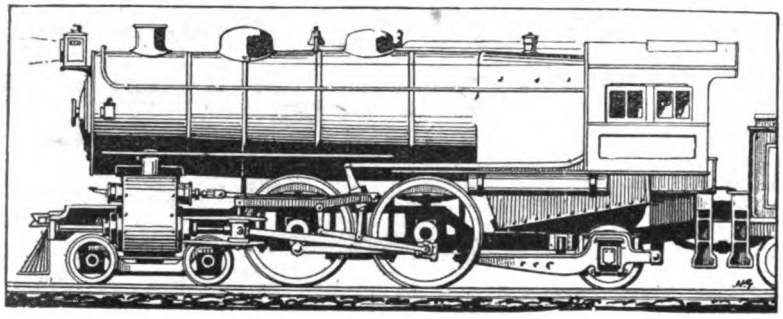
Reference.....

AMERICAN TECHNICAL SOCIETY, Dept. M-353 Chicago, Ill.

Digitized by Google

Model Railroad Materials

Standard parts designed by Mr. Henry Greenley, of W. H. Jubb, Ltd., Sheffield, England, now available for distribution in America.



All the parts mentioned in Mr. Greenley's articles in Everyday Engineering can be supplied.

Look for our permanent address next month.

F. DEY

Sole American agent for W. H. Jubb, Ltd., Sheffield, England

P. O. Box 497, City Hall Station, New York, N. Y.

Pattern Work in Wood and Metal

Prompt Service Guaranteed

U.S. PMC

Mail Order Work Solicited

Perfect wood or metal patterns made for any of the machines or model engines described in Everyday Engineering Magazine.

BRING YOUR PATTERN PROBLEMS TO US

We solicit the work of experimenters, inventors and model makers. Quotations gladly made upon the receipt of drawings and specifications. Patterns both large and small made for any part no matter how intricate or complicated.

Have you had the sad experience of taking a set of home-made patterns to the foundry only to have the foreman laugh and tell you that they are made wrong? Let us save you this embarrassment.

Our charges are reasonable, our service prompt and courteous.

U. S. PATTERN AND MFG. CO.

64-66 High Street, West. Detroit, Mich.

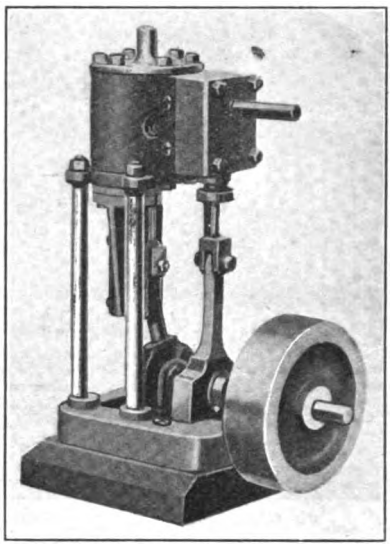
Speed Lathe, $7 Complete Swing 7 ins. 24 in. metal bed Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

MR. INVENTOR! Let us assist you with that idea that you can't just work out, or let us construct a model of your patent. We develop ideas, and are experts in MODEL and EXPERIMENTAL work. We specialize in designing and building special LABOR SAVING MACHINES. Or perhaps your device is ready for manufacturing. If so, get in touch with us. It would be to our mutual advantages.

ELK MFG. CO., INC.
1926A Broadway, New York

MODEL SUPPLIES



ENGINE—Finished as shown above. Special price of $12.50. Ready to run when received.

PUMPS — Double power and hand pump combined. Especially designed for model boats. Made with bore of 1/4, 5/16 and 3/8". Stroke 1/2". Cast in bronze with packing glands and mushroom valves.

Price $4.00

WATER GAUGES—Made with bronze castings and water-tight packing glands. Ready to attach to boiler.

Price $1.00

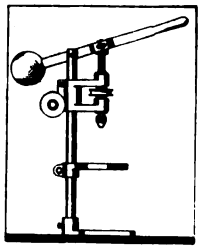
GLOBE VALVE — Cast in bronze with hand wheel.

Price $0.90

Get Acquainted With Us

MODEL MACHINE SHOP CO.
415 East 71st St. New York, N. Y.

LIGHT BENCH DRILL



Capacity — to 1/4". Rough or finished castings of this small, practical and sturdy drilling machine.

Rough castings or finished machines—6" lathe, hand power shaper and planer. Drawings for Model Boats. Stamp for catalogue.

HUHN MFG. CO.
588 Elm Street Arlington, N. J.



THE HURD 7 INCH HAND SHAPER

Rough Castings or Finished Machine

Send 25c for construction blue prints or $1.00 for complete set of detailed blue prints. This amount will be deducted from first order. Send stamp for circular.

MODEL TOOL WORKS,
908 West 3rd St.,
Plainfield, N. J.

ORDER YOUR APRIL NUMBER OF EVERYDAY ENGINEERING MAGAZINE NOW

Digitized by Google

How to Take Care of Dynamos and Motors

All About the Newest Wireless Apparatus

How to Wire Theatres and "Movie Houses"

All About the Newest Electrical Appliances

How to Build Small Motors and Generators

All About the National Electrical Code

A Thousand Things You Ought To Know!

EVERY day in your work you get up-against new problems—sometimes it is only some old "sticker" coming in a new way. Just the same though it takes a lot of time to figure them out. **Don't do it.** Here's everything worked out for you. Every problem, big or little, that you will meet in a day's work. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways **you** can make more out of the same work you are doing now.

The old days of hit-or-miss experience are passed. You have got to **know** if you want to keep in the running now. A little of your spare time and the Cyclopedia of Practical Applied Electricity will put you 'way ahead of the rest See our FREE trial offer and easy payment plan below.

Practical Applied ELECTRICITY

Eight great big volumes bound in genuine American Morocco with 3,800 pages and more than 3,000 blueprints, plans, pictures and wiring diagrams. It is the newest, most complete, most practical work of its kind ever published. Twenty-five well known experts prepared these great books, gathering the material from hundreds of different sources. Every man in the shop and on the job should have them. Over 50,000 sets of earlier editions have been sold. This is the new 1920 edition—new from cover to cover.

FREE Examination

No Money Down -- Pay Only $2 a Week

Send the coupon for these great Electrical books TODAY. You can't afford to be without them and you don't take any risk at all. The coupon brings the whole set by express collect for a week's free examination. Use the books a week and return them at our expense if they don't please you. If you like them, send us only $2.80 and $2.00 each month until $24.80 is paid. If you prefer to pay cash with order, send only $22.30. The return privilege holds good just the same. Send the coupon NOW and get a consulting membership in our Society free.



This part of the offer will be withdrawn when the membership is filled. Remember—sending for the books does not obligate you to buy.

American Technical Society

Dept. E 353 - Chicago

How to Estimate the Cost of Electric Wiring

How to Repair and Charge Storage Batteries

How to Run Alternators in Parallel

How to Design and Make Induction Coils

How to Install Transformers

How to Determine the Proper Size of Wire

How to Design and Install Switchboards

How to Wire Residences and Apartments

How to Select Material and Get the Best

FREE TRIAL COUPON

AMERICAN TECHNICAL SOCIETY,
Dept. E-353, Chicago.

Please send me the 8 volume set of Practical Applied Electricity, shipping charges collect. I will send you $2.80 in seven days and $2.00 each month until $24.80 is paid or return the books at your expense. If I buy the books I get a membership in your society free.

Name .....

Address .....

City ..... State .....

Reference .....

Please fill out all of these lines

All About Railway Car Lighting

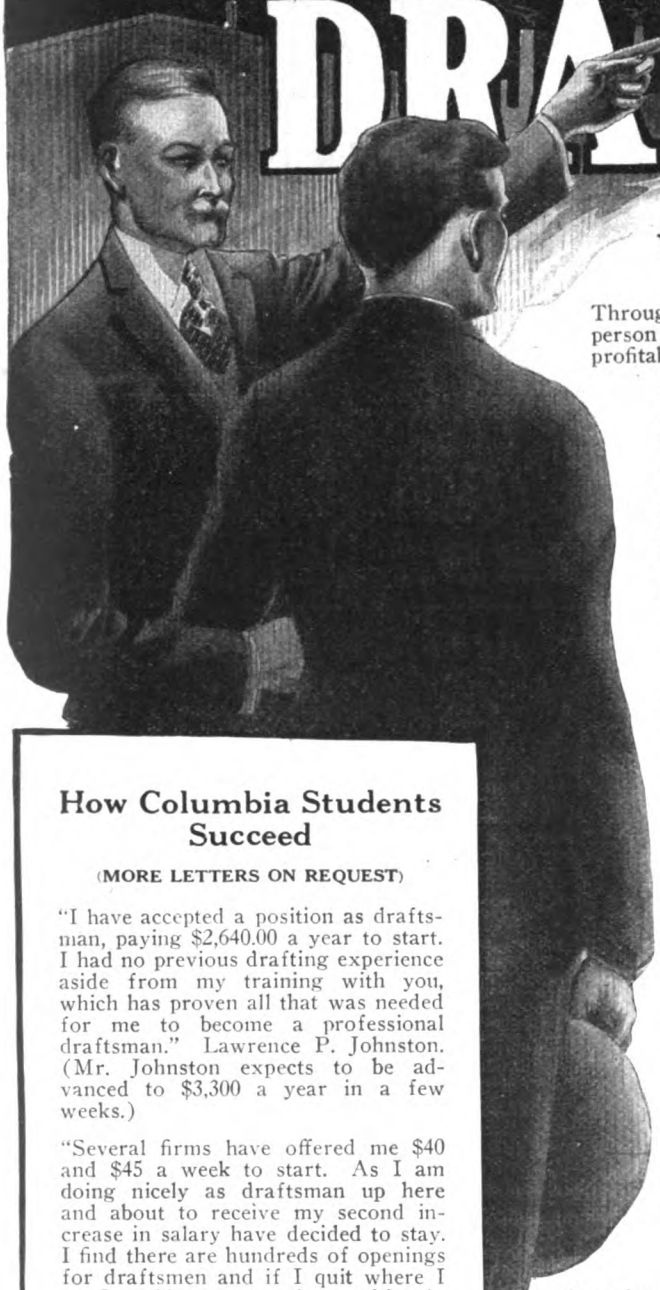
How to do Welding by Electricity

All About Electrical Meters and How They Work

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

The World of Industry Needs DRAFTSMEN



You Can Learn Quickly by Our Practical Method

Through our famous Home Study Course, if you are a person of even average ability, you can master this profitable profession in your spare time at your own home. You can become a first class Draftsman through our Home Study Course because of the fact that our training is most thorough and practical, the work being given to you in as practical a way as you would get it in a drafting room, and because you will be PERSONALLY instructed and coached by the President of the School, Roy C. Claflin, whose long experience as a Draftsman and a teacher especially qualifies him to give you the kind of training you need.



ROY C. CLAFLIN, President
The Columbia School of Drafting

Draftsmen Get $35.00 to $100.00 a week

Every mechanical idea must be drawn out by the Draftsman before it can become a reality. Therefore, on account of the importance of his work, he is paid a good salary and is always in line for advancement. Drafting is not only one of the best paying professions, but is the *stepping stone* to *bigger* opportunities. Many men, receiving up to $40,000 a year, and over, in technical positions, owe their success to their knowledge of Drafting as the starting point.

General construction companies, manufacturers of machinery, locomotives, and automobiles, designers of tools and special equipment, makers of aeroplanes, large engineering companies, in fact all branches of industry need DRAFTSMEN today in greater numbers and at better salaries than ever before.

"Columbia" Graduates are the Kind of Draftsmen That Are Needed

The properly trained Draftsmen, such as those graduated by the COLUMBIA SCHOOL OF DRAFTING, are the ones who get the preferred positions and best salaries, and are the ones who are most greatly in demand. The success of our students demonstrates this fact. Columbia Graduates are filling important positions in big concerns throughout the country. We would like to send you a book of testimonials from many of our hundreds of students and graduates whose present highly paid positions as Draftsmen are the result of their practical training with us. A few of these letters are here reprinted.

No Previous Training Required

As our students are given practical Drafting work from the beginning of our course, they grasp the essentials quickly, so that no previous training or drafting experience of any kind is required to take up this work with us. You do not even need a high school education to learn Professional Drafting as taught by this school and the training we give you is all that is needed to secure a position as Draftsman (Read Lawrence P. Johnston's letter).

How Columbia Students Succeed

(MORE LETTERS ON REQUEST)

"I have accepted a position as draftsman, paying $2,640.00 a year to start. I had no previous drafting experience aside from my training with you, which has proven all that was needed for me to become a professional draftsman." Lawrence P. Johnston. (Mr. Johnston expects to be advanced to $3,300 a year in a few weeks.)

"Several firms have offered me $40 and $45 a week to start. As I am doing nicely as draftsman up here and about to receive my second increase in salary have decided to stay. I find there are hundreds of openings for draftsmen and if I quit where I am I could secure another position in three hours' time. There will be a still greater demand for Draftsmen." Geo. Murray, Jr.

"I wish to express my appreciation for your courteous treatment and sincere interest in the progress of my studies and for aiding me, upon completion of your course, to secure a very desirable position at $140 a month to start. I am getting on well and the chances for advancement are excellent." A. L. Gash.

"I have accepted a good position with a large manufacturing concern in Chicago and wish to thank you for the training your school has given me." Emil B. Johnson.

A few of our many other successful graduates are R. Fowkes, $3,700 a year; G. Tangorra, $2,800 a year; T. R. Brown, $2,860 a year.

Drawing Outfit Furnished Students

We furnish, without extra charge, an individual drawing outfit to all our students for use throughout the course. This becomes your property as soon as the course has been paid for.

MAIL THIS COUPON TODAY

The success of your future depends upon what you do TODAY. If you are interested in learning this interesting and big paying profession send the following coupon WITHOUT DELAY for our Free catalog of particulars. Columbia School of Drafting Dept., 1095 14th & T Sts. N.W., Washington, D. C.

Columbia School of Drafting, Dept. 1095 14th & T Sts. N.W., Washington, D. C.

Without obligation to me, please send me FREE your illustrated book of particulars, testimonials from students, rates and liberal terms.

Name .....

Street and No. .....

City ..... State .....

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 8 MARCH, 1920 NUMBER 6

A Sixteen-Foot Shallow Draft Power Boat

A Simple, Easily Built Craft That Can Be Constructed by the Handy Man at Relatively Small Cost and with Limited Tool Equipment

By A. C. Leitch, N. A.

IT seems to me most every healthy, red-blooded man or boy living near the water some day gets the "boat bug", and if this happy disease is allowed to develop sooner or later he invests. The purpose of this article is that he may invest wisely; by investing we mean building or buying. If he be enough of a mechanic to build for himself so much the better, he then knows exactly what is in the boat.

If you decide to build your own boat do not attempt to "design it" unless you have had training along the lines of technical or practical experience. Select a design that is suited for the waters in which you intend navigating, and for your own desires and pocketbook one that has actually been built if possible, and do not depart from the design in the least, for I am sure you will regret it if you do. Successful designers are not alone technical men but experienced yachtsmen, and a successful design seldom if ever represents one single masterpiece, but invariably a series of boats of that particular type, each one an improvement over the other.

A boat that is able to run in water not much deeper than that required for an ordinary row boat is given herewith. The advantages of this type of boat for shallow, somewhat protected waterways will be obvious to those living upon or near some beautiful stream wherein there is not sufficient depth to float an ordinary power boat. When this little craft is afloat and running over bars and other shallow points the reason for this paradox is not apparent, for in appearance I have purposely designed her to convey the effect of a classy little power boat, of possibly V-bottom construction, with an air of "go" to her, seldom seen in ordinary flat bottom boats, which in reality she is. I have given plans for a flat bottom boat capable of running in about six inches of water, but with the above water appearance of a graceful little speed boat, with the advantages of the simple and cheap construction of the former.

Tunnel for Propeller

The secret of this boat's success is in a tunnel housing for the propeller wheel, the said tunnel extending in a fore and aft direction, being shaped as shown on the plans forming a part of this description. This boat is not designed for rough water use, it is only suited for operation upon a somewhat protected stream, where due to bars and riffles the ordinary type of power boat is useless; and is designed for a moderate powered, light weight motor, say from three to six-hp., with the average revolutions per minute of an ordinary two-cycle motor, say about 800. With this power the boat will show a speed of from 6 to 9 actual miles per hour.

The tunnel housing as here shown is at its highest point 1 ft. 1⅝ in. above the bottom edge of planking. This is about the size that would be necessary for the propeller wheel of the largest size of motor to be used in the craft. I would suggest before laying the curve of "Bottom of tunnel planking" down, you decide upon the size of motor you are to use and ascertain from the builders of the same, what size and style of wheel they recommend using in combination with their motor.

By informing the engine people what type of boat you are building, giving them the principal dimensions, etc., you will have a much more satisfactory outfit than if anyone else attempted to give you theoretical data for the same. You will then know how high to hold your greatest height of tunnel; arrange this point so you will have about 1½ in. clear all around your propeller, that is sides and top. Hold the after point of height, viz. 7⅛ in. above base line and the point on section 2 of 2⅞ in. and gradually flatten the curve of "Bottom of tunnel planking" until your highest point intersects the point about 1½ in. clear of the wheel, not forgetting to change the half breadth of the 2 in. chafing strips down on plan to also be 7⅜ in. The reason for holding the tunnel only about 1½ in. larger all around than the wheel is not to drag any more water than necessary.

Boat Construction Simple

It will be seen by reference to the illustrations that the construction of this boat is extremely simple, the most difficult part being the tunnel or housing for the wheel, but which by the way enables the craft to lay upon the beach as well as upon the water without injury to any of the motor parts. You should be able to build and finish the entire boat exclusive of engine for forty dollars. I should suggest, if possible, to build the boat under cover and preferably in a shed or shop having as good and level a floor as possible, and that the boat be constructed upside down. See sketch marked "Setting up diagram", an explanation of which will be taken up later.

The first step is to mark out full size sections of your stations; transom to No. 5 inclusive, making use of the table marked "Molded figures". For this you should have large sheets of stiff paper and upon them erect vertical center lines and near the bottom draw at right angles a base line (using a large steel square, making your lines exactly at right angles and taking your dimensions accurately, because upon the accuracy of this laying out depends the success or failure of your boat). This base line will be the bottom edge of your planking from sections 1 to 4 inclusive. We will lay out, for instance, frame three. Having drawn center line and base line at right angles thereto, by the use of the steel square, we next draw a line parallel to the base line ¾ in. above the same, this being the moulded height of bottom. Out from the center line on the moulded bottom line lay off the half breadth of moulded chine at station No. 3 or 1 ft. 8¾ in. See table of moulded figures.

Digitized by Google

Next measure up from the base line (not the moulded line ¾ in. above the base line) the moulded height of deck at station No. 3 or 1 ft. 9½ in., then measure out from the center line the moulded half breadth of the deck at side or 2 ft. 4 in., and at the points of intersection of the two latter mentioned points erect a line from the spot on the moulded bottom line. This will form the moulded side of half of your boat, next measure up from the base line on the center line 6 in. and draw a line parallel to the said base line through the said point, this is your water line and will be used later on as a check. Follow this same operation for all of your sections transom to No. 5 inclusive, if your paper is not wide enough glue two sheets together, so you can lay the entire frame down (both sides). Mark each drawing clearly, giving the station numbers, the base line, the center line and the water line.

The lines you have now drawn will not be the exact width of both forward and after sides of the frames due to the bevel, but will in all cases except frame No. 3 where there is practically no bevel, be the largest side of the frame, except at the transom where the forward side will be about ¼ in. wider than the after side, due to the boat's beam increasing as we go forward up to frame No. 3, and from this point forward the forward side of the frames will be the smaller. When making the transom cut the same about ¼ in. larger all around on the forward section, the exact bevel may be determined when fitting the planking.

Be sure to have the exact finished line marked clearly and sharply on the *after* side of the transom. The transom may be made of oak ⅝ in. thick and in two pieces joined as shown in the drawing by a seam batten ⅝ in. x 1½ in. Mark out a deck beam mould for the data given on a thin piece of pine or template board. By the use of this template you can mark off the exact crown of the deck at the different points, always having the center lines of the template and your frame or mould in line and being sure to have the curve just pass through the two spots of your moulded deck at sides, draw this in on all sections. Assuming all sections are clearly marked on the stiff paper the next point is to assemble your frames or moulds. No. 1 can be built up of cypress or pine, the size of materials being shown in the drawings. Mould No. 1 being through the tunnel it would be wise to fasten a temporary connecting strip across the tunnel gap to hold the mould in proper shape, this strip may be removed when fitting the tunnel in place. In frame two, run the bottom members continuous and cut it out afterwards to receive the shaft log.

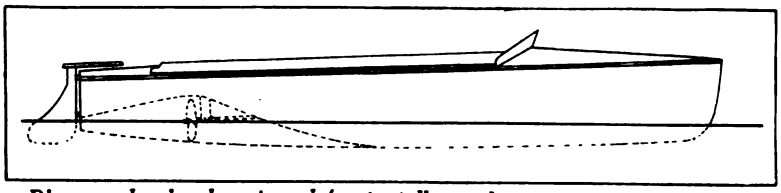


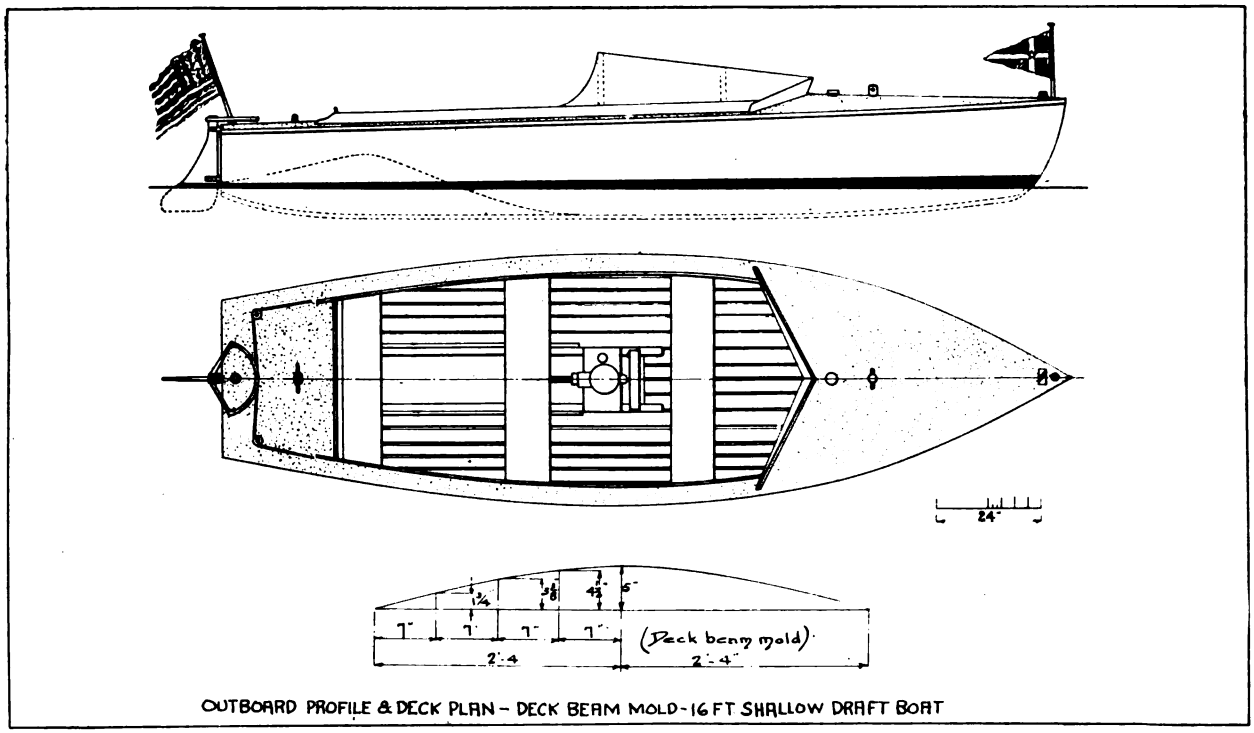
Diagram showing how tunnel for propeller makes a snappy shallow draft design possible

How to Construct Frames

Frames 3, 4 and 5 should be made up as per drawing, omitting the deck beams, but in their place securely fasten a temporary cross piece to hold them in shape. The proper way to construct the frames is to place your paper template upon the floor, tacking the four corners, then finish your floor timber, which by the way are also cypress, and may be ordered from the mill the exact size, that is, width and thickness, 4 in. x ¾ in., saw off about the length required, then get out your uprights or sides which as seen are ⅞ in. thick and 3 in. at bottom tapering to 2 in. at top. When all forms are made up as shown in full lines on sketch "Setting up diagram cross section", secure the temporary bracing as shown in same diagram in dotted lines which is the specific construction for frame three. A center brace is tacked on with the exact center line marked thereon, the said brace in the case of frame 3 to extend below the line of moulded deck at side 1 ft. 4¼ in.; side and cross bracing also to be fitted as shown.

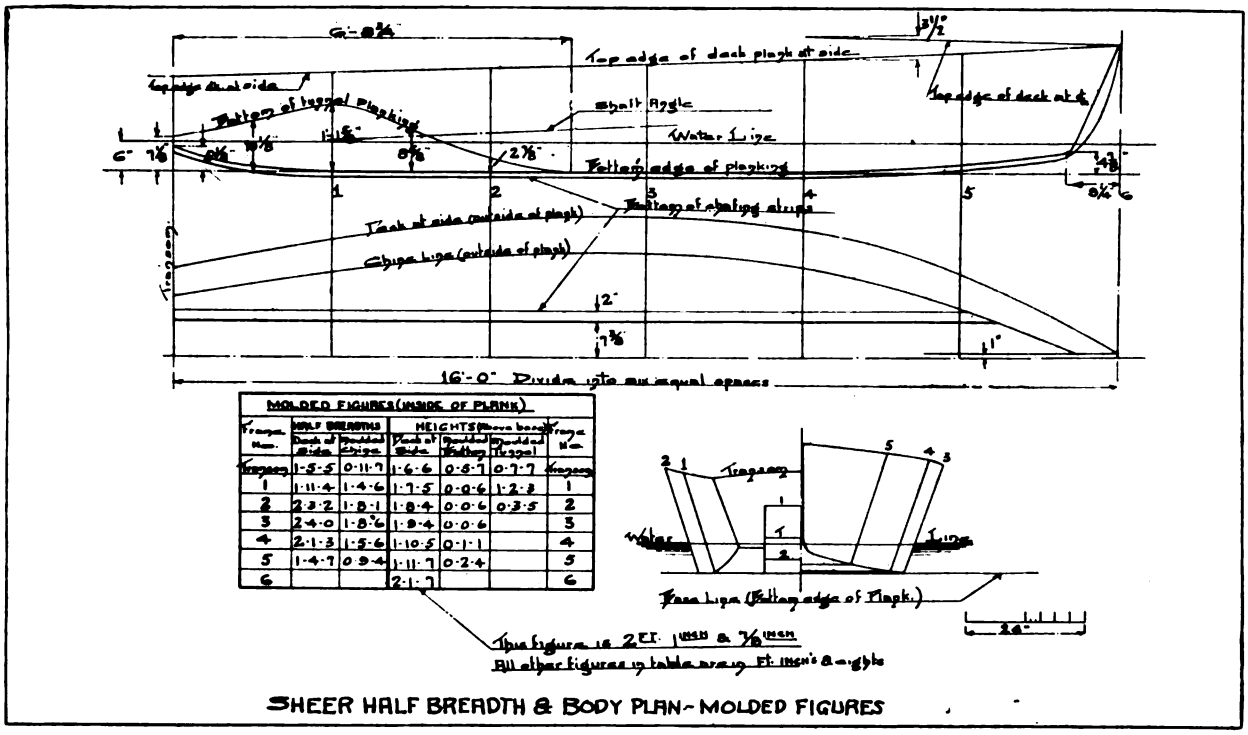
Boat Built Upside Down

The boat is to be built upside down so if on each frame the center and side braces are extended exactly the distance below the line of moulded deck at side as indicated on "Setting up diagram". Longitudinal section, the water line, check lines, placed on the frames, should all measure about 2 ft. 7¾ in.



OUTBOARD PROFILE & DECK PLAN - DECK BEAM MOLD - 16 FT SHALLOW DRAFT BOAT

Digitized by Google

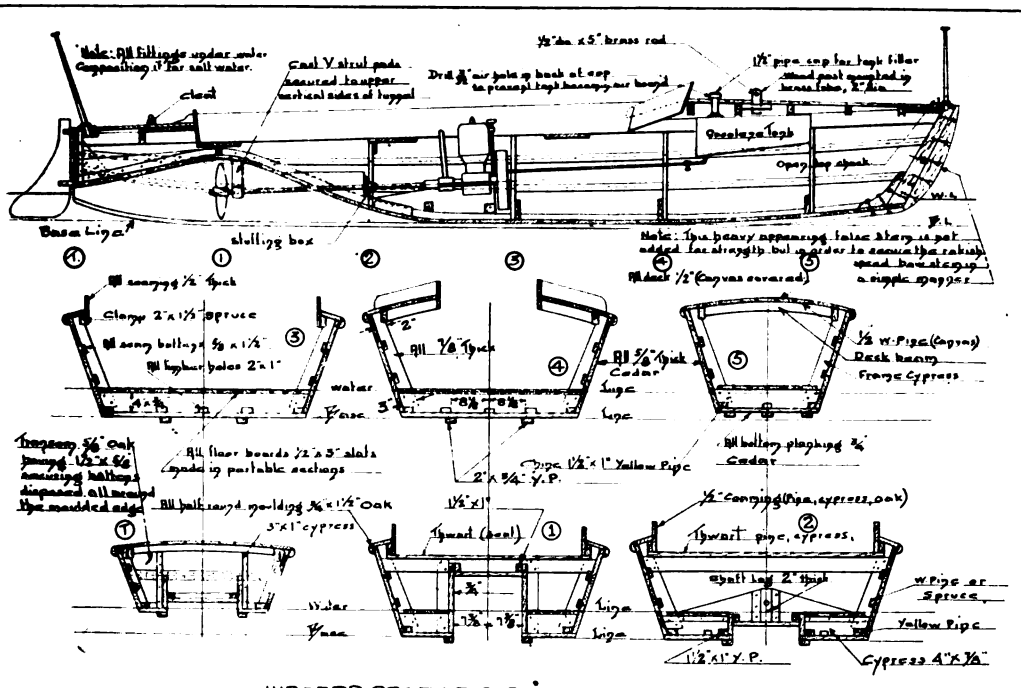


SHEER HALF BREADTH & BODY PLAN - MOLDED FIGURES

above your floor line. The temporary bracing may be of any material you have on hand, but the form should be followed substantially as shown, and be strongly fitted because there is a considerable tendency to rack and change the shape of the sections when bending on the sides. If any of the sections shift you will not have a fair boat. Before setting your frames up test them all over your full size drawings; the permanent fastenings in the frames should be either screws or rivets, well set up over washers, and I should mention the material used for frames should be straight grained material without any warp or other blemishes.

The stem may be made as shown, of oak having secured to its fore side after the planks are fitted the false stem, the seam having the outward curve as shown to give the boat a graceful appearance. You will notice by reference to the cross section of "Setting up diagram" that there are no notches shown to receive the chines, clamp or seam battens, so the next step is to divide the length of each side into three equal parts, and temporarily tack your seam battens to cover the spots, shifting them until they fair up nicely, the battens are to be 1½ in. x ⅝ in. white pine or spruce.

Having faired the battens, mark their top and bottom surfaces with a sharp instrument upon the frames and saw out the notches to receive them, being careful to cut them deep enough to allow their outer surface to come flush with the outer surface of the after part of frames 3, 4 and 5, and the fore part of Nos. 1 and 2; space the battens on both sides exactly alike, now by planing off the portion of the after side of frames 1 and 2 and the forward side of 3, 4 and 5, the amount that shows outside of the battens after they have been seated to their exact depth, all frames will have the exact bevel. The outside of the battens forward come flush with the outside of the stem proper and may be secured to the same by



INBOARD PROFILE & SECTIONS

Digitized by Google

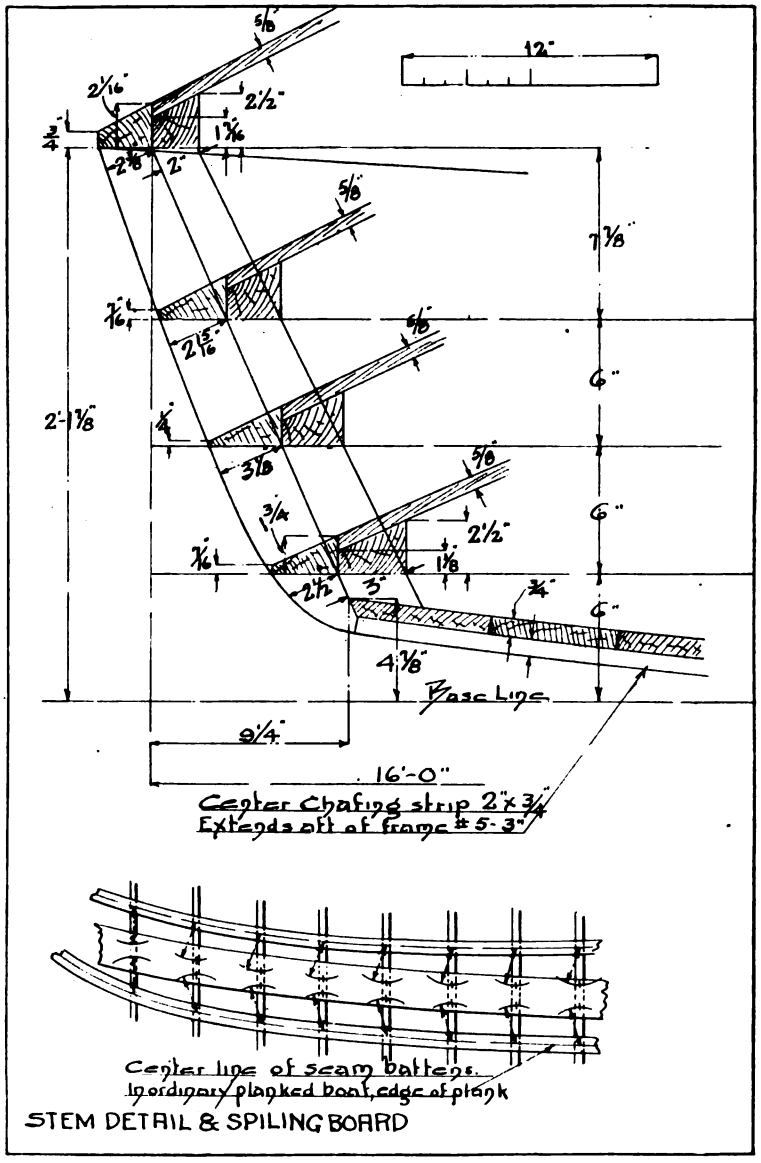
sufficiently long screws set at an angle.

At the transom the battens must come flush with the forward face of same, remembering the after side of transom is the true moulded side, the forward face may now be trimmed to the exact bevel by laying a straight edge on the battens, after the battens are all secured to the frames by either copper, brass or galvanized fastenings the planking may be gotten out and secured.

Taking a "Spiling"

As shown, there will be three planks to a side and the seams must come exactly on the fore and aft center line of each batten. In order to do this properly you must take a "spiling". This is done in the following manner: Mark clearly the fore and aft center line of the seam battens on each batten. Secure a thin piece of straight grained wood that will fit between the battens when bent on naturally, temporarily secure this to the frames, next secure a pair of pencil dividers and open them to a point just a little wider than the maximum space between the upper edge of your spiling batten and the center line marked on your seam batten. Say, for instance, this distance is 3 in., next place your center point of the dividers on the fore and aft center line of your seam batten and swing in a line with the pencil end of the said dividers on your spiling batten, repeat this at every frame, and say at one point midway between every frame.

Now repeat this operation on the batten edge and you will have a set of marks near the top edge and a set near the bottom edge of the spiling board, remove the board from the frames and lay it flat upon your planking for side of boat (better clamp it). Then with the same dividers set at the same spacing, use the lowest point of the curve for the center of your dividers and swing in a curve on your side plank. Repeat this for every spot, then unclamp your spiling board and with a stiff frame batten connect the spots with a fine line, and saw the plank out, leaving the line for trimming afterwards with a plane. If you do this work carefully you will find the plank when bent on naturally as was the spiling batten will come exactly to the fore and aft center line as marked upon the seam battens. A diagram of the spiling board arrangement will be found with the drawings.



Fastening Side Planks

Side planks are to be of cedar preferred—pine or cypress will do, and should be screwed to the transom, frames and stem. Use either galvanized or brass screws. The edges of the planks should be secured by screws or clinch nail fastenings, spaced about 4 in. centers, fastenings to be galvanized or copper. The bottom longitudinal and the chines may be fitted and secured in a similar manner to the seam battens, they are preferably of yellow pine but may be of white pine or spruce, spaced and fitted as shown on the cross sections.

The tunnel sides may be cut according to the data shown, not forgetting to cut them high enough to allow for the ¾ in. top and the 1½ in. fore and aft clamp, making a total extension of 2¼ in. above the moulded line shown on line drawing. From the highest point of the tunnel aft to the transom carry the sides about level so as to give ample fastening for the bracket piece shown; to make a good connection to the transom. The transom being made of two pieces joined by a seam batten as shown and further stiffened by vertical cypress strips 3 in. deep 1 in. wide, well screwed up and so disposed as to take the sides of the tunnel; all as shown.

Bottom Planking

The bottom planking 6 in. x ¾ in. cedar is run crosswise and should be carefully fitted and held to the chine and longitudinal battens by screws (three to each end of plank), planks to run continuously from side to side of boat, the tunnel top should be carefully fitted and secured in the same manner. The outer longitudinal rubbing strip of 2 in. x ¾ in. yellow pine may now be fitted, either riveted or screwed. Run an occasional rivet through inner and outer longitudinal to tie both well together. Now finish off the bottom and trim the overhanging edges of the bottom planking to follow the tumble of the sides. Cut away the temporary framing and turn the boat over. Set the 2 in. x 1½ in. clamps as shown to the upper inboard edge of the frames, use spruce for the clamp, white pine or cypress; rivet through plank frame and clamp, set up on washers and between the clamp and the sides of the boat fit blocks every 6 or 8 in to fill up the space left there, use through rivets here also. The half round beading ¾ in. x 1½ in. of oak may be secured by screws. The deck beams

Digitized by Google

cut to suit the curve of deck beam mould may now be fitted, they are notched into the clamp. The sides of the boat and the head of the frames and clamp may be cut to the proper level by use of the beam mould. The shaft log as shown is about from 2 in. to 3 in. thick oak fitted as shown, care being taken to have the bottom surface fit perfectly to the bottom curve of the tunnel screw thorugh the planking into the log, first smearing both surfaces well with white lead.

Simple Shaft Log Construction

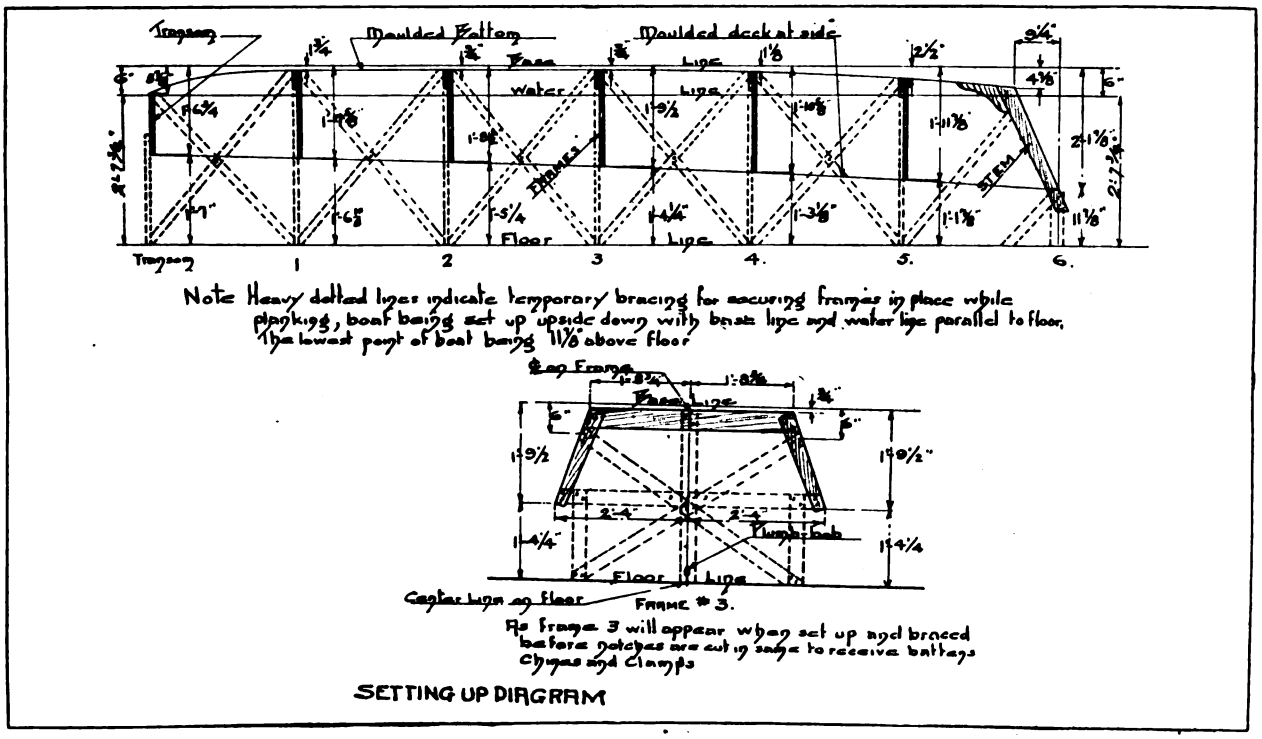
I believe the simplest way to construct a shaft log is in two pieces, that is, with a vertical longitudinal seam, the inner surfaces being nicely dressed, then bolted together, care being taken to keep the line of bolts clear of the line of shaft and also the base line to which the log is to be finished, then after finishing to curve of the boat as explained above, take out of boat and open up and after marking center line for angle of shaft, instead of boring hole gouge out half the diameter in each half of the log, smear the sides well with white lead and replace your bolts, galvanized iron or brass, and securely set up nuts on washers, or better still, rivet head over washers instead of using nuts. The location for the hole in the bottom of the boat may be readily found and bored with an auger.

The exact shape of motor foundation will depend upon the particular motor you select, but in general it should be two fore and aft members extending a little beyond frames 2 and 3 and notched into them and having two cross timbers joining them together at the batten, all as shown on the longitudinal inboard section, the bed may be entirely of yellow pine.

Fit a ½ in. round galvanized or brass bar around the forward edge of stem running same well down on center chafing strip. The rudder is oak 1 in. thick, shaped and hung as shown. The tiller should be substantially as shown in order to allow the ensign staff to be stepped as far aft as possible, the tiller may be made up or purchased. The strut is to be cast bronze V-shaped having either side pads for securing to the sides of the tunnel or top pads for securing to top of tunnel, in either case the fastenings must be through bolts well set up on a doubling strip, secured to the inside of the boat.

to cool and remove the clay. It may be necessary to use a Stilson wrench to start the shaft, work a little oil in with it and it should turn easily in a short while. The purpose of applying the lamp black to the shaft is to prevent the babbitt from adhering to the shaft.

The fine black dots on the deck plan indicate that the deck is to be canvas-covered. If you do cover with canvas you may use a poorer grade of decking, paint the deck with a priming coat, then thoroughly paint the bottom side of the canvas; stretch it in place while the paint is wet, bringing it down along the sheer and tacking same with copper or galvanized tacks, then put your half round beading over the portion extending down over the sides. The top may then be painted.



SETTING UP DIAGRAM

Strut Construction

In designing the strut make your pattern for the inside of the boss for receiving the shaft at least ¼ in. larger than the shaft, then after the strut is secured and the shaft placed into the shaft log and the inboard stuffing box, and the shaft nicely lined up, babbitt the bearing. This may be done by coating the shaft well with lamp black previously filing the inside of the boss fairly bright and cutting one or two good grooves into it, place a ball around the other end, leaving a good size opening at the top for pouring.

It is assumed you have some means for melting the babbitt metal (white brass), the metal should be heated until it will nearly char pine, but before pouring your hot babbitt, heat your bearing and clay with a gasoline torch and be sure there is no water in the boss, then pour your molten metal until it runs out of the vent at the top, allow

On the outboard profile of this little boat a canvas spray hood is indicated, this need not be fitted, it simply being indicated to show the boat, though flat-bottomed, to have the same classy appearance as the V-bottom boat design.

In a boat of some speed where now and then choppy water is encountered the spray hood keeps the engine dry and makes the boat more seaworthy, in as much as you are not at all apt to ship a head sea. It should not be necessary to caulk the boat. Run a little water into her before launching to swell the seams. If you find she makes too much water at any time it is an easy matter to "haul out on the beach" and drive the necessary cotton as caulking into the seams.

In Transylvania natural gas has been cracked by heat and a mixture of tar and soot obtained. This mixture was used as the basis for the manufacture of arc light carbons.

Digitized by Google

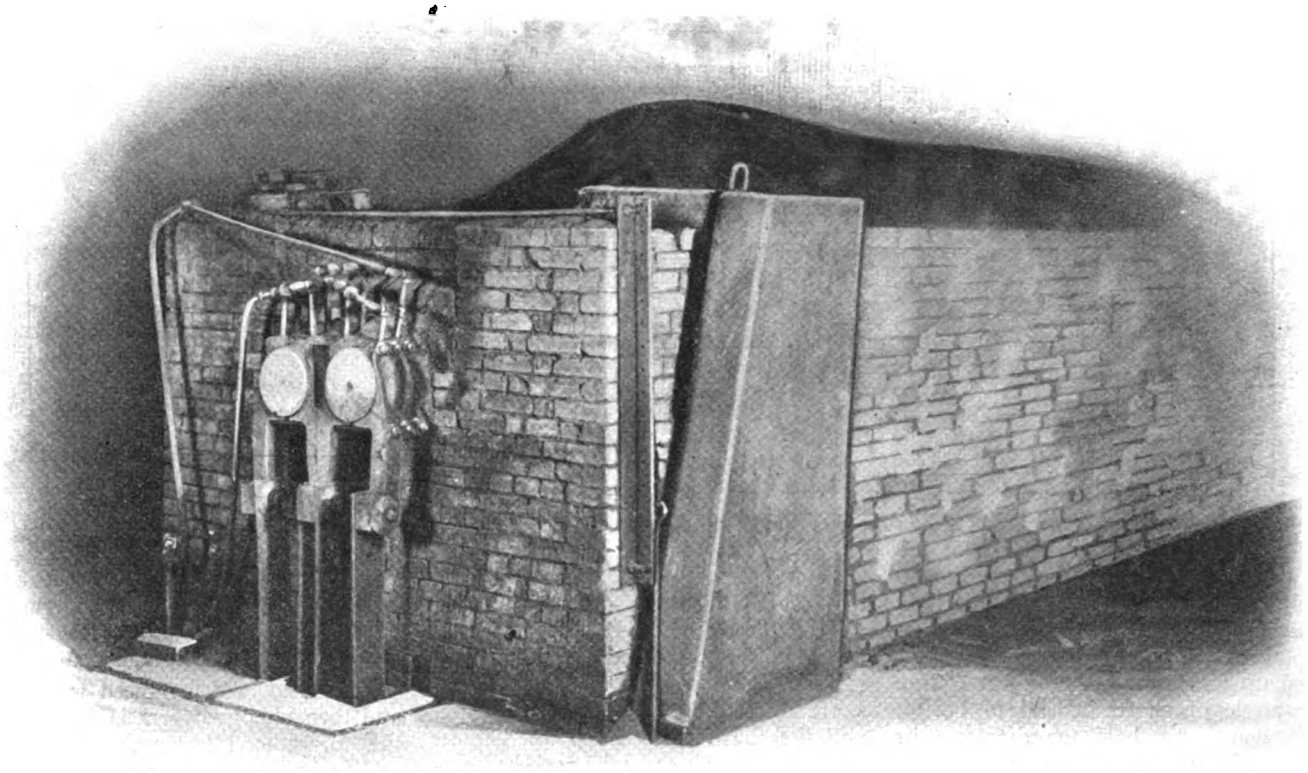
The Story of Artificial Abrasives*

By Raymond Francis Yates

AN old bi-polar dynamo strained to the limit of capacity to maintain an arc in a furnace made up of an iron bowl and electric light carbon played a very large part in the industrial history of this country and gave to the world a substance so hard and sharp that it takes its place next to the diamond. The man who placed a little mud and coke in the bowl with the hope that a new substance would be formed was Dr. Edward Goodrich Acheson; the place, Monongahela City, Pa.; the time, in the late '80s. When Dr. Acheson removed the mass of heated material from his "furnace" nothing was present that would have received the attention of the average man. Dr. Acheson was an experimenter; he was not satisfied with a superficial examination of the material he had taken from his improvised furnace. He looked closely and found a few little crystals clinging to the carbon electrode. The crystals were taken off and rubbed across a piece of glass; they scratched. Further experiments showed that these tiny crystals were so hard that they could scratch the surface of a diamond. These crystals were carefully collected, and placed in a vial. The substance was called Carborundum and sold to a diamond polisher in New York at a price that would have brought a pound of it to the magnificent figure of $800. So runs the story of Carborundum. Today this substance is being produced by the ton—by the carload. It is made into grinding wheels, powders, coated papers, etc.

A few years ago the world sharpened its tools, ground its dies and polished its work by the aid of emery. The emery wheel could not cut fast, was unable to hold its shape and wore away rapidly, but it was the best article available at that time. The whole tool and machine industry of the world depended upon the emery wheel. With the discovery and cheap production of Carborundum, the machine industry was revolutionized. Carborundum bows only to the diamond in point of hardness. Its keen, brittle crystals cut fast and clean. The advent of Carborundum made possible many things that were theretofore unattainable.—EDITOR.

Carborundum is born within the blinding whiteness of the electric furnace. It is here where the elements silicon (in the form of sand) and carbon (in the form of coke) are caused to unite chemically, the resulting substance being Carborundum which is recognized by the expression SiC. Carborundum furnaces are long, trough-like structures with graphite electrodes arranged at each end. These electrodes carry the current to a central core made up of carbonaceous materials. During the operation of the device the temperature of this core reaches 4060 degrees Fahr. The raw materials (coke and sand) are placed about the core and the terrific heat of the core is communicated to them. Each furnace has a capacity of 2000 electrical horsepower and this amount of energy is expended for a period of 36 hours before the complete chemical transformation has taken place. The walls of a Carborundum furnace are of a collapsible nature and at the end of each run they are taken down to facilitate the removal of the Carborundum crystals which are present in great iridescent masses about the carbon core.



One of the great furnaces used in the production of Carborundum. The interior of this furnace reaches a temperature of over 4000° Fahr.

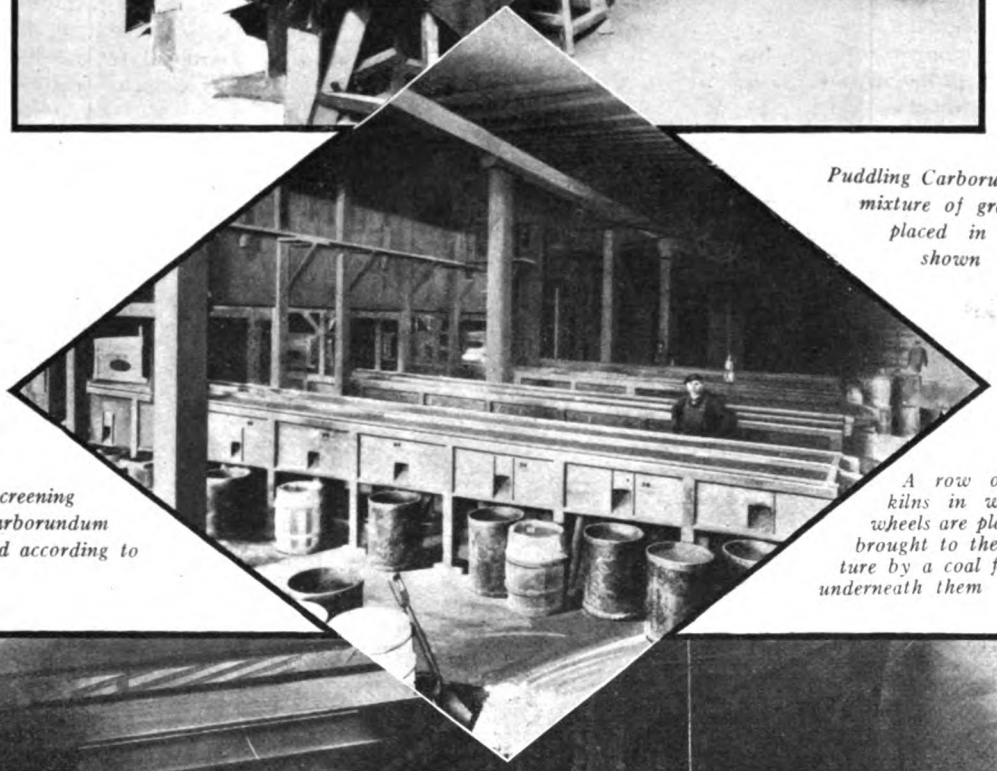
The Carborundum crystals taken from the furnace are crushed under great revolving stones after which the particles are thoroughly washed and graded. The grinding of the grains is brought about by a very ingenious device. A long incline is made up of screens with various meshes; starting with very fine screens at the top and ending with a very coarse screen at the bottom. The screens are oscillated and

*Photographs for this article were furnished through the courtesy of the Carborundum Co., Niagara Falls, N. Y.

Digitized by Google

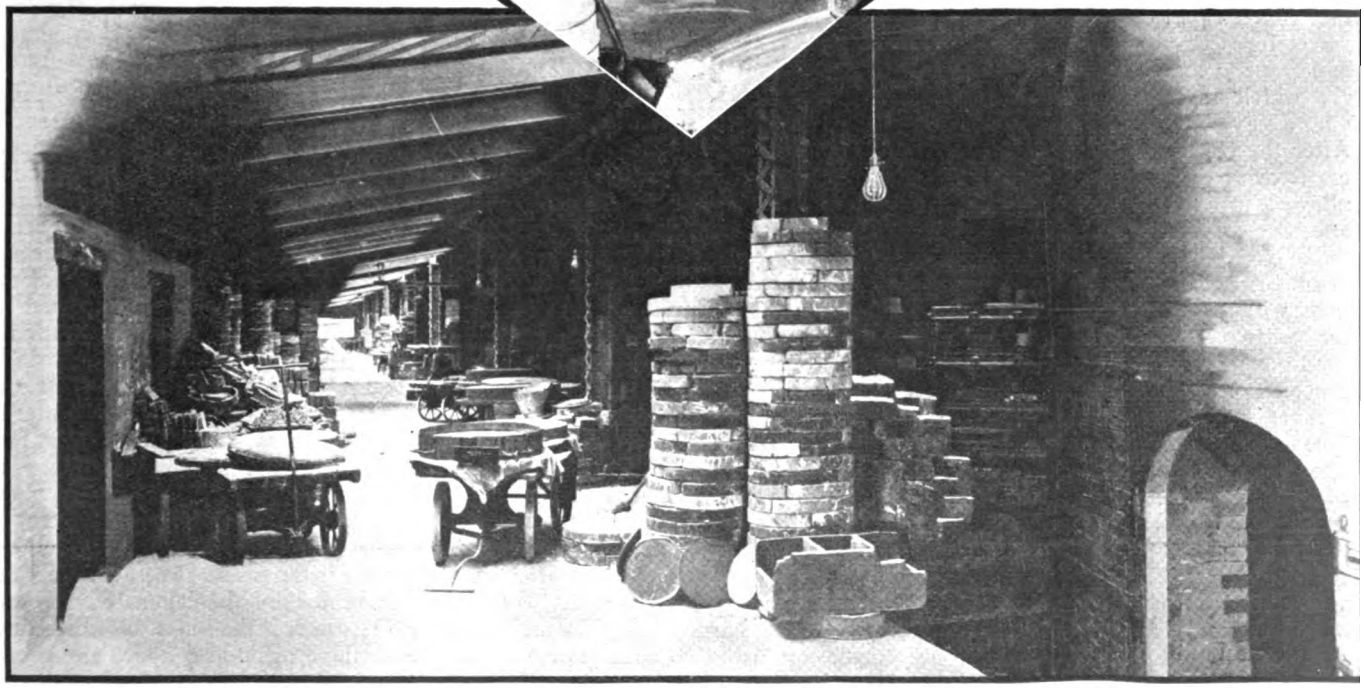


Puddling Carborundum wheels. The mixture of grains and bond are placed in the large forms shown



The grading or screening room where the Carborundum grains are separated according to their size

A row of great vitrifying kilns in which the abrasive wheels are placed. The kilns are brought to the required temperature by a coal fire which is placed underneath them



Digitized by Google

the grains starting at the top gradually bound down the incline until they reach the screen that permits their passage.

Abrasive wheels are made up of grains held together by means of what is known as a bond. The bond may be a vitrifying clay, sodium silicate, rubber or shellac. The vitrified process is the most widely used. The grains are first thoroughly mixed with the fusable clay in the proper proportions. The smaller wheels are pressed to shape under the ram of a hydraulic press while the larger wheels are formed by what is known as the "puddling" process. In this process the grain-clay mixture is puddled with water and cast into moulds where it is allowed to dry. After the mass has dried sufficiently, it is mounted and turned true on an especially designed lathe.

The puddling process produces a wheel with a greater porosity than those made by the pressed process. This is to be expected owing to the fact that pressure is not applied in the former case.

After the grinding wheels are formed by one of the two processes mentioned above they must be packed in sagers and placed in the vitrifying kiln which is then hermetically sealed and brought to the required temperature. Under this treatment the clay that forms a part of the wheel fuses or vitrifies and forms a hard matrix which incases the abrasive particles. After the baking process is over, the kiln is allowed to cool slowly and the wheels are removed to the lathe room, where they are again mounted on a lathe and trued up, this time with a diamond-pointed tool as the wheels are in a more finished condition and exhibit their abrasive properties more than before.

After being trued, the wheels are tested for speed. They are mounted upon a spindle and brought to a speed which is consistent with their size and weight. This speed is always considerably above that for which they are guaranteed. This is done to eliminate accidents due to bursting wheels when they are placed in use. During the speed tests the wheels are entirely covered so that should they burst no one will be injured by flying pieces.

Silicate wheels are made by mixing the silicate of soda with the proper amount of grain. This mixture is placed into moulds and put into a baking oven which brings about almost complete dehydration. After being trued and inspected the wheels are then ready for shipment.

The physical nature of abrasive wheels can be carefully regulated in the manufacturing process. The grit, grade and bond are under almost perfect control and wheels can be produced with properties that suit them to almost any task they may be called upon to do. In the case of vitrified wheels, ceramic experts are employed to keep watch over the clays used and to choose the proper clay for each different grade of wheels. The grade of a wheel is really determined by not only the nature of the clay but by the mixture of clay and grain. The larger the percentage of clay, the "harder" the wheel will be. The greater the mass of clay in a wheel, the more difficult it will be for the abrasive particles to break away from their seat after they have become dull. Thus, the wheel is said to be hard. "Soft" wheels are made by using a comparatively low percentage of clay so that the abrasive particles leave their setting when they become dull or partially so. In this way wheels can be made that are suitable for practically any kind of work. From the fore-running it will be seen that the grade of a wheel is important.

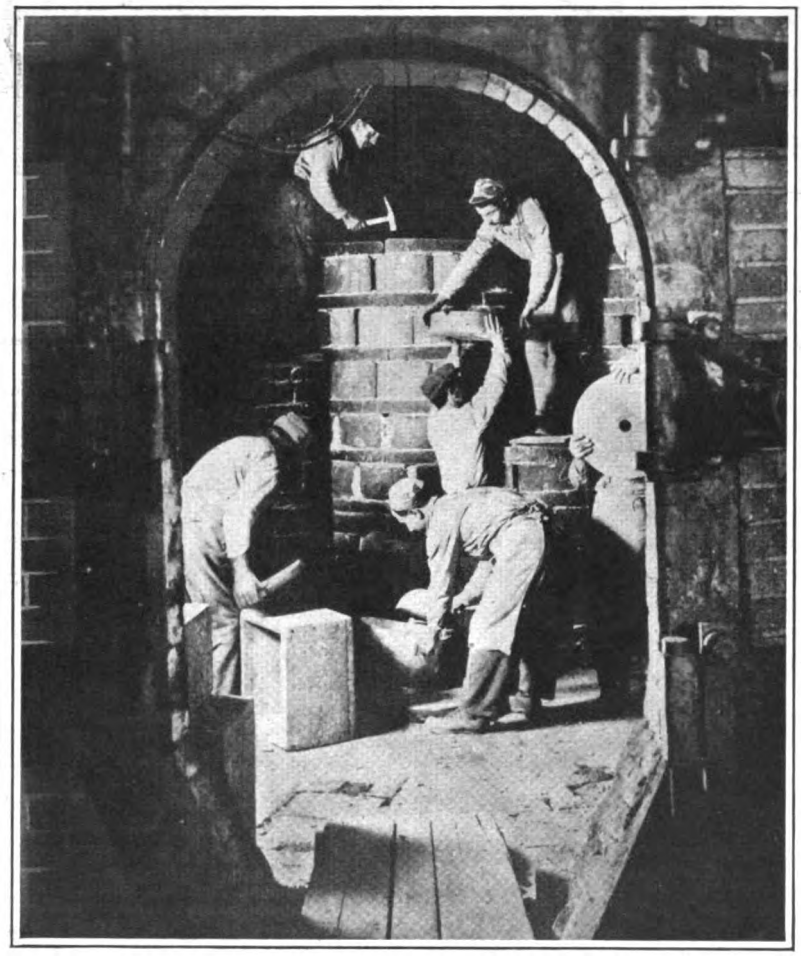
The grit of a wheel is the size of the particles that go to make it up. This is always designated by a number. If a wheel has a grit of 60, this means that its particles are capable of passing through a screen with 60 meshes to the square inch.

Shellac wheels are made by using shellac as the bonding material. After the grains are thoroughly mixed with the shellac in the proper proportions, the wheels are pressed to shape and placed in an electric oven and baked. These wheels are used for special operations.

Rubber wheels are made by pressing abrasive particles into rubber sheets as they pass under heated rollers. When heated, the rubber is capable of imbedding the grain in its fibre. When the rubber has been filled with the specified amount of grain, the wheels or discs are punched out. By means of this process wheels can be produced with remarkable thinness and owing to their elasticity they can be revolved at very high speeds.

Grinding stones are made in much the same manner as wheels. The grain, or powder, is thoroughly mixed with the bond, pressed to shape and baked. After the baking process is completed, the stones are squared by holding them against large discs revolving in a horizontal plane. A mixture of Carborundum powder and water is used upon the surface of the disc. The stones are manipulated by hand, several workmen being stationed at each disc.

Abrasive grains of all sizes are prepared for the market. They range in grit from 6 to 220. Beyond this the grains are sold in powder form. In place of being graded by screen, powders are graded by floating them on water. The powder that floats the longest is the finest. These powders are represented by the letters F, FF and FFF, which is the finest. Powders finer than those mentioned above are known as minute powders.



Loading a kiln with wheels. When the kiln is sealed and brought to the required temperature, the clay mixed with the abrasive particles fuses, forming a hard matrix

Digitized by Google

The Heat Treatment of Tool Steel

By Warren S. Dunlap

IN the average magazine article purporting to offer instruction to the experimenter, model maker and mechanic, in the art of treating the various tools he has to work with, we usually are able to sum the instructions up to the following: "Heat the tool to a cherry red and draw to a dark purple."

In times long since passed, such a rule may have answered most purposes for at that time only the ordinary straight carbon steels were used. Even then it must have been of a doubtful value to the mechanic as a reliable rule to follow; for what looks like a dull red to one man will appear to another as a dark yellow and so on. Another factor having much to do with proper heat to be applied is the percentage of carbon contained in the steel.

It will be patent then to anyone familiar with the action of heat on steel that if a piece containing 1.5 per cent carbon were heated to the same temperature that a piece containing .55 per cent would require, *the first piece would be burnt* and worthless as far as its cutting qualities were concerned. It necessarily follows that in order to get the best results and the longest service from a piece of tool steel it is of paramount importance that the carbon content be ascertained, and the proper heat be applied, most suitable to that content. Also, that the tool be quenched or plunged in the most suitable medium. This will also depend on the carbon content of the steel, and a suitable table is given elsewhere in this article, showing the proper heat and the proper quenching bath for different types of steel, including the chrome-nickel, chrome-vanadium, and the tungsten (or high speed) steels.

However, the purpose of this article is to offer some definite and reliable information for practical work and not to go into the intricate and technical principles involved. It is a matter of long and persistent study and research for those interested in the theory and metallurgy of steel.

It must not be forgotten that if the steel to be treated contains other hardening agents such as chrome, silicon or tungsten, we are obliged to look at the work from a slightly different angle and this will be the subject of a future article.

In treating steel there is no set of hard and fast rules by which to be governed, as the character of work to be performed, the temper of the steel, the kind of service to be used in, will all necessitate different processes in treating the tool. But, in all cases it must be remembered that the steel should be brought up to the proper heat, and should be the same temperature clear through, and not have any dark spots. Plenty of time should be consumed in heating, and the instant it reaches the proper temperature it should be withdrawn from the fire and plunged in the bath and left there until cold. If the proper heat has been applied there is little or no danger of cracking except in very high carbon steel and these should be quenched in oil which will not cause breakage.

In treating long reamers or other tools, never lay them in the water or oil length-wise, but end-wise and as quickly as possible, otherwise it will warp and distort the tool so that it will be worthless. In fact, all tools should be dipped in the bath end-wise whether long or short.

If a tool to be treated has any holes in it for bolts or screws, always fill these holes with fire clay or asbestos before treating as breakage is almost sure to follow if this is not done, especially in the case of the very high carbon steels (most drill rod is in this class).

Some shops use tools made of machinery steel (.25 to .40 C.) and put them through a case-hardening process, but this is a doubtful procedure and the tools are not as strong or reliable as those made from the correct steel. However, case-hardened steel has its field of usefulness elsewhere, aside from the fine tool field, and it justifies itself there.

Last, but not least, never place a piece of fine steel in a coal or coke fire so that it comes in contact with the fuel. If you do, it will be ruined as the thin edges will be blistered and burnt and there will, in all probability, be a soft skin of de-carbonized steel formed on the surface. Always lay a piece of pipe in the fire and the tool in the pipe. This gives the effect of the muffle furnace and protects the tool from harm. In addition it enables you to see the correct color of the steel.

If a nice finish is desired on the hardened tool, dip it in water when cold, and roll in powdered boracic acid. Then place in the fire until it has been heated to about 400° Fahr., take out of fire and again dip in the acid, making sure every part is covered by the glass-like film. Replace in the fire and treat in the regular manner. The acid will fall off in the quenching bath. The tool should be of a frosted silver color and very nice looking when this is done properly.

Below is given the most suitable steels to be used for the different classes of tools and they may be obtained from any reliable steel manufacturer:

Name of Tool	*Temper**	*Color of Hardening Heat*	*Quenching Bath*	*Draw to (Color)*
Chisels	.60— .75	Bright Cherry Red (1400 F.)	Water	D rk Straw (480 F.)
Drills	.85—1.5	Dull Cherry Red (1350 F.)	Water** Oil	Pale Yellow (460 F.)
Reamers, Taps....	.75— .90	Medium Cherry Red (1375 F.)	Water**	Straw Yellow (470 F.)
Springs	.50— .65	Red (1425 F.)	Oil	Dark Straw (480 F.)

*Carbon. **Water for low carbon. Oil for high carbon.

If the steel contains chrome or silicon, it will need a somewhat lower hardening heat than those given above, about 2 per cent, but the draw will be the same. If it is a vanadium or nickel steel the heat should be raised about 3 per cent, and draw the same.

If it is desired to treat tungsten or high speed steel, the proper method is to pre-heat the tool to a bright red (1500 Fahr.) then bring to a white heat quickly (1975 - 2100 Fahr.) quenching in oil until cold; next replace in the fire and bring up to a very dull red (900 Fahr.) and allow tool to cool off in the open air. This makes a very hard, tough tool with unexcelled cutting qualities, and while the better grades of high speed steel cost from five to ten times more than carbon steel it is more economical for some classes of work, as a properly treated tool made of it will hold an edge when smoking hot and is capable of doing a tremendous amount of work.

In the case of a tap or hand reamer it would be folly to make them of this material as one could not commence to operate the mat anywhere near an efficient speed by hand. But where a

(*Continued on page* 421)

Digitized by Google

Makeshift Crankshaft Repairs for Obsolete Engines

WHEN the crankshaft of an automobile engine breaks, the best method of repair is to replace the injured member with a new one, as most repairs are very costly and not at all certain. Sometimes the car is an old model no longer manufactured or it may be a foreign car for which repairs would be difficult to obtain. The oxy-acetylene or thermit welding methods may be used for repairing, or the crankshaft may be made to serve for a time by a mechanical repair.

The four throw crankshaft is shown at *A*, Fig 1, has broken in one of the main journals. The first step is to turn off the broken parts flush to the crank webs in a lathe. To prevent springing of the shaft under the tool cut, blocking may be clamped between the webs as shown at *A*, Fig. 2. The end of the shaft is gripped in a chuck, or centers are used and the shaft steady rested and turned by a dog, whichever method is considered preferable by the mechanic doing the work. Holes are then drilled in the webs as shown at *B*, Fig. 1, and two keyways are cut in, 90 degrees apart. The hole should be about ¾ the diameter of the new journal piece which is turned from a piece of 50 carbon steel or special chrome-vanadium alloy steel if available. The piece is shown at *C*, Fig. 1. The dimension *E* conforms to the length of the bearing; the turned down portions *G* are as long as the web is thick. The diameter *F* should be about .002 in. larger than the hole in the web so it will be a force fit. Keyways are cut in the ends of the pin to correspond to those cut in the crank webs and keys are carefully fitted.

Before assembling the crank webs are heated to enlarge the holes somewhat and the cool pin is drawn in place by the special fixture shown at *D*, Fig. 1. The construction of the fixture is clearly outlined at *E*, Fig. 1. It consists of two forcing plates drawn together by substantial bolts. After the crank webs are forced in place against the shouldered portions of the new crank journal and allowed to cool, as a further precaution; holes can be drilled through the web and pin-reamed for taper pins, which are driven in and headed over. The keys insure that the webs will not turn relative to the journal, the taper pins insure against spreading, though if the force fit is properly made, this is a remote contingency.

The built-up crankshafts of some engines, notably those used on motorcycles employ the method of crankpin retention shown at *B*, Fig. 2. The holes in the webs may be reamed tapering and the replacement pin machined to fit. In this case, nuts on the pin itself may be used to keep the crankshaft parts in place. The nuts must be thin enough so as not to interfere with any parts as the crankshaft revolves. If the break comes in the rear main journal, as at *C*, Fig. 2, the repair is made in a similar manner. In this case the part for replacement may be shouldered or tapered and drawn firmly into the hole in the crank web by a clamp nut, care being taken to key it in a positive manner. If autogenous welding apparatus is available, the most satisfactory and really permanent repairs may be made by this method.

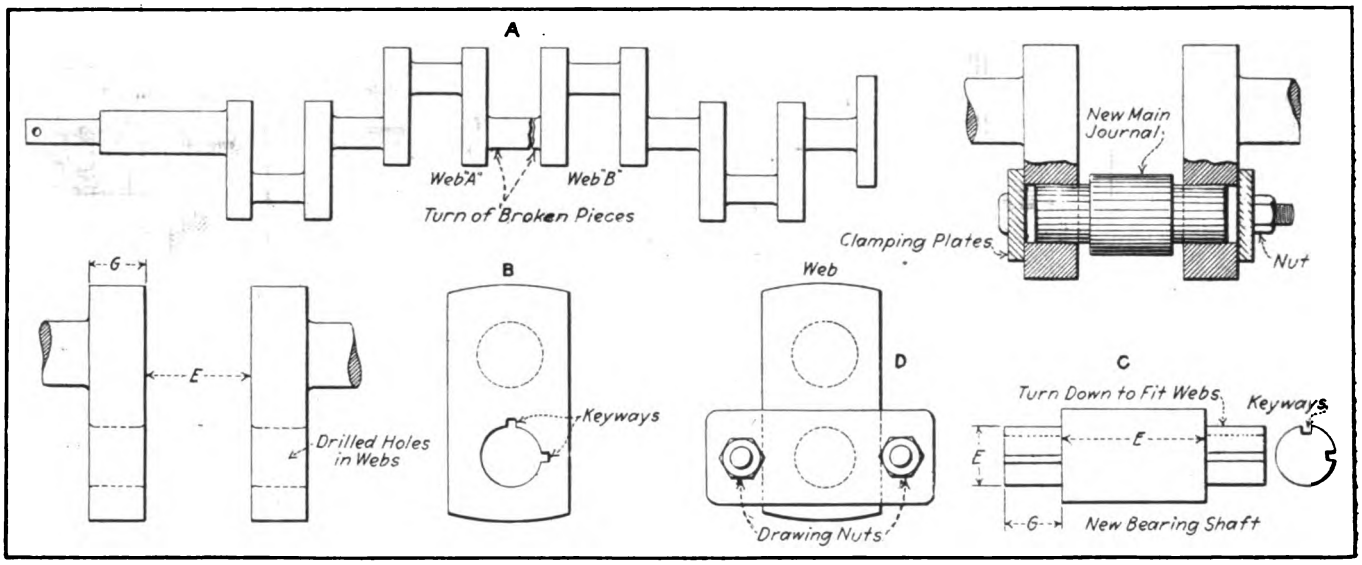


Fig. 1. Showing steps in turning off broken main journal pin and replacing with new main journal shaft

SQUARING THE CIRCLE

By Prof. T. O'Connor Sloane

THERE are certain problems which in past ages have occupied a peculiar position in science. For many generations finding the longitude at sea was an unsolved problem. The sextant, or rather its predecessors, the old wooden and ivory quadrant, the astrolabe and other crude instruments enabled the approximation of the latitude to be obtained, but not the longitude. At last the problem was solved by no new scientific discovery or mathematical calculation, but simply by the production of a clock which would either keep time, which it rarely does, or which would run day in and day out with a uniform rate of error.

Lunars, as observations of the moon for longitude are termed, had a certain vogue, but their complication and the fact that small instrumental or observational errors were greatly magnified in the final result, have caused their general abandonment.

What the future of wireless telegraphy has in store for the navigation of ships is open to conjecture. There is every reason to believe that it may take the problem of the longitude to a great extent out of the clockmaker's hands and give it to the electrician. It is fascinating to think of what radio-telegraphy may have in store for the sea navigator as well as for the aeroplane pilot.

One of the most famous of the unsolved problems of the world is the squaring of the circle. This means a method of finding the side of a square whose area will be equal to that of a

Digitized by Google

circle of a given diameter. This resolves itself into finding the ratio between the diameter and circumference. One of the lessons of childhood touches on this ratio. How many of us have been taught that three times across the circle is once around it, which would be a very valuable and interesting figure except that it isn't so.

The factor by which the diameter is multiplied is symbolized or designated by the Greek letter κ, pronounced pi; it is supposed to be the initial of "periphery." The efforts to find it go back

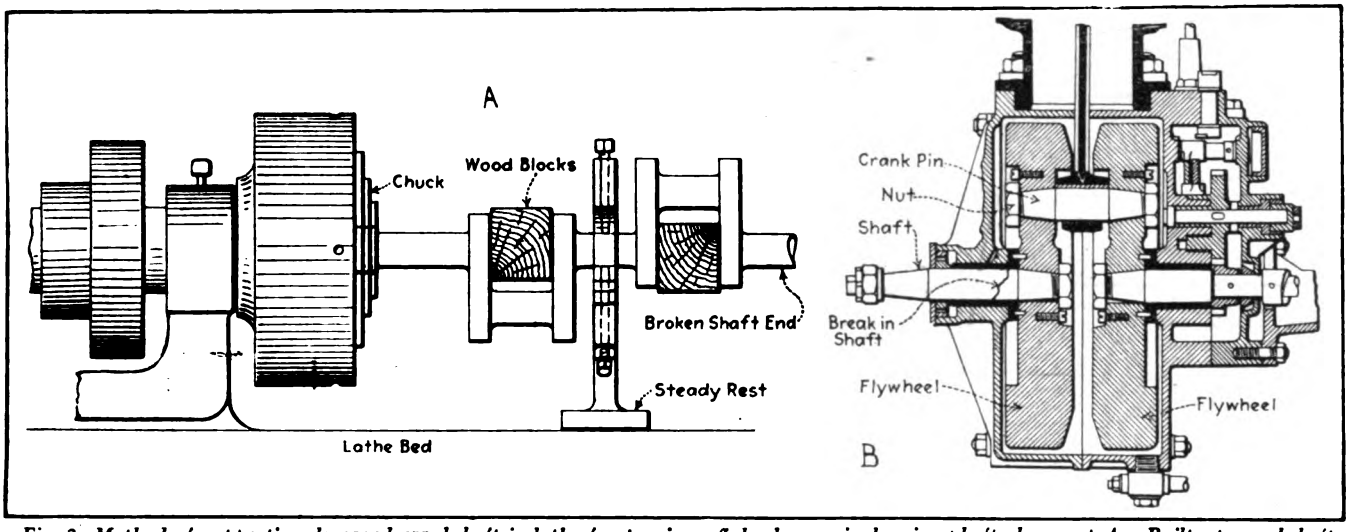


Fig. 2. Method of supporting damaged crankshaft in lathe for turning off broken main bearing shaft shown at A. Built-up crankshaft construction at B

thousands of years. Archimedes, before the Christian era, put it between 3 1/7 and 3 10/71. The first of these is a little over the mark about 13/30,000 too big. The second one is too small by about half the same error, so by averaging them a reasonably close approximation would have resulted.

Another of the old-time factors was the square root of 10 $\sqrt{10}$, which is worse. The Arabians attribute this approximation to the Hindus, so it is fair to say that it goes back into remote antiquity. If you want a square root for a factor try $\sqrt{9.87}$—this is quite close. The Chinese κ is 3 7/50, about as bad as the Hindu factor. Copernicus, a few hundred years ago, put it at 3 17/120, which is a very good approximation, whose error is about 17/300,000.

It was at the end of the 16th century that a Netherland mathematician, Peter Metius, evolved the fraction 355/113, which is extremely close to the mark—so close that its use is to be highly recommended for those who prefer vulgar fractions to decimals. It is computed that the error for a circle of 100 feet diameter would be less than 1/12 inch of the circumference; the error by Archimedes figures would be between one and two inches. A later mathematician, Ludolf Van Ceulen, calculated the value of κ to 35 places of decimals and in his honor the Germans call κ the "Ludolfian number." The error with 35 places of decimals is inconceivably small. The reader can cipher it out, if he is so disposed.

It is said that Metius distinguished himself by evolving his fraction 355/113 to surpass a rival, Simon Van Eyck. The error comes in the 7th decimal place; the comparison below shows the astonishing approximation by so simple a fraction:

Metius's factor 355/113 3.1415928
True value of κ 3.141592+

The value of κ can never be fully determined as it involves an endless decimal which can be extended as far as desired without ever reaching an end. For practical use 3 1/7 or 22/7 is frequently close enough—355/113 is close enough for anything short of astronomical dimensions. It would give the moon's orbit within about 200 yards if it were a circle. A very usual decimal is 3.1416. This is less than 1/30,000 wrong and is applicable to about all mechanical calculations of the more exact kind. Never use the factor 3—it is too far off the mark.

If you like to use percentages multiply the diameter by 3 and add to the result 4.7%. This is fairly close. A circle 1 foot in diameter would measure approximately 3 feet $+ 3 \times 4.7\%$ or 3.141 feet in circumference by this method. This is closer to the truth than the 22/7 factor would give it.

MOTOR CARS FOR RAILROADS

THE use of motor cars in connection with railway transporation has developed very slowly. Of the various disadvantages which kept the internal combustion engine off the railways, the chief were the limited efficient speed range of the engine itself, the absence of a satisfactory means of building up a train speed from a dead stop, and the high cost of operation and maintenance.

During recent years, however, war conditions have greatly improved the standard and efficiency of motor vehicles of the motor omnibus and truck type, and the alternations in railway and motor costs have greatly improved the relative position of the automobile. The author of an article in *Canadian Machinery* describes a standard omnibus for twenty passengers set on a flanged wheel chassis. Two of these motor-buses are running on a standard gauge railway 15 miles long. A three-times-a-day service used to be maintained with a steam propelled mixed train, now the service has been increased with a greatly reduced staff.

On another system two cars have been coupled together at the back to obviate the necessity of turning round at the end of the journey. In this way one car is alternately the engine car and the trailer, and the speed between stations is 40 miles per hour. A very slow and inefficient service has thus been converted into an excellent one.

A third type of rail motor-car is driven off the track at the terminus and turned like an ordinary motor-bus, this being preferably on a square paved with stone, to prevent damage to the road from the wheels. The rail car is then driven on to the rails again. These methods of eliminating the expense of turntables or similar devices have proved expeditious and satisfactory.

The scarcity of tin during the war has had the effect of drawing attention to cadmium as a substitute in the making of solder. 20,000 tons of tin are needed annually for this purpose in the United States. It is believed that 600 tons of cadmium could be recovered from the dust of zinc smelters alone, instead of the trivial amount, 100 tons, now recovered annually. Germany is supposed to have used the comparatively rare metal for this purpose during her blockade early in the war. One pound of cadmium goes as far as three to five pounds of tin in the manufacture of solder.

Another odd instance of the killing of germs is to the effect that lemon juice, vinegar, white wine or alcohol have the power of killing in five seconds the coli bacilli in the oyster to the extent of 40% to 80% of the organisms present. The epicure in flavoring his oysters kills the germs.

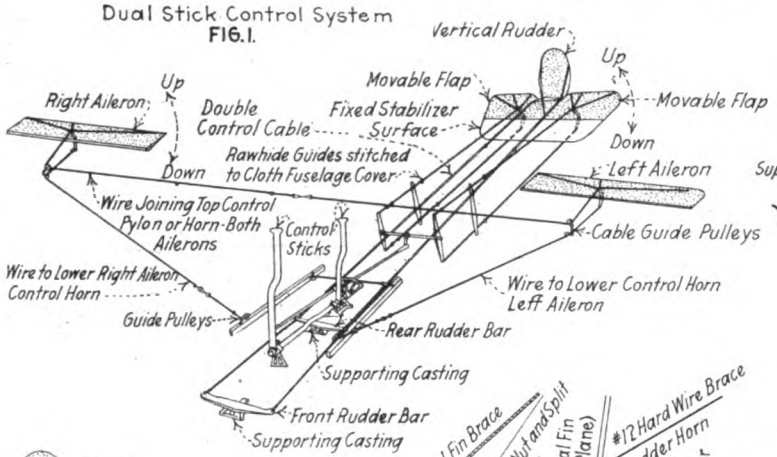
Digitized by Google

CONTROL (STABILITY)

LATERAL, LONGITUDINAL, DIRECTIONAL
TWO SEATER SEA-PLANE
DESIGNED BY C.E. MULLER M.A.E.

PLATE TEN

Dual Stick Control System
FIG. 1.



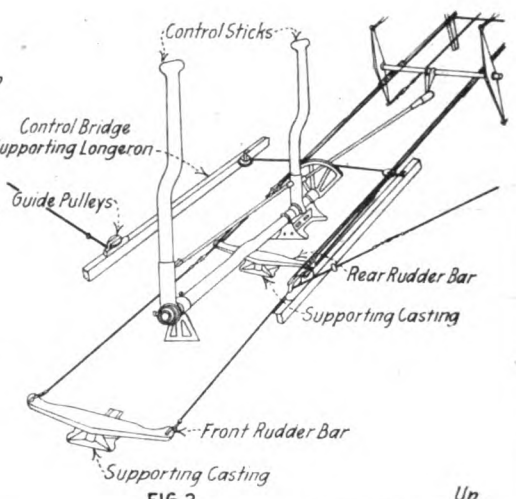
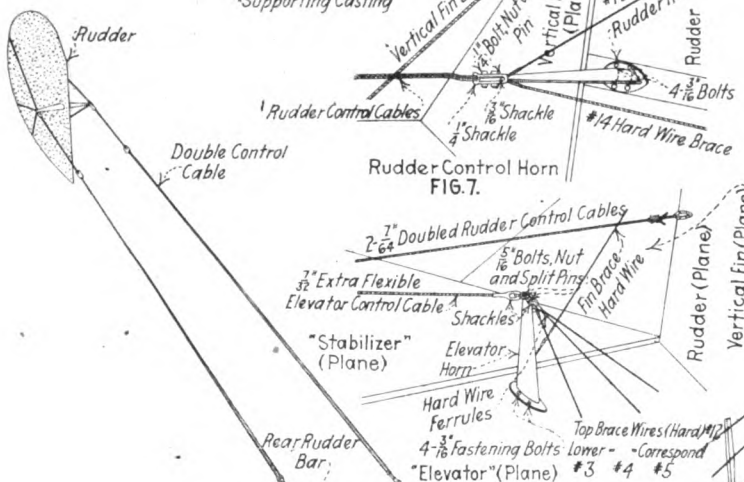
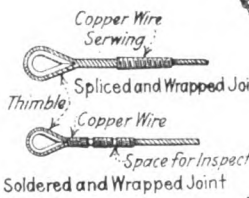


FIG. 2.

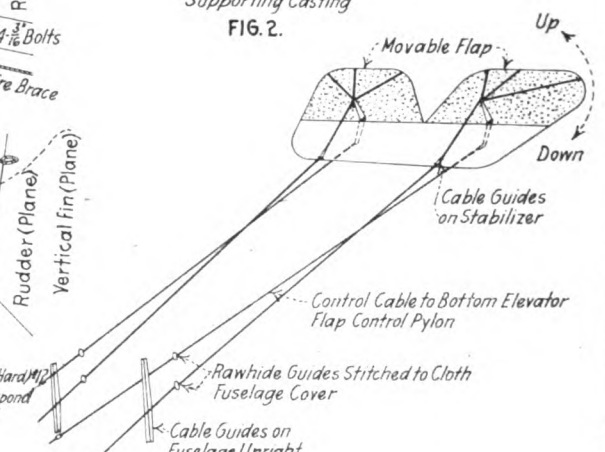
Rudder Control Horn
FIG. 7.



Elevator Control Horn and Fastenings
FIG. 8.

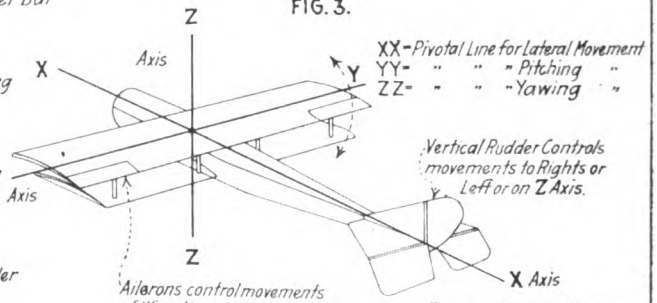


Rudder
FIG. 4.



Dual stick control system showing various parts that should be inspected frequently.

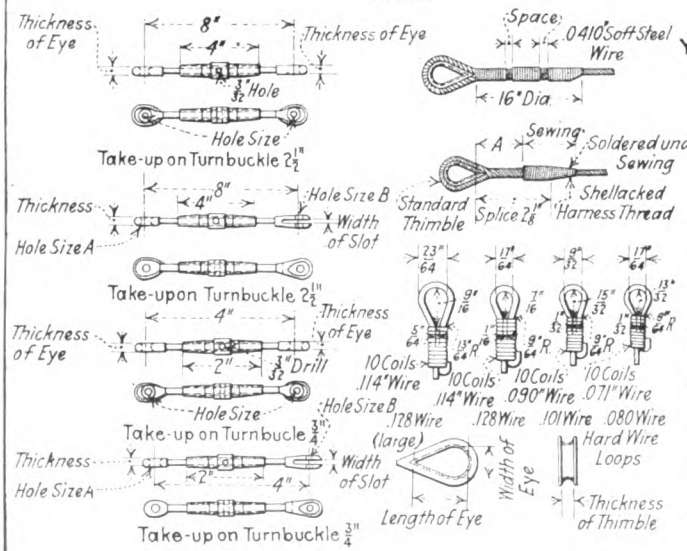
Elevator
FIG. 3.



X - Axis about which Lateral Movement takes place
Y- " " " Pitching " " "
Z- " " " Yawing " " "

FIG. 5.

A Diagrammatic Representation of the Three Axes about which Movement of an Airplane in Flight May Take Place.



Details of Standardized Thimbles and Turnbuckles
FIG. 6.

DIAMETER OF CABLE	LENGTH OF SPLICE	NUMBER OF TUCKS	LENGTH OF SERVING	FULL STRENGTH OF CABLE
3/32 7x14	1 1/4	3 over core buried 4 under	1	1/2 800
1/8 7x19	1 1/2	"	1	1/2 2000
5/32 7x19	1 3/4	"	1 1/4	1/2 2800
3/16 7x19	1 7/8	"	1 1/4	3/4 4200
7/32 7x19	2 5/8	"	1 1/4	3/4 5600

Digitized by Google

Building A Two-Passenger Seaplane

By Charles E. Muller

Consulting Aeronautical Engineer

CONTROL ELEMENTS
PART 7

THERE are three kinds of stability necessary to consider in the design of an airplane. Dynamic stability, that which maintains the equilibrium of the airplane in flight. Static balance which is necessary to manipulate the machine from its position at rest to its flying speed and vice versa. To the layman this is perhaps overlooked but to the pilot it is an essential that constitutes the greatest flying problem. Its influence is decidedly felt when adverse conditions arise, that is, in maneuvering over the ground and when accelerating to take off and in landing, especially in forced landings. Aside of the very rare accidents in the air such as fire, failure of over-stressed parts and those due to combat, the only real problem is that of landing. This will be explained in the last article of the series.

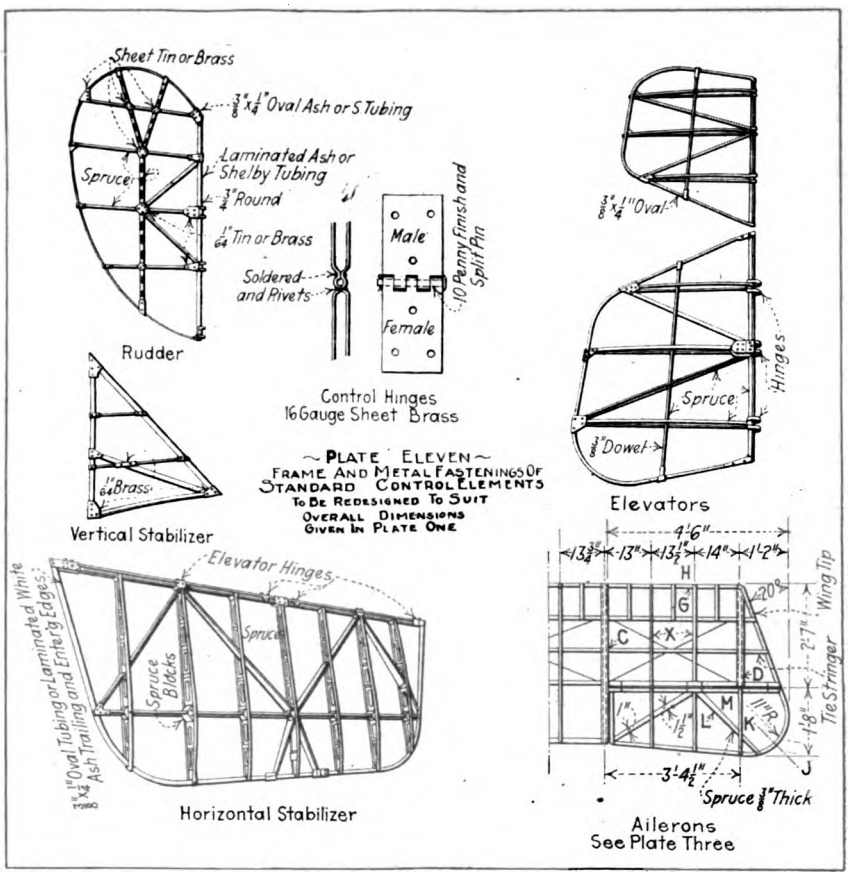
The static balance has been carefully considered in the design of this airplane in that the pontoons have been lengthened and are more than 100 per cent. over capacity for flotation. The wheel landing gear has been strengthened and placed well forward of the center of gravity to prevent nosing over. Inherent stability is that which tends to balance the machine automatically as is to be explained in a later article. Of course inherent, static, and dynamic balance operates on the X-Y- and Z axis as depicted graphically in the fuselage diagram in the January edition of this magazine and in figure 5 of this issue. A study of the diagram in figure 5 will show that these, singly or some combination of them, constitute all the movements of any body in the three dimensions. It is a movement on one axis, more often a combination of two and frequently on all three axis that requires immediate adjustment or manipulation of controls when doing the so-called "stunts."

The movement on the X axis is called Rolling and is similar to a ship in a side sea. This is known as Lateral Stability. On the X axis it is called "Pitching" as it nautically and aeronautically is known as Longitudinal or Fore and Aft Stability, controlled by the elevators. The motion about the Z axis is called Yawing and is known as the Directional Stability attended to by the rudder. The Lateral Stability is controlled by the ailerons, as shown in Fig. 1, which are actuated by a 5/32nds of an inch cable easily traced and clearly defined in illustration. All control cables are usually in duplicate for a very high safety factor which is required by the government. However, it is not considered necessary in this machine as the single cables are sufficiently over-size. All control wires are always kept taut, i.e., one wire takes up the stresses applied while the compensating wire is played out in such a manner that as little slack as possible is permitted.

Caution must be observed that no control wires are ever tensioned highly enough to cause a binding tendency, especially of the ailerons. In the early days, the Farman type had large ailerons on top and lower wings connected together only on the respective sides. They were held horizontally by air pressure during flight, actuated by units independent of the opposite side acting as lifting surfaces only. In modern practice they are compensating while one side lifts the opposite side is depressed. Tracing the aileron cable from the Joy Stick quadrant Fig. 2, on through the pulleys on the seat sills, thence to the under pulley attached to the main wing bar in the outer wing section on to the lower aileron pylon shown at Fig. 8, plate 10. (The details of this horn appear in plate 4, Fig. 21.) A turn-buckle is placed in this cable between the pulley on seat sills and the outer wing section approximately a foot from fuselage covering.

The upper and lower horns are bolted through blocking attached to the framework supported by brass or tin strap bindings well braded with escutcheon pins by 4 3/16" steel bolts as shown in Figs. 7 and 8, plate 10. They are braced by 3 No. 12 hard-drawn wires, as shown. These are anchored to the trailing edges where they are braced by ribs that act as compression members. A study of the components in plate 11 with instructions for making wire terminals should suffice for all wire work required. You will observe that all control cable terminals are attached to shackles. All other wires are attached to small anchorage plates, shackles and fitting lugs. The wire connecting the overhead aileron pylons is called the compensating wire. It should have a turnbuckle near its center for adjustment and for convenience in disassembling the machine.

The Joy Stick actuates the ailerons by a side-wise motion and the elevators by a fore and aft motion. If the Joy



Digitized by Google

Stick be considered as rigidly fixed, one may liken the stick as an integral bar, pushing it in the direction in which he wishes the machine to go. Pushing forward to descend, pulling backward to ascend, to the right to lower the wing on that side, etc., remembering the machine normally pivots on the axis as shown in Fig. 5, plate 10.

The rudder, however, is directly opposite in its movement; you push the bar on the side to which you wish to turn. This is just opposite to the bobsled, as you may readily see in Fig. 4. The reason this is done is to obviate the need of crossing the wires. However, it is optional, one may cross the wires and the same relative motion may be applied to the rudder that applies to the Stick. The mastering of these movements are absolutely necessary before flight is attempted. It is usually acquired by the student holding the Joy Stick lightly while the pilot manoeuvers the machine in dual control types.

Later the rudder bar is likewise learned, then combinations are tried as frequently and instinctively, some combination of all three are required to be executed almost instantaneously, especially during gusty weather when near the ground. This will be explained thoroughly in the last article of this series. I shall try to convince the readers that there is absolutely nothing in flying that a normal man or woman with steady nerves, machine and weather right, may not acquire.

The Joy Stick may be made of a straight grained piece of reliable hickory, white oak or ash, 1¼" at the butt, which must be bolted in the socket, tapering to about 1 inch with a knob at the top or rubber taped. A piece of 1⅛" tubing with a hardwood core may be used. The fittings shown in Fig. 2, plate 10, quadrant bearings, yoke sockets, etc., may be aluminum castings or built-up steel fittings, as the builder wishes.

Wiring

Aviation cable is used where there is excessive vibration or wear over the pulleys, principally because of the warning it gives by broken strands if over-stressed. Vigilant inspection should be given as instructed later. Hard drawn wire may be cracked or badly stretched without detection, so therefore are not used for the more important wires such as lift wires. It is recommended that the four main wing lift wires be 3/16" cable, approximately 4,200 pounds tensile strength, for a safety factor of 10 or on double wires 20. The landing cables will be ample if of ⅛" diameter, approximately 2,000 pounds. The landing gear cables should be 7/32" cables. The stagger wires may be of No. 12 hard-drawn wire Turn-buckles are recommended for all wire to make the necessary adjustment required after hard landings.

A close study of Fig. 6 will show how the wire and cable terminals are made. The cables are spliced and soldered as shown or turned back to at least 12 diameters of the cable over a thimble and wound with soft steel wire, then soldered. Sometimes the loop, which must be ample, is wound with a copper wire serving in lieu of the thimbles.

The hard wire is looped over a pin or bolt three or four times the wire diameter with a bend free from any kink with sufficient length to take hold of the end to bend back over the coil, Fig. 6. The surplus may be easily snapped off by filing a nick in it and then flexing it. The coil must be of hard drawn wire tightly and closely wound at least ten times. The loop is then dipped in soldering paste (acid is tabooed by experts), then in a pot of molten solder.

It is urgently recommended that several of these terminals be made for practice before attempting to cut the wires to length. A certain allowance must be known before it is safe to cut the wires to length. Make up the largest ones first, as, if there is any discrepancy or error, they will make the shorter ones by cutting to the required length.

A very easily and satisfactory made loop is accomplished by placing a ferrule sawed from a piece of copper tubing (16 gauge) whose diameter will permit its being flattened to an oval that will just admit the wire and the turned-back end. The same dimensions and method is shown in Fig. 6 (hard drawn loops) will suffice. This method is now nearly obsolete and not recommended. A cheap substitute for a turn-buckle will be diagrammatically explained next issue.

The framework of the control members, shown on plate 11, are of the general standard type and sufficiently clear to guide one in the designing of these components for the Seaplane. The rudder of the Seaplane is a balanced one. The general construction is the same as shown with the exception that the top trailing edge does not stop at the rudder post, but continues to form the section that is usually occupied by the vertical stabilizer or fin. This fin is located underneath the fuselage and is rigidly braced to form a solid anchorage for the lower rudder hinge. These hinges may be made of 16-gauge sheet brass similar to that shown on plate 11, and the same construction may be used for elevators and ailerons.

At Fort Worth, Texas, there is being established a new helium plant to extract the gas from natural gas. The latter is to be piped ninety-six miles, and the pipe-line is to have a capacity of forty to fifty thousand cubic feet a day.

INFLUENCE OF AVIATION ON ENGINE DESIGN

Experience gained in connection with aircraft engines will have an important influence on future automobile engine design, writes Charles Faroux in *La Vie Automobile*. "I am convinced," he says, "that we shall see the overhead camshaft type of engine become popular on the regular touring car, as well as on the speedster. This arrangement of the valves is the most rational from every point of view, and the objections which could be raised against it at the start are no longer valid. There are some very nice constructions, and some of these have already been described. Hemispherical combustion chambers also have a great future before them, and are destined to become the standard construction.

"The remarkable increase in mean effective pressure will also become evident in touring vehicle motors, and the specific output will increase proportionally. In the approaching races, we will see the output of 30 h.p. per liter (61 cu. in.), where we left off in 1914, improved upon, as well as speeds of 3,000 r.p.m. Touring vehicle motors will follow the same ascending path, and will exceed 20 h.p. per liter."

SIMPLE COPPERING METHOD

When clean iron or steel is dipped into any copper solution that is neutral or acid, the copper is deposited upon the surface by simple substitution. The iron dissolves and the copper takes its place. This fact has long been known and this method preceded that of electro-deposition by many years. Use is made of this property to coat small iron and steel goods with copper and it is still employed for the cheapest classes of hardware which will not admit, because of cost considerations, of electroplating with copper in the usual manner. Large amounts of iron and steel wire are coppered in this way and nearly everyone is familiar with the well-known coppered steel rods and wire so extensively used. While the amount of copper on the surface is very small, it acts beneficially in protecting the steel against rust, and for this purpose it is the cheapest process that can be used. A very general use is in machine shops where steel and iron surfaces are coppered with a simple "bluestone" solution to provide a surface on which dimension lines, circles, etc., as a guide for machining are easily scribed.

A receipt for liquid glue gives 500 parts of glue, 400 parts of water, and 100 parts of resorcine or though not so good of phenol, if the former is not to be had. The usual system of making liquid glue by the use of strong acids is in many cases objectionable.

Digitized by Google

INSTRUMENT TO AID IN AIRPLANE CONTROL

A COMBINATION recording instrument to aid the pilot in navigating aircraft under conditions that are not favorable to ordinary observations owing to lack of a horizon such as in clouds and darkness or when caught in a fog, has been developed in Germany. All three motions, climbing, turning and banking may be indicated simultaneously on a single dial. To ascertain if the airplane is banking or climbing when it is difficult to see the earth, a pendulum and a level are used. A miniature reproduction of the airplane is rigidly connected to the fuselage and is visible in the dial of the indicator, the amount of climb or bank being easily seen at a glance. For determining whether or not the machine is turning the use of the gyroscope is introduced.

A level, designed to show very small inclinations of the axis of the machine to the horizontal, consists of a fluid in an endless tube. The pendulum oscillations are damped in glycerine. The gyroscope frame is restrained so it moves about one axis only, at right angles to the axis (horizontal in normal flight) of the gyroscope, and parallel to the direction of the motion of the machine. Even this freedom is restricted, the motion being controlled by springs. A pointer attached to the frame passes over a scale to the "picture" of the airplane on the dial, and shows at a glance the angle of bank. The instrument is staed to be reliable in action.

SMALL FARMAN MONOPLANE

THE Farman "Mosquito"—a diminutive single-seater monoplane, equipped with a two-cylinder engine of about 20 horse-power is announced by that prominent French maker as a type of single seat sport machine that will supply a popular demand. It is small enough to be stored in the average garage and its upkeep should be a simple matter, because of the simplicity of its construction. It is said to make a speed of about 65 miles an hour and land to at a speed of about 25 to 30, so that it can start or land on an ordinary road, if necessary. In flight, however, such small planes do not possess the stability of the larger machines. It pitches and swerves from side to side, which would seem to indicate that the pilot must be constantly on the alert to avoid accidents.

The sinking of a well, twelve miles deep, for purposes of scientific investigations and for determining the constitution of the earth's crust, was advocated at the last meeting of the British Association for the Advancement of Science. A period of eighty-five years and the expenditure of five million pounds was estimated for the carrying out of the investigation.

Making Cable and Hard Wire Terminals By Machinery

ONE of the most difficult obstacles to overcome in aeronautics has been the making of secure terminals on cables. A plane up in the air with the engine gone dead is in danger only to the extent of choice of landing. To be in the air with broken cable terminals is fatal, as control of the plane is impossible under such condition.

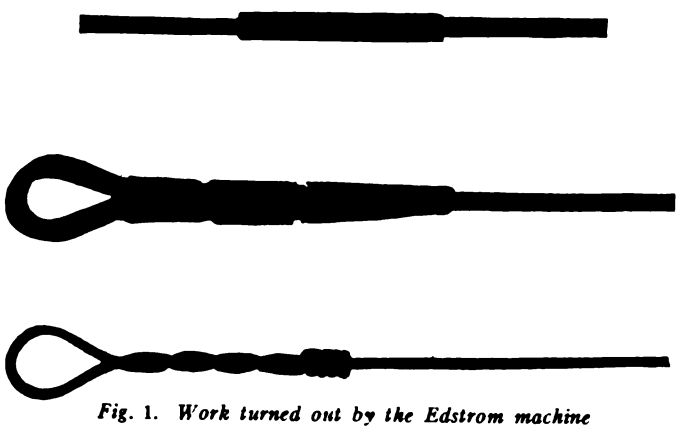


Fig. 1. Work turned out by the Edstrom machine

To serve terminals by hand, a very soft wire, of low tensile strength, must be used—copper wire is used in most cases—to enable the wrapping to be done by hand. This wire, when used under full tensile strength, falls short of a strong terminal, as is clearly illustrated by test, Serial No. 646, taken at McCook Field, Dayton, where it was shown that cables served with copper wire stood 71 per cent, against 100 per cent when served by special strength wire, both samples being made on the Edstrom machine. This, again, comparing with 32 per cent, being the best test on hand-served terminals, clearly shows the difference between hand work and machine, soft wire and a strong, springy wire that cannot be handled by hand.

The illustration at Fig. 2 clearly shows how tension is obtained by the Edstrom machine. First the spool is tensioned with lock-nut and spring, the wire then is dragged around the stationary drum, giving it the most uniform tension possible. By tightening the lock-nut, tension can be had that will break the strongest wire made, and what makes it possible to drag the wire to this high degree is, as will also be noticed in illustration Fig. 2, the continual wrapping up against the right-hand chuck, which is geared to work back just fast enough to permit the new turn room between the chuck and the last turn.

To save time, as well as improve the work, the company also has a machine to automatically clamp a metal flange on the cable, to keep it from flaring when cut; also a machine for cutting the cable, shown at the top, in Illustration No. 1. To do away with the expense of ferrule and soldering for hard wire, also greatly reducing the weight and cost, a machine has been built to turn out work, as shown at the bottom, in Fig. 1. Added to these, a test machine makes it a full and complete set of wire serving machine.

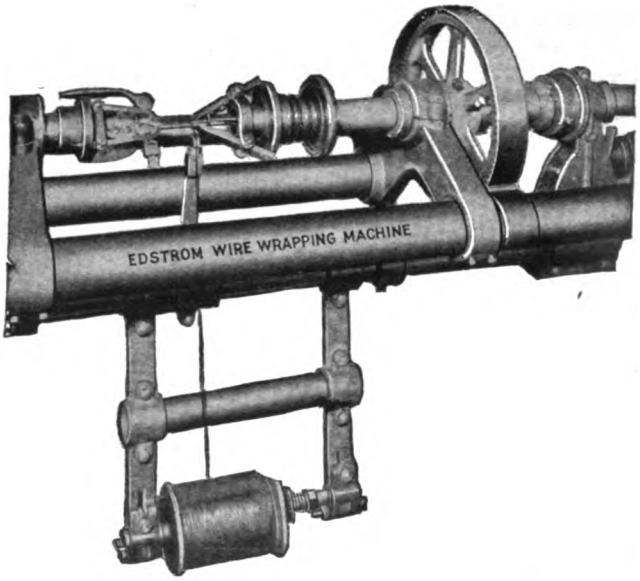


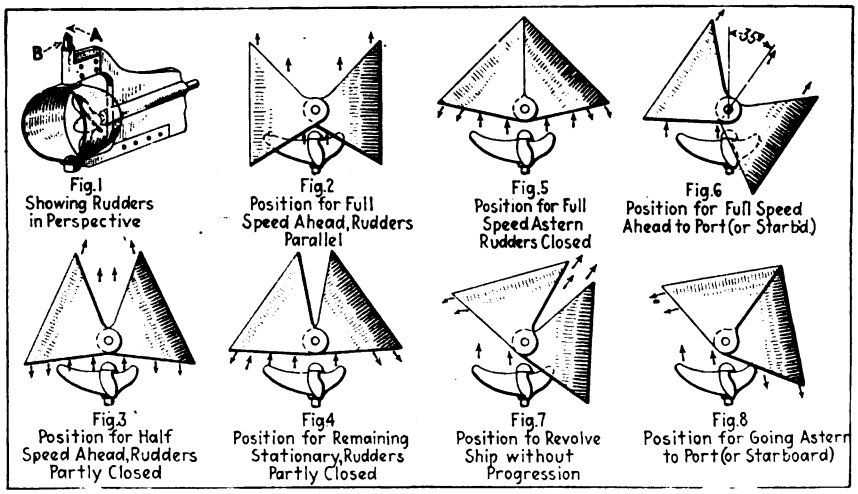
Fig. 2. How cable wrapping machine serves cable ends with wire under tension

The value of machine-made wraps to the aircraft is the fact that safer and better looking work is turned out, at a much lower cost of production, and, as the machine work will have a large influence in standardizing of cables, this will make still lower cost of production

Digitized by Google

The Kitchen Reversing Rudder

THE Kitchen rudder is fairly entitled to be called a curiosity in motor boat appliances. It is a double rudder, whose blades can be moved simultaneously to right or left, and which blades can also be brought close together at their rear ends. In one position they act exactly like an ordinary everyday rudder. But by bringing their ends together the boat can be brought to a slower rate of speed or to a dead stop or can be made to go backwards and all this without touching the engine, which continues to go in the one direction. No reversing gear or feathering blade propellor is required; the rudder does everything.



Figs. 1 to 8. Showing various positions of Kitchen Reversing Rudder

The first series of eight illustrations, Figs. 1 to 8 inclusive, explain the construction and operation of the rudder, and gives the various positions used for the different operations of the boat. The arrows indicate the water currents. The only thing to bear in mind in the cuts is that the rudder is astern of the screw. Thus in Fig. 5 the rudder forms a closed chamber astern of the screw, into which the latter drives a stream of water whose reaction forces the boat backwards. In all the cuts of this group except Fig. 1 the hull of the boat is supposed to lie below the screw and rudder as they are placed on the page.

The next cut, Fig. 9, gives a rear view or view from astern of the screw and the rudder blades, the line of the boat's counter showing above.

The manipulation of the rudder is simplicity itself. It is effected in different ways. In the illustration, Fig. 10, is shown an arrangement by which turning the hand wheel will rotate the two blades on their common axis so as to be parallel as for forward work, or can have their aft ends brought to any degree of closeness. There are two concentric shafts. The outer one is fixed as regards longitudinal motion; the inner one can be moved back and forwards by the screw mechanism in the forward end of the tiller. It will be understood that this double or telescopic shaft is the tiller of the boat. As the inner shaft is forced aft by the screw it forces aft the two oblique pivoted arms whose inner ends are connected to its aft end. Diverging therefore like a letter V, each has its other end pivoted to one of the rudder blades by an arc and sleeve. Going towards the stern these arms force together the after ends of the blades. When moved in the forward direction they separate the ends.

Each blade has its own stock or rudder-post concentrically arranged,

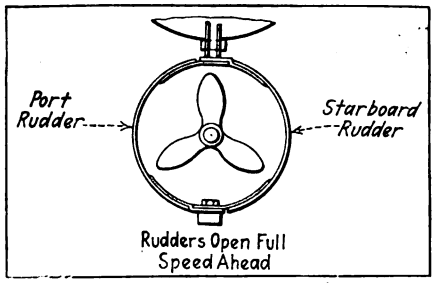


Fig. 9. Rudders open for full speed ahead

and the whole can be turned together in one piece, as it may be expressed, by swinging the forward end of the tiller to right or left, exactly as in the ordinary hand tiller in use on smaller boats.

There are a number of ways of working the rudders; what we have described is one of several that have been in actual use. In one mechanism the blade manipulation is effected by raising and lowering the tiller's forward end, steering with it in the regular way. In another arrangement a smaller wheel to one side manipulates the blades, while the steering is done by a regular pilot wheel. This disposition is shown in the next cut, which is supposed to show the bridge of a power boat or the helmsman's place. Here the steering apparatus perhaps nearly the boat's length distant is operated by chain and wire gear.

Records of various official trials of boats fitted with a Kitchen rudder are given below:

Pinnace, 20 ft., 7 brake horsepower (Admiralty, 1919).

Ahead speed: 6.2 knots (same as with ordinary rudder).

Astern speed: 2.02 knots (propeller full speed ahead).

Full speed ahead to moving astern: 7 sec.

Full speed ahead to dead stop: 4 sec. (in less than half boat's length).

Full speed astern to moving ahead: 4 sec.

Diameter of turning circle at full speed ahead (helm hard over): About one length of boat.

Launch, 25 ft., 16 brake horsepower (Air Ministry, 1918).

Ahead speed: 9.80 knots.

Astern speed: 3.5 knots.

Full speed ahead to dead stop: Boat pulled up in 23 ft. (four men aboard).

Full speed ahead to dead stop: Boat pulled up in 16 ft. (one man aboard).

Time taken turning complete circle on own axis without progression in any direction: To starboard, 33 sec.; to port, 26 sec.

SCHOOP METAL SPRAYING PROCESS

A PROCESS for covering articles with a metal spray has been invented by M. U. Schoop. In this, the ends of two wires are brought to the melting point by passing a heavy amperage current through them, the current density being from 40,000 to 50,000 amperes per sq. in. The liquid metal globules thus formed are carried off by a jet of air or gas and deposited on the article to be coated. If continuous current is used the wire connected with the negative pole melts more rapidly and must be fed forward 1.6 times as fast as the other one. In the case of alternating current the fusing of both wires is at the same rate. A careful study has shown the melting and spraying phenomenon to consist of a quick succession of uninterrupted spark discharges which are accompanied

Digitized by Google

by a special arc. The current density during the rapid succession of short circuits is so great that the particles of fluid metal would be thrown explosively in all directions, if they were not carried in a definite path by the air jet.

In order that no excess of metal vapor be present, the potential difference between the wires must not be too high. With the special metal spraying pistol a pressure of 30 volts is used. To lower it still further is inadvisable as the wires then melt away too slowly With a wire diameter of 0.032 in. this voltage gives a current flow of 35 amperes. The rate of feed of the wires is two to three yards per minute.

The air pressure of 50 lb. per sq. in. is generally used, but is not closely limited as in the case where the wires are melted by a gas flame. This permits of more finely spraying the metal and insuring a better bond between the object and its coating. Aluminum or copper sprayed on glass under an air pressure of 80 lb. per sq. in. cannot be removed without detaching smaller or larger glass splinters. Microscopic examination has shown that the glass at the points of contact is raised to the melting temperature and intimately unites with the coating. It is essential in this connection that the metal particles be absolutely pure and the temperature at contact high. It is said to be possible to coat readily inflammable materials such as wood, paper and even celluloid with metal by this process, without it catching fire.

FUELS FOR HIGH COMPRESSION ENGINES

IN a recent paper by E. W. Dean and Clarence Netzer, publicity has been given to an important series of trials by various government agencies and the Delco Laboratories to determine the relation between the nature of the fuel employed in an internal combustion engine and the maximum compression ratio that can be used without interfering with smooth operation. The Delco Laboratories carried on their first experiments with an air-cooled engine adapted for operation on kerosene, and found that the use of compression ratios above a certain value caused what was described as "the kerosene knock" or "pinking." With proper selection of fuel this "knock" could be avoided. It was this "knock" which at the time caused the general conviction that the compression ratios of airplane engine should be limited to the proportions of 5.4 times atmospheric pressure.

A similar process of selection was applied to aviation engine fuels. The chemical properties of the fuels were obviously more important than the physical properties of the fluid. Accordingly, samples of gasoline were obtained from different varieties of crude petroleum; various types of synthetic gasolines were obtained. Benzol, alcohol, and cyclohexane were other fuels employed. Tests were conducted in a single cylinder Liberty engine, in which compression ratios could be varied from 5.3 to 1 up to 8.2 to 1. The final result of the investigation was that "hecter" benzol, alcohol and a special alcohol-benzol-gasoline mixture showed only a slight tendency to knock under any 8.2 to 1 compression ratio.

On a Liberty 12 a mixture of 70% of cyclohexane and 30% of benzene, give with a compression ratio of 7.2 favorable results both on the block and in the air, with perfectly smooth runs. Altitude laboratory tests showed a decided increase in power at all levels. Since one of the main points in aviation engine design is the employment of high compression ratios to keep down engine weight, the above results are very valuable and the chemist has shown the engineer a way out of some difficulties, which has much promise.

Much attention has been excited in recent years by calcium cyanimide, the basis for the fixation of atmospheric nitrogen. Now comes the statement that it can be used in case hardening steel and iron. The Shimer process uses melted alkali and alkaline earth chlorides, to which are added 5% of the calcium cyanimide. The cyanimide is at once acted on and a sort of effervescence takes place, which is advantageous in securing a good mixing of the fused material, although there is involved a loss of the cyanimide. The iron to be case hardened is immersed in the bath. The bath is cheaper than corresponding cyanide baths, and is free from the intensely poisonous effects of the same.

The preservation of chloride of lime, calcium hypochlorite, is greatly improved by drying it. Various agents have been tried, among the best were dry sodium hydrate and basic calcium chloride. Phosphoric anhydride and sulphuric acid were not so good. Only a little of the chlorine of the calcium hypochlorite was lost in the drying. The trade name of the compound is bleaching powder, and its value lies in its content of chlorine available for bleaching so that its preservation from losing this haloid is all important.

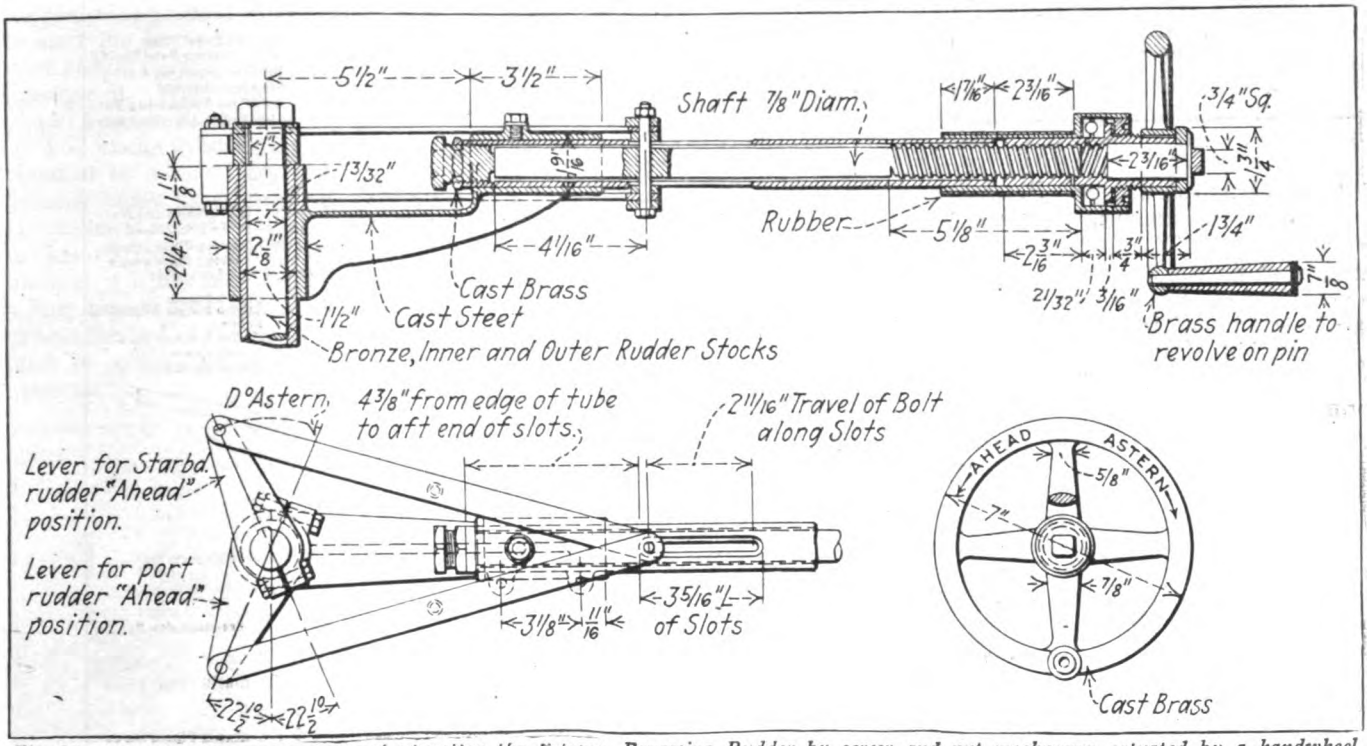


Fig. 10. Diagrams showing method of operating the Kitchen Reversing Rudder by screw and nut mechanism actuated by a handwheel

Digitized by Google

Adjusting Planetary Transmission

THE Planetary Transmission used on the Ford automobile is clearly outlined in part section at Fig. 1, the various adjustments and operating pedals are shown at Fig. 2, and a view showing its location relative to the flywheel of the engine is also shown at Fig. 2. The various adjustments are also clearly outlined. The operation is very simple and positive, there being three groups of planetary pinions P-1, P and

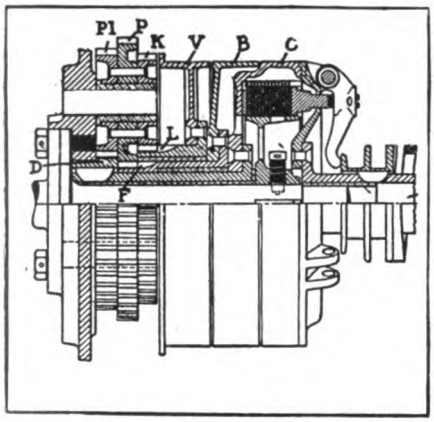


Fig. 1. Sectional view of Ford transmission

K. Gear P-1 meshes with gear D, which is keyed to a driven member attached to the drum C. The drive gear F is mounted on the end of a bushing which is riveted to the brake drum D. The gear L is attached to the brake drum B. The clutch is a multiple disc type normally held in engagement by a coil spring.

Three brake bands are used for this transmission, the one that constricts around the drum C is the foot brake and acts to retard movements of the car regardless of whether any of the other clutches are engaged. Tightening a band around drum B produces a slow speed. When the band is tightened around the drum V or that nearest the flywheel, a reverse motion is obtained. To apply either the slow speed or reverse band, it is necessary to break the direct driving connection by releasing the clutch spring tension and allowing one set of clutch discs to move independently of the other set. One set of the clutch plates is carried by the clutch case C which is keyed to gear D. The other set is carried by a clutch disc carrier which is supported by an extension of the engine crankshaft and prevented from turning by a set screw passing through the clutch disc carrier hub into the shaft. The adjustment of the Ford clutch is a very simple operation, this consisting of releasing the set screws in the clutch fingers by pulling out the split pin that acts as a lock and turning the adjusting screws. The slow speed adjustment is at the side of the gear case, and may be reached without removing the cover plate of the transmission which is necessary to adjust either the reverse clutch band or the foot brake band.

The chief trouble with a planetary transmission results from slipping clutch bands. In all cases these are provided with adjustments that can be tightened in event of wear of the friction linings up to a certain point. When the friction material wears thin, new brake lining must be riveted to the clutch bands. Care must be taken when making adjustments not to tighten any of the bands too much, as if these bind on the drum they encircle, it will produce friction which results in heating and wearing away of the brake lining and will also decrease the efficiency of power transmission. Noisy action of a planetary transmission is usually caused by excessive wear in the gearing or in the bushings of the drums. Slipping of the high speed clutch may be easily remedied by making compensation for wear by the methods of adjustment previously described. When taking down a planetary transmission, it is important to note the condition of the bushings on which the planetary pinion groups rotate. If these are worn or if the pins supporting them become reduced in size, the gears will rattle when in use and the transmission will be noisy on low and reverse speeds and when in neutral position, though it will be silent in action on the high speed.

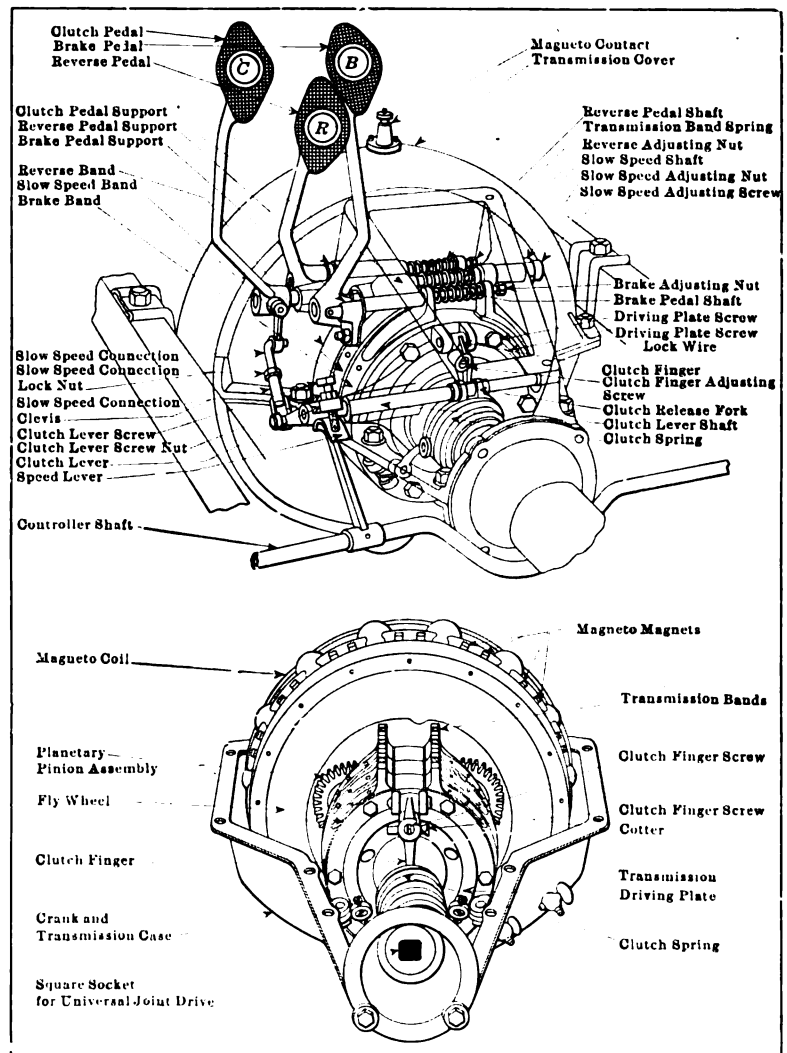


Fig. 2. Phantom view of Ford transmission at top shows operating pedals and leverage. The view below shows brakebands and high speed clutch adjustment

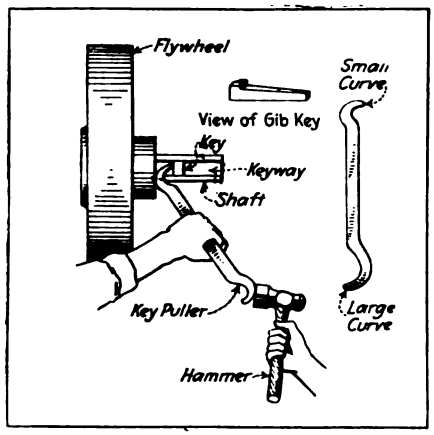
The brake drum surfaces often become grooved and these may be deep enough as to seriously reduce the strength of the brake drum. Where this condition is noted, new brake drums must be provided.

Digitized by Google

EVERYDAY MOTORIST

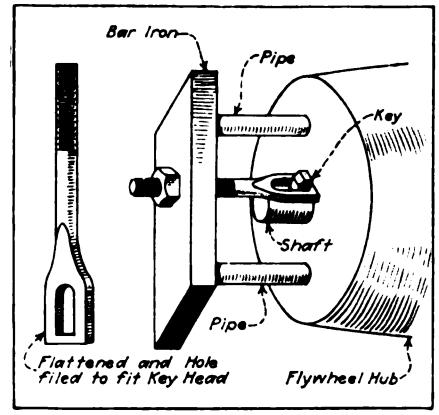
REMOVING KEYS

ON a number of cars of early vintage, such as the double-cylinder Maxwell and on many small marine engines, the flywheel is held on the crankshaft by means of jib-keys. When it is desired to remove the flywheel, as it is sometimes necessary to withdraw the crankshaft from the engine-base when rebushing the bearing, difficulty is sometimes experienced in removing the key. A very effective method of accomplishing this is shown in accompaning illustration. The key extractor or puller is forged of steel as indicated, having two hooks at the ends formed on curves of different radii. The one having the more gradual curve is used first to start the key while the one having more abrupt curve is employed for withdrawing it. When the key puller is placed between the head of the key and the hub of the flywheel a cam action is obtained by which the pressure of the hammer blows on the other end of the key puller is increased many times and the key started. If the key is rusted in place or if it has not been removed for a long time it may be found desirable to heat the end of the shaft with a blow torch or to soak the rusted parts with kerosene.



Special Forged Tool for driving out keys

Another simple and easily made appliance for removing keys that have rusted into place is also shown. This device consists of a large bolt the head end of which has been heated and flattened, a hole drilled through it and filed to receive the head of the key. A piece of bar iron is used to screw the nut against, this being held from the flywheel by spacers of pipe, steel shaft or metal blocks. Before using this puller, the key may be heated as recommended above and tapped on the head and sides sharply with a hammer for a time in an endeavor to break the rust bond. When the nut is screwed down so there is tension on the bolt, the end of the bolt can be given several sharp hammer blows which may expedite removal of the key.



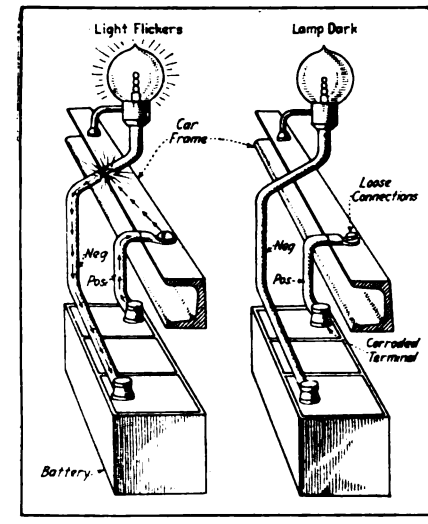
An easily made key puller

FAULTS IN WIRING

IN the two wire system every wire, connector and socket must be insulated from the car and should not be in metallic contact at any point except at the terminal. It is imperative that all wires be insulated from each other and the car frame except at points where permanent connections are made. All connections should be soldered to insure positive contact, held securely by means of cleats of insulating material and must be mounted in such a way that there is no possibility of sharp metal corners or edges wearing through the insulation and causing grounds or short circuits.

All wiring should be protected from the rotting action of grease, oil and water, and when the wiring is run where these substances are apt to accumulate the regular insulation should be supplemented by a conduit of insulating material such as circular loom or fiber tubing, or armored cable should be used. All wire should be so installed that there is no danger of interference between them and operating rods and levers. The abrasion of these members will wear through the insulation and result in short circuits. Brass or copper terminal connections should be used at all points and no connection should be made by winding as the strands may bridge across the terminal or to some metal part and cause a short circuit or ground. Special care should be taken with the connections in the lamps and other points. By the term "short circuit" electricians mean that two wires of opposite polarity are in metallic contact. Under such conditions the storage battery will be discharging and there will be no lights at the lamps. A short circuit may occur at any point in the wiring system, but is usually found at terminals that have been carelessly made or by worn insulation on wires.

A short circuit will be indicated by the position of the amperemeter pointer. Always note the position of the index hand of that instrument when the car is stopped. With the engine at a standstill and no lamps burning the hand should point to zero. If it does not the amperemeter is either out of calibration or there is a leak of current from the battery at some point in the wiring. To ascertain if the amperemeter is correct, uncouple one of the battery terminals of the lighting system. Obviously, if the hand swings to zero, the trouble is leakage of current, which should be immedaitely corrected after the trouble is located. If the index does not point to zero when the battery terminal is disconnected the instrument is out of calibration and while this does not affect the operation



Causes of flickering or inoperative lamp

of the system it should be taken into account when reading the amperemeter.

If the engine backfires when the ignition is interrupted and it makes one or two revolutions in the reverse direction, the amperemeter pointer may be found at the extreme of the scale on the discharge side. This is caused by the circuit breaker contact being held closed and means a short circuit of the

Digitized by Google

battery through the generator winding. This must be corrected at once by momentarily disconnecting one of the generator wires or starting the engine. If the wires are removed from the generator for any reason, make sure that they are connected to the same terminals as they were originally.

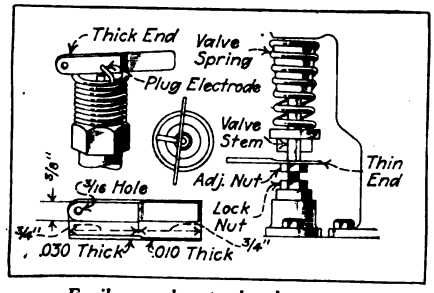
If the wires are reversed the amperemeter will indicate a dead short circuit by swinging to the extreme on the discharge side of the scale when the engine is started, and if this defective condition is not corrected the battery will be soon discharged. In case of a short circuit examine all of the wires connected to the battery terminals and to the lighting switch.

Make sure that the insulation is perfect and that it has not been cut through at any point. Whenever any wires are removed from any of the units always mark the terminals and the wire so that they will be replaced exactly as they were originally. If a short circuit exists when all the switches are opened, if one takes off a battery terminal and makes and breaks contact between the wire and that member a small spark will be in evidence. If no sparking occurs, connect up the terminal to the battery and then with the engine at a standstill close the switches to the lighting circuit one at a time and watch the amperemeter closely, as each switch makes contact. If the pointer does not move far from zero it shows that the current consumption is normal; if, however, the pointer swings to the extreme of the discharge scale it is evident that a short circuit exists somewhere in the circuit just brought into action. All the circuits can be tried in this manner one at a time.

If the amperemeter indicates only a normal amount of current consumption for the various lighting circuits it is apparent that no further search is necessary. If, however, the needle indicates a short circuit on one or more of the switch positions, examine the wires carefully for the circuits at fault, and if the trouble does not exist there it may be located in the lamp socket, the connector or the bulb itself. In case one or more lamps fail to burn the trouble is due to either a broken wire or a defective connection at the switch connectors, or lamp sockets or a bulb or fuse is burnt out.

SPARKPLUG GAUGE FOR MOTORISTS

A SIMPLE but useful attachment for the motorist's key-ring is shown in the accompanying illustration. It can be made of spring steel or hard brass, steel being preferred, however, since it can be hardened and tempered. It is made from a piece of stock about .050-in. thick, 1½-ins. long and ⅜-in. wide. Before hardening, a 3/16-inch hole is drilled in the end and the corners rounded off to make it easily inserted on a key-ring. The piece is then ground down to about .030 inch thick for about half its length and

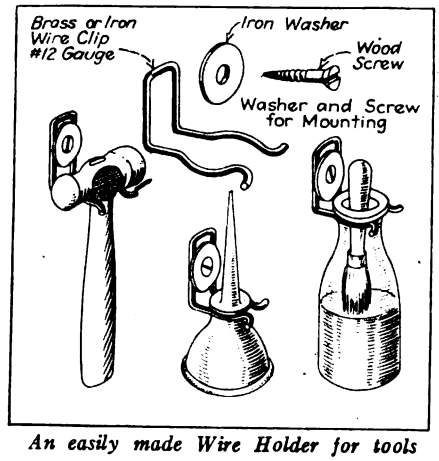


Easily made spark plug gauge

to about .010 inch thick for the remainder. The thick end is used for setting the gap between the electrodes of the ignition spark-plug; the thin portion will be found useful when adjusting the clearance between the valve stems and adjusting nuts on valve-lift plungers.

HOLDERS FOR TOOLS

SUBSTANTIAL clips for holding oil cans, hammers and other tools may be made as illustrated in the accompanying drawing. Pliers are used to bend lengths of suitable wire to a "U" shape and a bend is made in both prongs. The ends are shaped to conform to the neck of the container, or to



An easily made Wire Holder for tools

the handle of the tools to be placed in them. A washer and a screw are used to secure the clip to the dash of the car, or the wall of the garage. Such clips are easily made and installed and are very useful in keeping tools, oil cans, shellac bottles, etc., off of the bench top and keeping them out of the way until wanted.

OVERSIZE TIRE TABLES

OVERSIZE tires, designed primarily for exceptional and hard service, have come into favor among owners of medium and large capacity passenger cars, because of their extra strength, easier riding and longer mileage that may be expected from them. They are popular also because in the opinion of many owners they add to the appearance of the car.

Some users of oversize tires think that a tire with increased cross section diameter, but with no increase of diameter measured through the hub from outer edge to outer edge of tire, is an oversize. This is a mistake. In other words, if the regular size tire is 34x4, the oversize is not 34x4½ but 35x4½.

A tire manufacturer gives the following table to show the proper regular and oversize tire for a given rim which is the same as the regular tire:

Regular Tire	Oversize Tire
28x3	29x3½
30x3	31x3½
30x3½	31x4
32x3½	33x4
32x4	33x4½
34x4	35x4½
32x4½	33x5
34x4½	35x5
36x4½	37x5

Only the oversize tires in above list should be used to replace the regular size given because they have been designed to fit the same rim sizes as the regular tires and can be applied in their place without straining the beads. It will be noticed that not only the tire width but also its diameter is increased over the regular size.

CORRECTING FAULTY STEERING

AFTER driving a Saxon Six for some time I became annoyed with the abnormal amount of slack in the steering gear which developed slowly and without any apparent cause. Inspection showed that it was caused by a very little looseness in each joint, but there seemed to be no easy way to take it up. I finally decided to try a spring to pull on the wheels in one direction and this proved a complete success. The spring is a heavy coil 1" by 16" and is fastened under the front axle, one end on the steering rod and the other on the frame, so the wheels are pulled to the right. The tension must be adjusted for best operation. In driving, the wheel only needs to be kept steady, but in turning it will be found that the car responds quicker in either direction than without the spring.—Leo M. Lafare.

MAGNET RECHARGING

THE permanent field magnets used on magnetos are easily recharged by inserting them in solenoids wound for a current of 20 amperes at a potential of 6 volts so they can be coupled up to an automobile starting system battery of that voltage. The connection is made only for an instant as several contacts of a second's duration are all that is needed and this will not injure the battery. It is stated that a freshly charged tungsten steel magnet of a large magneto will lift in the neigh-

Digitized by Google

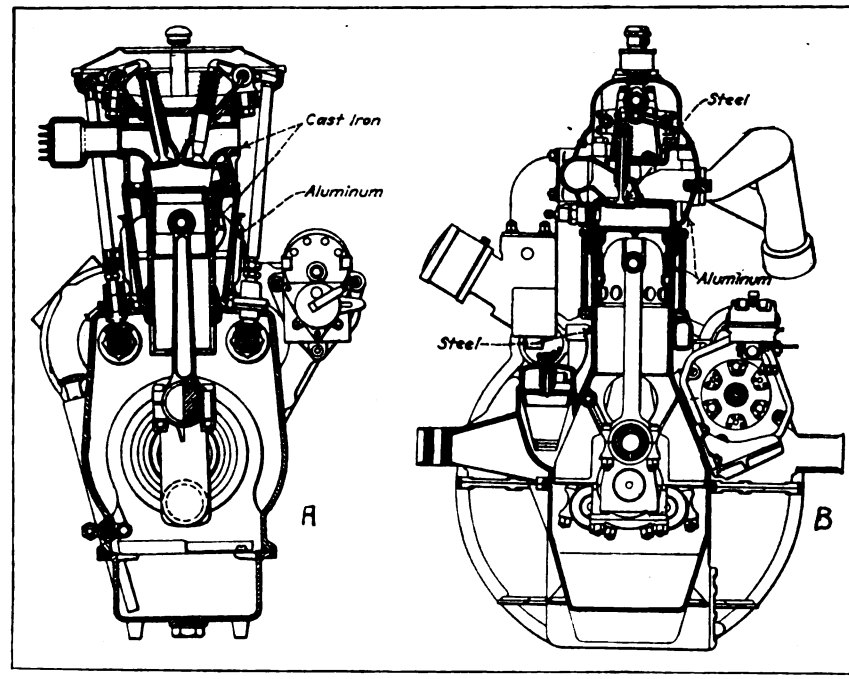
borhood of 20 lbs. as ordinarily energized. This may be tested by a spring balance attached to a suitable armature member. In some cases where the magnets are large, the pull may be as high as 30 lbs.

TESTING MICA INSULATED SPARK PLUGS

PLUGS using mica insulation are very deceptive as in many cases short circuits exist that cannot be detected by the eye in daylight. A good way to test a suspected mica plug is to lay it on top of the cylinder after dark, taking care not to have the insulated terminal in contact with any metal parts except the high tension current lead. The engine is then run on the other cylinders and the inside of the spark plug watched to see if sparks jump between the insulator and the plug body, instead of between the points. If a short circuit exists, it will be easily detected by the minute sparks plainly evident in the darkness. It is sometimes possible to test a plug out in the daytime by shading it from the light in some manner, as with a black felt hat.

ALUMINUM CYLINDER BLOCK CONSTRUCTION

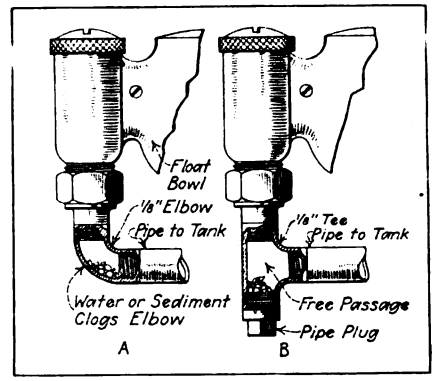
ONE of the contributions of aeronautical engineering to modern automobile engine construction is the use of aluminum for the cylinder blocks of automobile engines. There is also a growing realization of the advantages of the overhead valve placing, the actuation of these members being either by means of cam shafts carried in the engine base and depressing the valves through the medium of rocker arms actuated by tappet rods or mounting the cam shaft directly over the cylinders and driving that member by means of bevel gearing. The former type of engine is shown at A in the accompanying illustration, while the newer construction in which an overhead cam shaft is used is shown at B. When aluminum is used as a cylinder block it is not sufficiently hard material to stand the constant wear due to the reciprocation of the piston in the cylinder. For this reason a liner of harder metal such as steel or cast iron is interposed between the piston and the cylinder casting. There are two methods of using a liner of this type. The latest method developed, which is known as the "wet liner" type is shown at A. In this a cast iron member is machined in such a way that it has a flange at its upper end and is a close fit in the holes made to receive it at the upper and lower portions of the cylinder block. This cast iron liner is forced in place against a packing at the bottom and a water tight joint is formed at both top and bottom by the accurate fit of the liner. The reason that it is called a "wet" type liner is that the cooling water circulates directly around the cast iron walls. In the other construction, which is shown at B and which is known as the "dry liner" type, the sleeve is in the form of a thin steel tube which is pressed into the aluminum cylinder block and which is in contact with the aluminum casting its entire length. In this construction the water does not come into direct contact with the steel liner, which need not be very thick inasmuch as it is reinforced by the cylinder walls. Both of the engines shown are of recent English development.



Showing aluminum cylinder block construction methods

SEDIMENT IN CARBURETOR FEED LINE

REGARDLESS of how carefully fuel is strained when filling the automobile or motor-boat tank, a small amount of impurities will be introduced with the gasoline. The ordinary fuel filter using wire gauze screens does not prevent small particles from reaching the carburetor. While a screen will retard lint or scale, it will permit particles of rust or small drops of water to pass through. If the fuel supply pipe is joined to the carburetor with an elbow, as shown in accompanying illustration, the dirt or water is apt to accumulate at the bend, resulting in erratic engine operation because the flow of gasoline is impeded and sometimes stopped altogether.



Using a pipe tee as a sediment collector

The method shown at B is an improvement. A tee-fitting is used instead of an elbow and the open end is plugged with a standard pipe plug, or a 1/8" petcock to serve as a drain. Impurities then collect in the bottom of the tee instead of flowing into the carburetor and constricting the fine passage. A piece of pipe 1" or 2" long, capped at the end, may be substituted for the pipe plug. This gives a larger sediment chamber.

HIGH-SPEED SENSITIVE TAPPING DEVICES

AFTER pointing out the necessity of endeavoring to counterbalance the cost of labor by increasing the speed of production and aiming at standardization, a French writer describes a roller-bearing tapstock friction clutch, suitable for taking the usual taper shank sensitive chuck. A male cone comes in contact with a female cone under pressure of the tap, and forms the friction clutch to transmit the power of the latter. The female cone is also conical externally and carries on it five bearing rollers, which, when the hole is tapped, engage on an internal cone ring made all in one piece, with the first-mentioned male cone, thereby reversing the direction of rotation and releasing the tap. It is claimed that the use of this device will result in a great saving of operating time.

Digitized by Google

Design and Construction of Model Locomotives

By Henry Greenly

Member Institute of Locomotive Engineers, England

AFTER having settled the design of the cylinder for a model locomotive the most important item for consideration is the valve gear. The older American locomotive had its valves usually operated by a form of Stephenson link motion, the eccentrics for which were placed inside the frames. The expansion links were attached to a rocker and the motion thereby transmitted outside the frames to the slide valves on top of the cylinders. The more modern practice is to employ Walschaert's Bakers' or some other form of radial valve gear which is entirely outside the frames and wheels, and it is with a view to the use of such a gear that the cylinders already described were designed.

Walschaert's gear is by far the most widely used but in a small model it becomes rather complicated and requires quite a number of rather delicate parts. In a working model such are to be avoided and to provide ample wearing surfaces in all joints, the writer has devised a form of radial valve gear which has given excellent results in trials which have been made during the last ten years. The gear is one which employs Hackworth's tilting slide shaft, an arrangement invented in 1842, and subsequently adopted in Joy's, Bremmes' and many other forms of radial valve gear. A further advantage of the writers' motion in a model is that the provisions of "advance" (i. e. the lap and lead function of the slide valve) can be effected by a much smaller number of pieces than those required by Walschaert's gear and at the same time the external appearance of the model fitted with the gear is, to a casual observer, not radically different to Walschaert's as usually applied to examples of the latest American locomotive practice. The gear is similar in its action to the primitive radial gear illustrated in Figs. 1 and 2 herewith. The vertical component of the movement of the crank is converted into a horizontal motion by a tilting slide. The timing of the horizontal movement of the valve is therefore at 90° to the horizontal movement of the piston and in this way the gear reproduces the action of the eccentric, as employed in an ordinary stationary steam engine, but provides a simple means of reversing. The slide is tilted in an opposite direction to reverse the motion. The tilting slide shaft has a suitable die block which forms a common joint for both the vibrating link (VL) and the valve rod (VR). It is also obvious that by altering the angle of the slide the valve movement can be modified in respect to both tuning and amplitude. Although not shown in the diagrams, it will readily be seen that no horizontal movement to the valve will take place if the slide is placed in a truly vertical position. The diagrams Figs. 1 and 2 show the relative position of the valve with the big end of the connecting rod on top and bottom centres, in "forward" and "reverse" positions of the gear. While the arrangement shown in Figs. 1 and 2 explains the fundamental action of the gear, it does not represent a practical form. The point on the connecting rod from which the motion is derived (point A_1 or B_1 in Fig. 1) moves in an elliptical path and one would expect that by connecting this point to a slide block in a slide of the form shown that the four positions, mid-left, top-centre, mid-right, and bottom centre, would be reproduced in the position of the slide block in its slide, as shown in Fig. 3. Due to the effects of angularity in the vibrating link (VL) which connects the block to the connecting rod this is not so. If the mid-left and mid-right positions are arranged to come right, i. e. to coincide with a position of the slide block in the centre of the slide as shown in Fig. 4, then, due to the angularity of the vibrating link, the top and bottom position will be reproduced equally in the manner indicated by the respective dimensions of P and W in Fig. 4.

Especially where a valve with lap and lead functions is required some form of correcting gear is necessary to neutralize the disturbing effects of this angularity. There are many examples, the two best known being those of David Joy invented about 1884. Joy's gear had a considerable vogue some two or three decades ago but now only exists on various inside-connected engines such as built by the British model maker has been superseded by the writer's form of corrected gear. This gear can be applied to models of outside cylinder locomotives the drawings herewith (Figs. 5 and 6) showing its adaptation to a "half-inch" scale model such as outlined in the previous article on cylinders.

The gear looks like Walschaert's

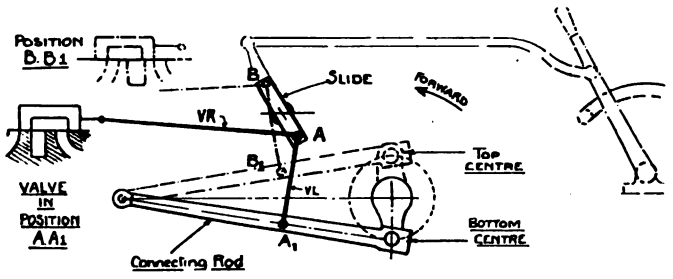


FIG. 1

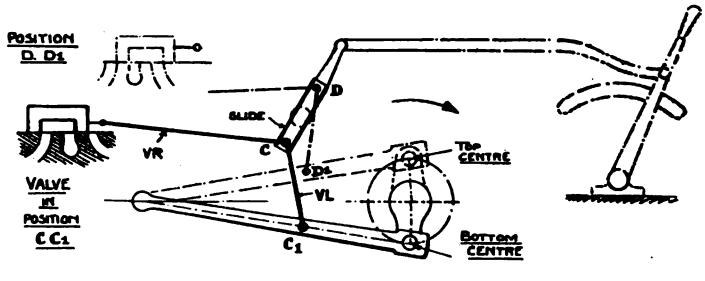


FIG. 2

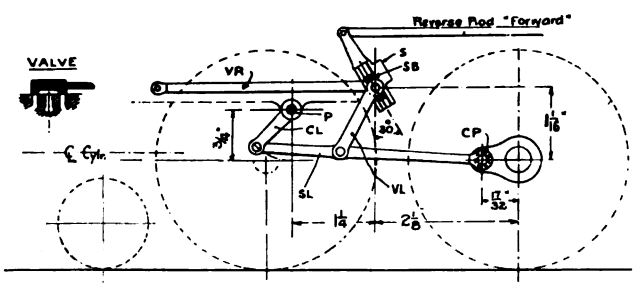


FIG. 5

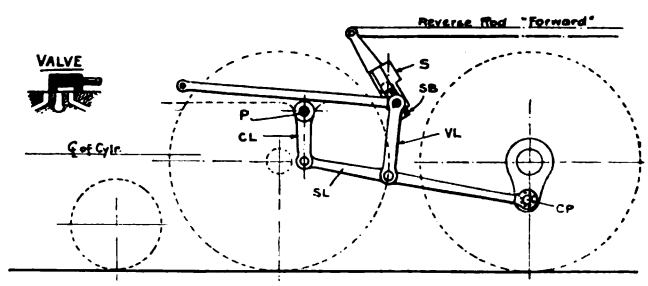


FIG. 6

Figs. 1 and 2. Diagram of primitive form of radial valve gear in forward and reverse positions. Fig. 5. Greenly's connected radial valve gear for 2½" gauge. It is shown on dead center position. Fig. 6. Greenly radial valve gear shown in bottom center position

Digitized by Google

valve gear and makes use of the girder frame so common to modern American engines using the latter valve motion.

The valve gear provides for the correction of the angularity of the vibrating link (VL) by arranging the latter on a separate swing link (a miniature connecting rod), this link (SL) taking its motion from the crank pin (CP). Instead of being fixed to the crosshead the other end is supported by a link which swings from a fixed pivot (P) on the girder frame. This link is called the correcting link (CL in the drawings Figs. 5 and 6), and its function is to lift the swing link the exact amount required to neutralize the angularity of the vibrating link. This it does with mathematical accuracy and any reader can study its action quite easily by rigging up a few pieces of stiff paste board to act as links with some drawing pins as hinge joints. While such accuracy is necessary the proportions of the links are not absolutely fixed except in their relation to each other, and can be varied considerably to suit other considerations which may arise in the arrangement of the valve gear.

The lap and lead functions of a slide valve are absent in very small working models but independently of all ideas of the economy obtained by the expansion of the steam it will be found that engines with cylinders above half an inch in diameter work very much faster if the valve has a small amount of lap with, of course, an "advance" commensurate with this lap.

Lead is not necessary until cylinders approach 1½ ins. diameter and even then only in the case of high-revolution model steam engines such as used for the direct driving of dynamos. Lap and advance also reduce excessive cylinder condensation which is one of the characteristic failings of working models.

In a radial valve gear the horizontal component of the motion of the crank is employed to give advance to the valve. Lap is, of course, of no use without advance and in Walschaerts' motion the advance is obtained by a separate rigging, viz., a vibrating link operated from the crosshead.

The fundamentals of this motion is illustrated in the primitive form of gear shown in Fig. 7. The valve rod is not pivoted to the vibrating link at its joint with the slide in the slide block, but at a point above this joint. The selection of this point for a given stroke of piston will depend on the lap added to the valve. This lap is indicated by the blackened portion of the valve in the sketch and is approximately (not more than) half of the dimension A. This dimension is, of course, a function of the proportions of the vibrating link as exemplified by dimensions X and V. So much for the principles of the gear. In the next article the writer intends to show in detail the practical application and the dimensions of the parts standard valve gear, component, suitable for 2½ in. gauge models. Any difficulties he will be pleased to clear up if the perplexed reader will put them before the Editor in the ordinary way.

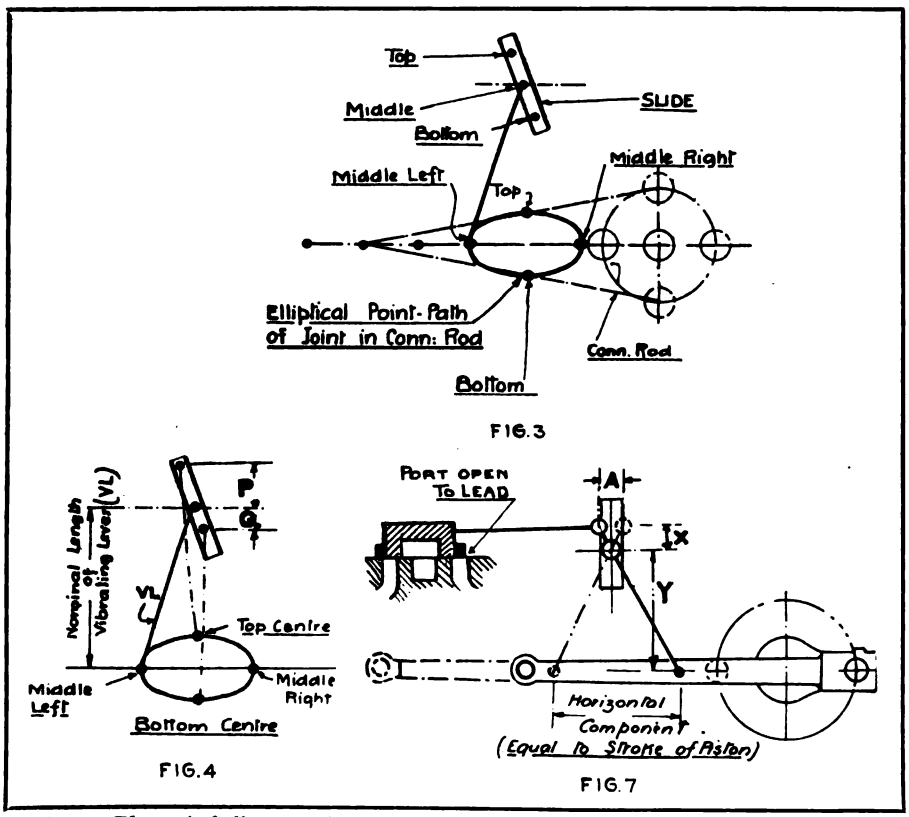


Fig. 3. Theoretical diagram of action of simple form of radial gear. Fig. 4. Showing the disturbing effects of angularity of rods on valve opening. Fig. 7. Diagram showing obtaining "advance" in a radial valve gear

PLATINOID

THIS alloy is a kind of German silver, with an addition of 1 to 2 per cent. of tungsten. The latter, in the form of phosphor-tungsten, is first melted together with a certain quantity of copper, the nickel is next added, then the zinc, and finally the remainder of copper. In order to remove the phosphorus and a potion of the tungsten, both of which separate dross, the resulting compound is several times remelted. Finally an alloy of a beautiful white color is obtained, which, when polished closely resembles silver, and retains its lustre for a long time. Platinoid has the properties of German silver in a pre-eminent degree. It shows great resistance, which remains quite constant at different temperatures, and is about 1½ times greater than that of German silver.

AMALGAM OF LIPOWITZ'S METAL

THIS amalgam is prepared as follows: Melt in a dish, cadmium, 3 parts; tin, 4; bismuth, 15, and lead, 8, and add to the melted alloy 2 parts of mercury previously heated to about 212° F. Amalgamation takes place readily and smoothly. After the introduction of the mercury immediateiy take the dish from the fire and stir the liquid mass until it solidifies. While Lipowitz's alloy becomes soft at 140° F. and melts at 150° F., the amalgam melts at about 143.5° F. This amalgam may be used for the manufacture of small, hollow statuettes and busts, which can be readily gilded or bronzed by the galvanic process.

Small statuettes are readily made by preparing a hollow mold of plaster of Paris and after uniformly heating it to about 140° F. pouring in the melted amalgam. The mold is then swung to and fro, this being continued until the amalgam is solidified. After cooling the mold is taken apart and the seams trimmed with a sharp knife. The operation may also be modified by placing the mold upon a rapidly revolving disk and pouring in the melted amalgam in a thin stream. By the centrifugal force developed the melted metal is hurled against the sides of the mold, and in this manner statuettes of considerable size can be cast.

NEW WAY OF ANNEALING STEEL

HEAT the piece as slowly as possible, and when at a low red heat put it between two pieces of dry board and screw them up tight in a vise. The steel burns its way into the boards, and, on coming together around it, they form a practically air-tight charcoal-bed. When it cools off the steel is apt to be found thoroughly annealed.

Digitized by Google

A 2500-Watt Step-down Transformer for Arc Welding

By E. F. Tuttle, Jr.

THIS transformer was built for a theatrical outfit and is capable of delivering a very high amperage at the secondary terminals. Numerous experiments can be performed with the use of this transformer which are very startling to the layman and the device will also prove useful in the laboratory as a source of low-potential, high-amperage current.

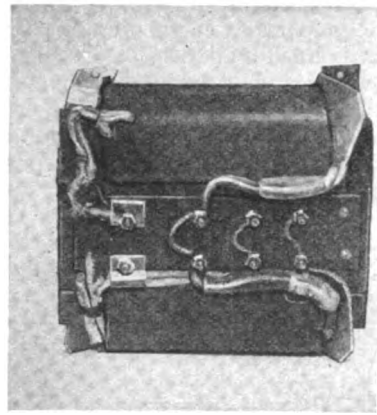
For the core of the transformer we will need about 140 strips of soft black iron (stovepipe iron) of about .017 inch thickness and 1⅛ inches wide and 5 inches long, and also about 140 pieces 1⅛ inches wide by 8 inches long. There should be enough of each size to make a stack of 2¼ inches high. They should be cut accurately to size and all rough edges removed. For the best results, each piece of iron should be given a coat of varnish or shellac as this will cut down losses through hysteresis and increase the general efficiency of the machine.

While the pieces for the core are drying, a form may be made for assembling the core by taking a board about 8 x 11 inches and nailing a block exactly 3⅞ x 6⅞ by about 1½ inches thick in the center of it. When the core is built up to 1⅛ in. in height and pressed tightly together, it can be drilled with 3/16 in. holes as shown for rivets. The rivets should be made of copper wire (No. 5 bare) and the holes should be countersunk at each end so the rivets will be flush with the surface. The four rivets marked AAAA should not be put in now as the end will have to be removed to put on the coils. The eight legs should be made and one put at each corner (top and bottom) as the corners are riveted together.

The end of the core may now be taken out and laid aside and the other two legs of the core should be well insulated with either oiled cambric (empire cloth) or friction tape to a thickness of ⅛ inch. It would be well to file off the rough edges of the core before applying the insulation to avoid cutting it.

A winding form for the coils should now be made of wood 1½ inches square with two end blocks on it as shown. If a lathe can be used it is much quicker than hand winding, but if a lathe is not available round ends must be made on the form so it can be run in wooden bearings of some sort. A block 7¼ inches long by 6 inches wide is nailed to the bench and two uprights with 1 inch holes 3 inches from the bottom are nailed to the ends of the 7¼ inch block. These serve as the bearings and a handle is fastened to the form to complete the job.

Both the primary and secondary are wound with No. 15 D.C.C. wire and about 15 pounds will be needed. A strip of cotton tape about ½ inch wide and 16 inches long is laid along each side of the form and tied with a string down into the corners at the ends and then a layer of rather heavy paper is put on and the winding placed over this. Start at the left hand end, leave about 8 inches at the end and wind 90 turns which should come to proper position at the other end. If it does not, the end block will have to be moved to the correct place. Then put on a layer of empire cloth and continue the winding back to the other end. This is continued until there are four layers in all wound on the leg of the transformer. This completes one of the primaries.



The completed welding transformer

Four layers of empire cloth should now be wound on after which the core is ready for part of the secondary winding. This consists of four layers of 90 turns each of number 15 D.C.C. wire, each layer starting at the left hand end of the form and being wound in the same direction as the primary. The winding is discontinued at the right hand end. Each end of the wire is left about 8 inches long and the four at each end of the form are connected together. There is no need of putting empire cloth between the different layers of the secondary, but two layers should be put over the outside and the ends of the four tapes brought together and tied. The coil may now be removed from the form by taking off one of the ends and well taped lengthwise through the hole with strips of empire cloth or bias oiled cambric. Do not use friction tape for this as it will not allow the coil to slip over the core without considerable trouble.

Wind another primary and secondary just the same as this one, being sure to start at the left hand end with both and to have just 90 turns of wire in each layer.

After these windings have been finished, one is slipped over each long leg of the core so the primary terminals will be at opposite ends. The top of the transformer should now be made from ¼ or 5/16 fiber, or, better still, Bakelite. The larger holes in it are ⅜ inch and the smaller ones 3/16 inch. The four ⅜ inch holes marked A are for fastening the top to the upper legs and holes BB and CC are for the secondary and primary terminals respectively. The D. P. D. T. switches will be needed and should be obtained before drilling the other holes, D and E. These holes are correct for a "Bryant 5190" switch. After putting in the end of the core and riveting on all the legs, and putting on our top we are ready for our connections. These are shown in the top view and allow us the following changes in voltage and amperage with the different positions of the switches.

Primary Switch	Secondary Switch	Ratio	Secondary Voltage	Secondary Amperes
Series	Series	720: 80	27½	45
Series	Parallel	720: 90	13½	180
Parallel	Series	360:180	55	90
Parallel	Parallel	360: 90	27½	180

These figures are for full load and on a dead short at the terminals. This condition should always be avoided, however, and the transformer used only with some sort of regulating device; a rheostat or impedance.

Mark one coil number one and the other number two and mark the inside and outside ends of all wires. Join the 4 secondary ends at each end of each secondary and connect them as follows:

Inside primary No. 1 to connection No. 3.
Outside primary No. 1 to connection No. 2.
Inside primary No. 2 to connection No. 1.
Outside primary No. 2 to connection No. 4.

Run a single No. 5 wire from No. 5 to No. 6. Now run a double No. 15 wire from terminal No. 13 to connection No. 1 and another double wire from terminal No. 14 to connection No. 2.

Digitized by Google

The terminals No. 13 and No. 14 are located at holes CC and should be capable of carrying 25 amperes. The terminals No. 15 and No. 16 are for the secondary circuit and should carry 180 to 200 amperes. They may be of any style desired but I find that the brass storage battery connections are very good and as cheap as any. If these terminals do not make a good contact or are too small they will cause trouble by heating.

The inside wires of secondary No. 1 go to switch connection No. 9.

The outside wires of secondary No. 1 go to switch connection No. 8.

The inside wires of secondary No. 2 go to switch connection No. 7.

The outside wires of secondary No. 2 go to switch connection No. 10.

Run 4 No. 15 wires from No. 7 to No. 16 and 4 No. 15 wires from No. 8 to No. 15 and 4 number 15 wires from No. 11 to No. 12.

The switches should be marked "Primary" and "Secondary" and on the fiber cross piece of the switch is stamped "Series" and "Parallel" as shown. These switches should not be opened while carrying current—especially the secondary switch as it carries such a heavy load that it will arc and burn the contacts.

A couple of flexible electric cords each about 6 or 8 feet long and about No. 6 or 8 gauge may be fitted with terminals to fit No. 15 and No. 16 on one end of each and on the other end soldered to a brass screw about 3.8 inch diameter by ¾ inch long to which may be fastened suitable clamps for holding carbons for an arc or even nails and iron rods up to 5/16 inch diameter to be welded. In welding, the pieces should be put together before the current is turned on and the current turned off before moving apart.

In using the connections for 13½ or 27½ the terminals may be held in the bare hands if they are not gripped too tightly and an arc 1 inch long between carbons ⅝ inch in diameter may be held between the hands. The 13½ volts is best for welding and 27½ best for the arc owing to the high resistance of the carbons. Copper and iron wires may be melted with this outfit but a pan should be placed under the wire to catch the molten metal.

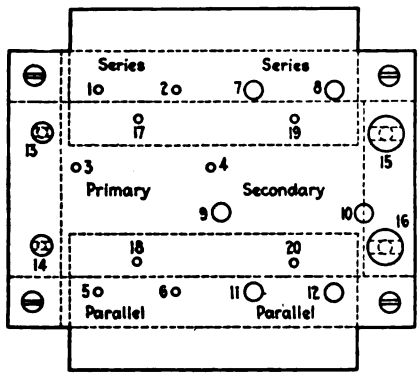
Also by sprinkling metal filings along in a ridge on a brick or other non-combustible article and connecting a wire to each end the filing may be welded together into one solid piece.

This transformer is designed for 110 volts and 60 cycle current such as is used for house lighting but heavier fuses should be put in than are ordinarily used as the transformer takes 23 amperes on full load.

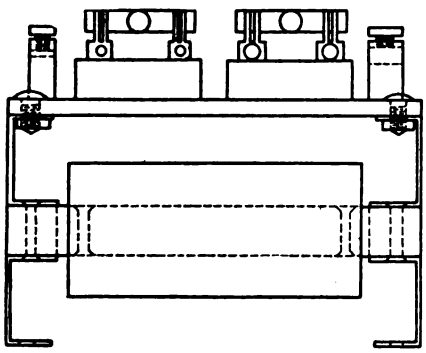
REMOTE CONTROL FOR LARGE SEARCHLIGHTS

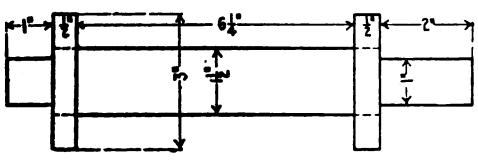
A RECENT copy of the *General Electric Review* contains a very interesting discussion concerning large searchlights and their use for military purposes. It has been found very difficult for the operator of a large light to train the light on the object to be illuminated owing to the dazzling effect the light has on his eyes. The only remedy for this condition is remote control and experiments are being conducted along this line. In the case of remote control the operator is stationed at least 500 feet from the searchlight and at this distance he is not affected by the beam. The control is brought about by placing the field of the operating motor across a certain portion of a rheostat. By means of a dial switch, the armature may be connected to the center point of the rheostat or to a point either to the right or left of it. This will depend entirely upon the direction of rotation.

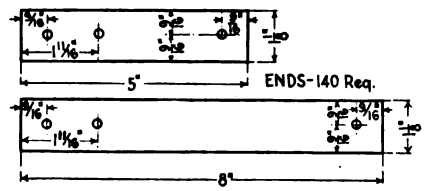
It is possible that such a plan could also be used on battleships as the same trouble is had in training the light on distant objects.

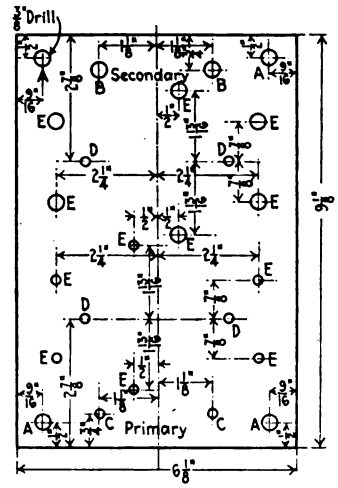


TOP VIEW

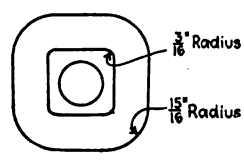

SIDE VIEW. WITH SWITCHES IN PLACE

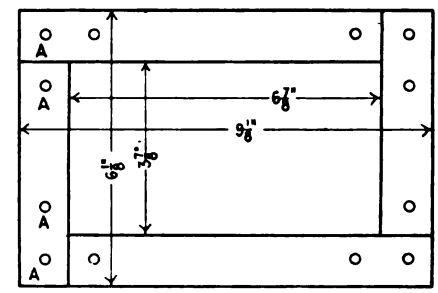

WINDING FORM

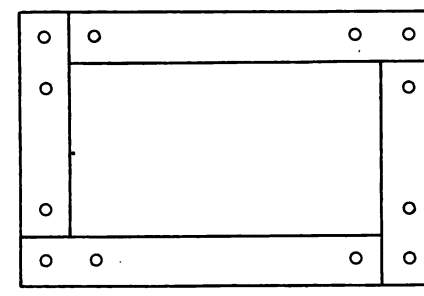


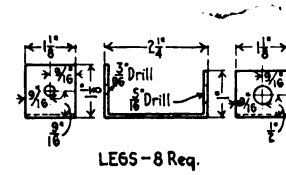


TOP-1 Req.




ALTERNATE LAYERS=1,3,5,7,9-Etc.


ALTERNATE LAYERS-2,4,6,8,10-Etc.



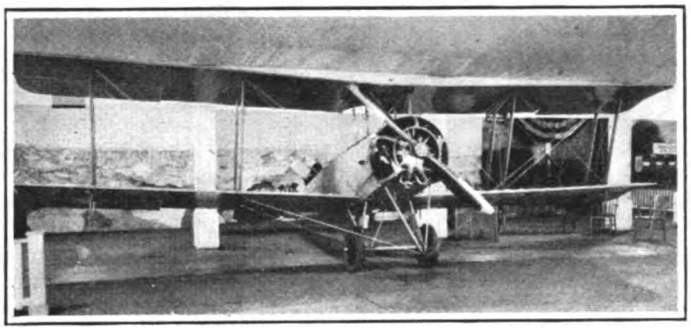
LEGS-8 Req.

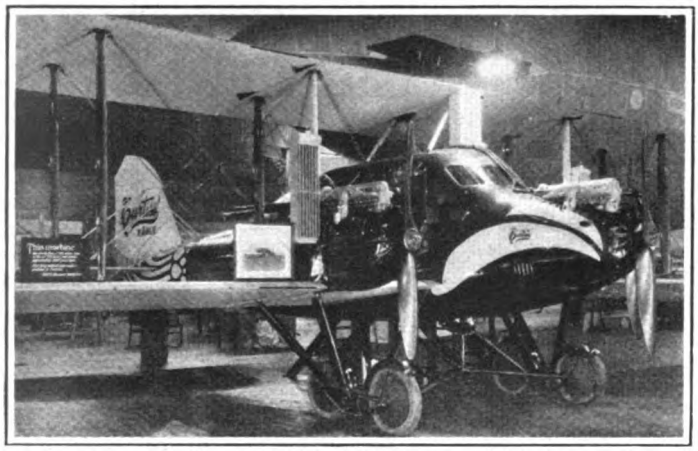
Digitized by Google

Complete Enclosure for Passengers the Feature of New Airplanes

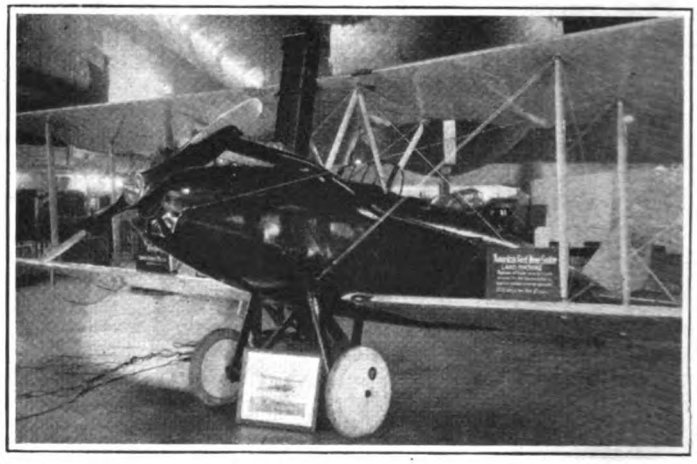
A MARKED feature of the recent Aeronautical Exhibits at Chicago and New York is the trend noted in airplane design away from the types intended for military use to those that have been designed recently with an appeal to those who can use airplanes for commercial requirements. One of the largest machines at the shows and one that attracted considerable attention is the Curtiss Eagle, which is provided with three engines, all of which drive tractor screws. The machine weighs about 7,500 pounds and has a useful load of over a ton. The engines are the six-cylinder type of 150 horsepower each. The feature that impresses the aviator is the large size of the machine and the relatively low capacity of the motor power provided, which means considerably higher transportation efficiency than is usually attained by aircraft. The completely enclosed and well arranged cockpit provides accommodations for pilots and passengers. The engine mountings are directly on the lower wing and special care is taken in stream-lining the outboard motors. The motor, mounted on front of the fuselage is, of course, very thoroughly stream-lined. The fuselage is a two-ply veneer construction. There are two wheels used on either side, these being placed in tandem with axles supported by a strong, bridge-like truss. The chassis is composed of steel tubing which has been faired to reduce resistance. The span of the machine is sixty-one feet, length thirty-seven feet and the height twelve feet four inches. It provides accommodations for eight passengers and is equipped with a dual Dep control system. Another attractive Curtiss exhibit was the Oriole machine which provides accommodations for two passengers and a pilot.

The Avro biplane, an English type that was widely used for training purposes in Europe

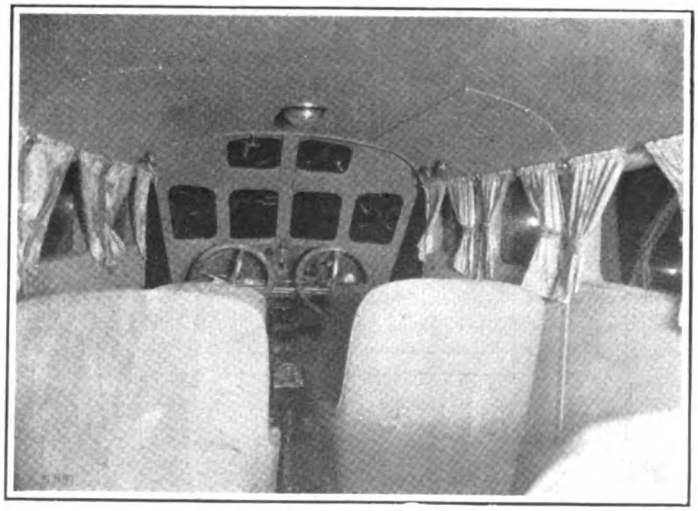




The Curtiss Eagle, a distinctive three-engine passenger carrier



Curtiss Oriole provides for two passengers in forward cockpit



Interior of Curtiss Eagle cabin, showing dual control and passenger accommodations

The passengers sit side by side in a roomy cockpit and are protected by well-designed wind shields. The pilot has his own cockpit placed back of the passenger compartment. The fuselage is built up of veneer and is an exceptionally well stream-lined monocoque form. The engine is a six-cylinder type and develops 150 horsepower.

The machines shown by the Dayton-Wright Company were very good examples of the modern method of enclosing the passengers in a light, but well-protected cabin. Two models were shown, one of which

The landing chassis is exceptionally substantial and is original in design.

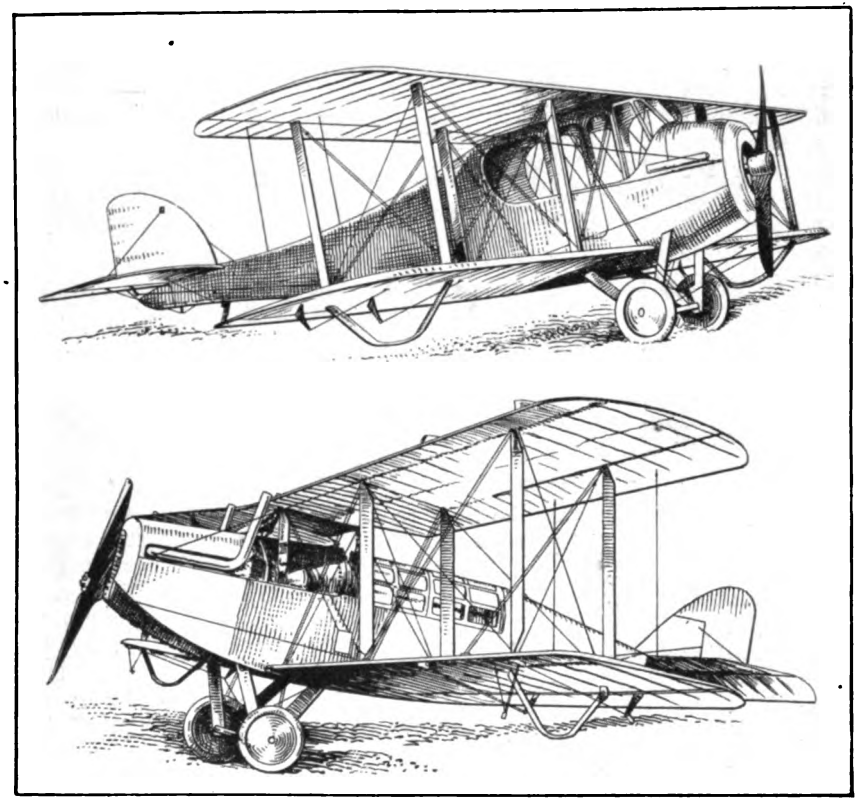
Digitized by Google

was known as the cabin cruiser, which is provided with a twelve-cylinder Liberty engine. The other model, which was of smaller capacity, is provided with the Hispano-Suiza motor and is known as the aerial limousine. The Avro three Place Biplane shown is a modified form of the type that was used in such large quantities for training pilots in Europe by both the American and English air forces. This machine was noted for its reliability, ease of control and strength. The engine is a one hundred and ten horsepower, Le Rohne rotary, readily accessible for inspection on account of its mountings. This was the only machine shown that had a combined skid and wheel landing gear. It is surprising that this construction is not built to a greater extent because a well-braced skid of this type acts to prevent nosing over on a rough landing and the rear end of the skid can be used to exert a powerful braking action on the ground to retard the speed of the machine when landing.

Among the other aircraft shown that created considerable interest were the Curtiss Sea Gull Flying Boat type, which was very similar to the M. F. boats used for training Navy aviators during the war. The Aeromarine Flying Yacht also received its share of attention, especially as the passengers and pilots are totally enclosed in a cabin provided with transparent pyralin windows. The pilot can open the windows in front of his seat if vision or control is impaired for any reason by their remaining closed. The engine is the Aeromarine, six-cylinder, vertical type, rated at one hundred and thirty horsepower.

The Goodyear Company had an interesting exhibit known as the "Pony Blimp," a small dirigible balloon providing accommodations for a pilot and passenger. This is a non-frigid airship of 35,000 cu. ft. capacity, 95 ft. long, 28 ft. diameter and 40 ft. overall height. It is the smallest craft of its kind in existence and is interesting because it seems to be the smallest size practicable for the carrying of two passengers. Fitted with an Ace 40 hp. engine, the craft has a high speed of 40 m.p.h. and a full speed endurance of 10 hrs The disposable lift (crew, fuel and ballast) is 800 lbs. The envelope is notable for its blunt form, the streamline ratio, 3.3 to 1, marked a decided departure

(*Cont. on page* 421)



Two Dayton-Wright commercial models. Limousine model at top and cabin cruiser below. In these passengers and pilot are completely protected



General view of exhibits at Chicago Aero Show, with Curtiss Eagle in foreground and "Pony" Blimp in center of the hall

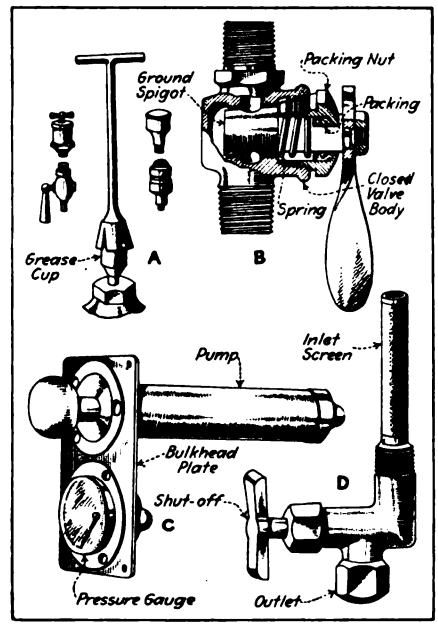
Digitized by Google

New Fittings For Motor Boats

THE accompanying illustration shows a number of new fittings that will be found of value by motor boat owners because they are simple in construction and serve a really useful purpose. The wrench shown at A is a simple device that will be found exceptionally useful for screwing up grease cups and for reaching into normally inaccessible places to open or close drain or relief cocks. It is of substantial construction and requires no adjustment. Because of its peculiar shape it will fit grease cups of any type as shown in illustration and either Tee or L handle pet cocks.

Leaky gasoline is a source of fire risk in a motor boat because it is apt to collect in the bilge and may become ignited from an electric spark or other causes. The gasoline cock shown at B is of very good construction and cannot leak on account of having a closed bottom and packed stem. The ordinary drain or shut-off cock construction is such that the spigot goes right through the body, and if it becomes loose, the gasoline may leak even if the valve is in a closed position. The construction shown has a ground spigot which is kept seated by a substantial spring and as a further safeguard a stuffing-box or packing nut is provided to close the space around the stem and make it gasoline tight.

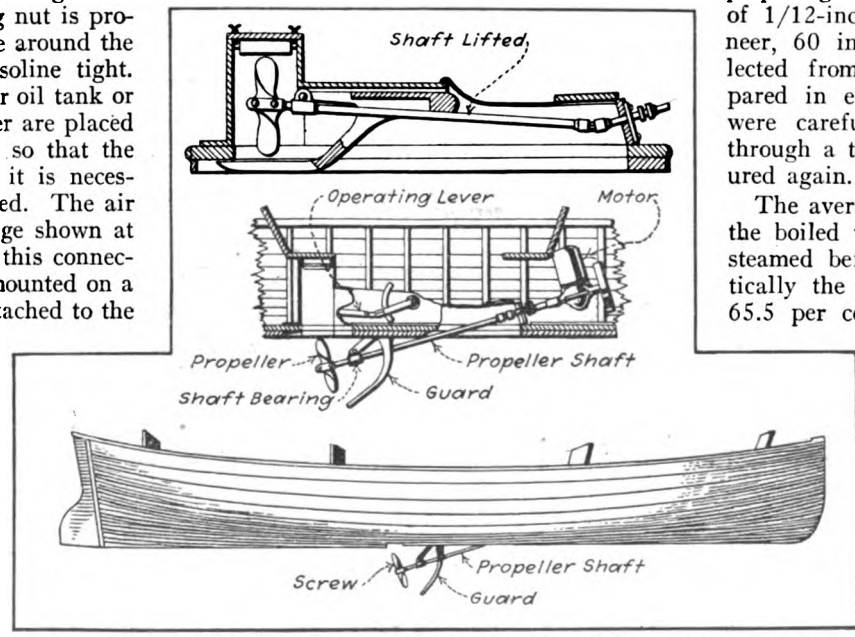
When the gasoline or oil tank or water tanks of a cruiser are placed low down in the boat so that the liquids will not flow, it is necessary to use pressure feed. The air pump and pressure gage shown at C should be useful in this connection. Both units are mounted on a plate intended to be attached to the bulkhead. When sufficient pressure has been pumped up by the pump, a turn of the pump handle prevents the escape of air and the gage registers the pressure at all times. A vent, operative by turning the pump handle, is also provided. The tank shut-off valve shown at D includes a combination of a needle valve with a wire gauze strainer in one fitting. It is made throughout of bronze and can easily be installed in any gasoline tank.



Some new fittings of value to motor boat owners

POWER DRIVEN SKIFF WITH NOVEL PROPELLER ARRANGEMENT

THE suggestion given in accompanying diagram is a useful one for those who operate boats in shallow water, or who desire a light craft that could be hauled out on the beach when not in use. A light, double ended power-driven skiff that is reasonably seaworthy is depicted. The arrangement of the propulsive mechanism is such that the shaft and its propeller may raise up within the hull of the boat, leaving nothing projecting below the keel that may be damaged by contact with the beach or with obstructions in the water. The speed of the boat may be controlled to a reasonable degree by regulating the depth of immersion of the propeller. As will be seen, the propeller protecting shoe is an integral member with the supporting piece that carries the stern bearing. A double universally jointed driving shaft is used and the rear bearing for the propeller shaft is also hinged so that it can assume the required position due to the change of shaft angle when the mechanism is raised and when the propeller is pushed down into the water. The general construction of the mechanism is clearly shown in drawing, as is the location of the power plant and the operating lever.



Diagrams showing method of operating disappearing propeller so boat can be hauled out on the beach without damaging propulsive machinery

SHRINKAGE OF VENEER FROM BOILED AND STEAMED LOGS

ACCORDING to present practice, logs which are to be cut into veneer are either steamed or soaked in hot or boiling water for several hours to soften the wood. The claim is sometimes made that the veneer from boiled logs is likely to shrink and swell less with changing moisture content than the veneer from steamed logs. This point was made the subject of investigation by the Forest Products Laboratory at a plant using both methods of preparing the logs. Thirty sheets of 1/12-inch rotary-cut birch veneer, 60 inches square, were selected from about six logs prepared in each way. The sheets were carefully measured, passed through a textile drier, and measured again.

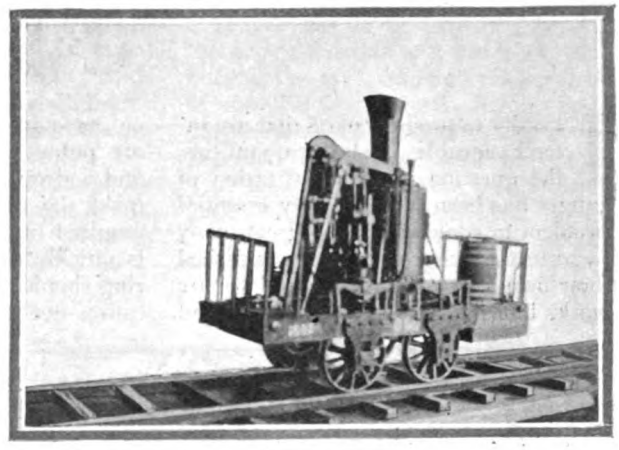
The average moisture content of the boiled veneer and that of the steamed before drying were practically the same, being 64.8 and 65.5 per cent, respectively. The average moisture content for both kinds after passing through the drier was 10 per cent, and the moisture contents of all dried sheets were between 7 and 13 per cent. The shrinkage caused by drying was found to be the same for both kinds of veneer. When the dried sheets were resoaked, they expanded to their original dimensions, and when subjected to a second drying they shrank as uniformly as before.

Although these tests were very crude, they indicate that the shrinkage of veneer from boiled and steamed logs is practically the same. The variation is no greater than is found between pieces from different logs which have undergone the same treatment.

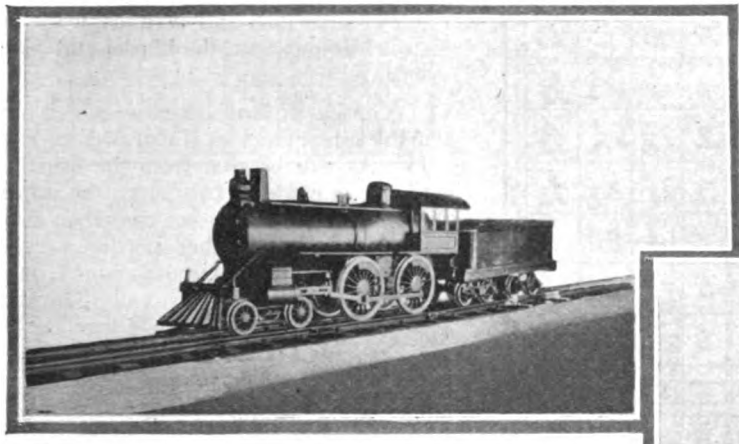
Digitized by Google

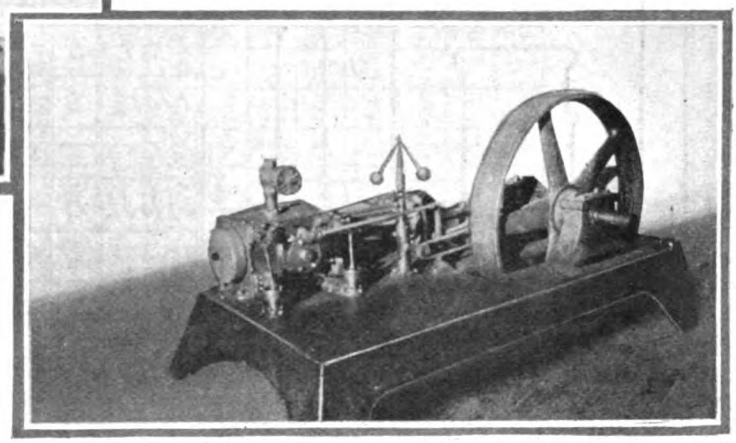
Models Made by a Reader

THE models pictured on this page are the work of Mr. George R. Aitken. Those interested in the construction of historical models will enjoy looking at the pictures of the Atlantic, "Puffing Billy," "The Rocket," and Robert Fulton's *Clermont*.

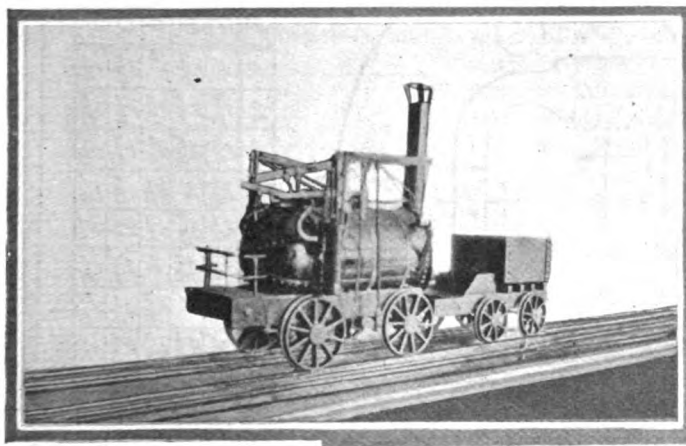


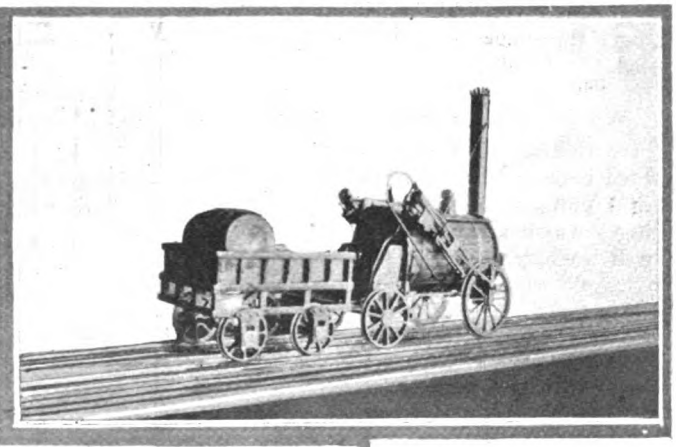
A well executed model of the Atlantic which was placed in service on the Baltimore & Ohio in the year 1832. The original of this now historical locomotive was built by Davis & Gartner of York, Pa.



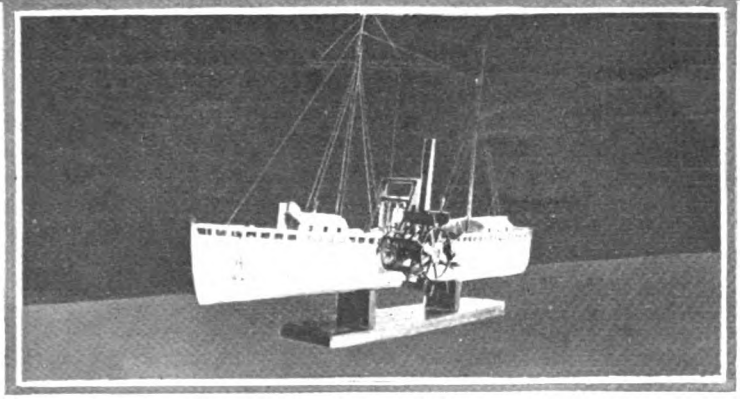


A model of a modern passenger locomotive built by Mr. Aitken. This is a distinct contrast to the early types pictured on this page. The horizontal engine shown at the right is complete in every detail, including governor





Above is shown the famous old locomotive "Puffing Billy," which was built in 1813 by Timothy Hackworth, a blacksmith, for the Wylana Railway, England. The center bottom shows Robert Fulton's "Clermont," which made its famous trip up the Hudson in 1807



"The Rocket," which was put into operation in the year 1815 by George Stephenson. This was the first engine in which the power was given to the wheels by direct transmission

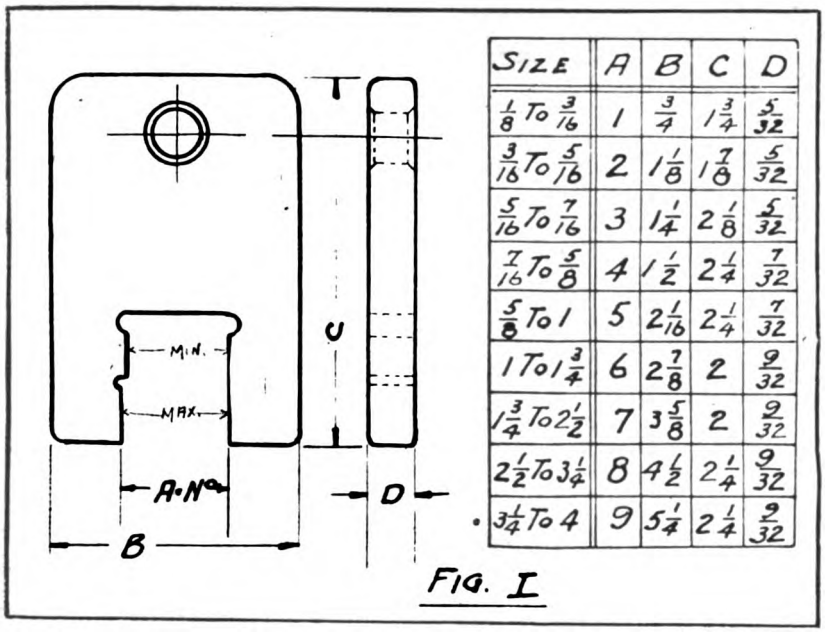
Digitized by Google

Standardization of Gauge Design

By Walter J. Oldroyd

Supt. of Equipment, Springfield Armory

IN order to produce parts that are interchangeable in large quantities, the question of standardization of gauges has been found a very essential problem to contend with, a great many factories already having established their own standards for jig and fixture work, but the subject of gauging had not been given as much consideration. In order to show just what has been accomplished in standardization of gauges this manuscript has been compiled.



SIZE	A	B	C	D
1/8 To 3/16	1	3/4	1 3/4	5/32
3/16 To 5/16	2	1 1/8	1 7/8	5/32
5/16 To 7/16	3	1 1/4	2 1/8	5/32
7/16 To 5/8	4	1 1/2	2 1/4	7/32
5/8 To 1	5	2 1/16	2 1/4	7/32
1 To 1 3/4	6	2 7/8	2	9/32
1 3/4 To 2 1/2	7	3 5/8	2	9/32
2 1/2 To 3 1/4	8	4 1/2	2 1/4	9/32
3 1/4 To 4	9	5 1/4	2 1/4	9/32

FIG. I

Snap Gauges

I will first consider the snap gauge, which is one of the simplest of gauges. Fig. 1 shows a set of standards for snap gauges which are very satisfactory for small work, gauging up to four inches in length. They are made of a good grade of carbon steel, carbonized, hardened and ground. They have been designed with the idea of departing from the old idea of putting many gauges onto one piece of steel, there being one gauge to a piece and this with a maximum and a minimum step.

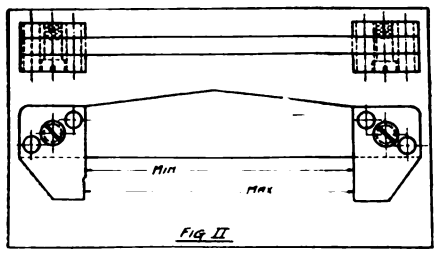
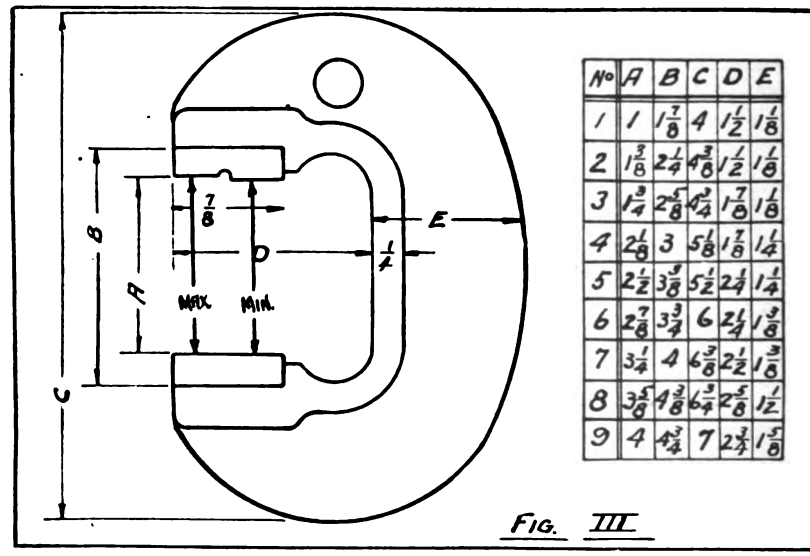


FIG II

When several gauges are to be used on one operation, several of these snaps are put onto a loose-leaf binder ring and a drop of solder on the joint will make the ring solid, and should it be required to correct the gauges, the ring is quickly opened. Each gauge on the ring should be given the same identification number with a letter following to indicate the order in which it is to be used in gauging the work. There is plenty of space on these gauges to mark the component name and the operation number as well as any other markings that the system might require.

The illustration at Fig. II shows a form of built-up gauge for use in gauging work more than four inches long. The end blocks are the same for all lengths but the shape of the bar may be changed to suit conditions and the span of the gauge. The gauges in Fig. I are not suitable for gauging round work over one inch in diameter, but are satisfactory for the length of work up to four inches. To furnish a snap for diameters from one inch up to four inches the gauges shown in Fig. III are used. The capacity of each gauge varies by five-eighths inch and they are made of steel forgings with the blocks and plug set in.

A design of built-up gauge which has many advantages is illustrated in Fig. IV. As will be seen from the illustration it is made in two parts, the upper portion is a simple piece of carbon steel ground and the other portion of the gauge has the steps machined and ground one step on each end. The two parts of this gauge are held together by means of two filister head screws. While this gauge is often used up to two and a half inches, yet its greatest usefulness is on smaller openings, such as up to one-quarter inch, where grinding the opening in a gauge of the design shown in Fig. I is not practical. This type of gauge also has a distinct advantage over the ordinary snap gauge in that it may be taken down at any time when the steps become worn and by simply regrinding it can be put back in its original shape again and this process may be followed for an indefinite period of time or until the parts are too light to be of any practical use, which, of course, would be a very long time. It will be noted that these gauges are chamfered on the minimum side and provided with a radius on the



No	A	B	C	D	E
1	1	1 7/8	4	1 1/2	1 1/8
2	1 3/8	2 1/4	4 3/8	1 1/2	1 1/8
3	1 3/4	2 5/8	4 3/4	1 7/8	1 1/8
4	2 1/8	3	5 1/8	1 7/8	1 1/4
5	2 1/2	3 3/8	5 1/2	2 1/4	1 1/4
6	2 7/8	3 3/4	6	2 1/4	1 3/8
7	3 1/4	4	6 3/8	2 1/2	1 3/8
8	3 5/8	4 3/8	6 3/4	2 5/8	1 1/2
9	4	4 3/4	7	2 3/4	1 5/8

FIG. III

Digitized by Google

maximum side. In this way a man soon becomes used to the gauge and does not pay constant attention to the numerals identifying the size.

Plug gauges, while simple in construction, may be made to a variety of designs and constructions, but one that

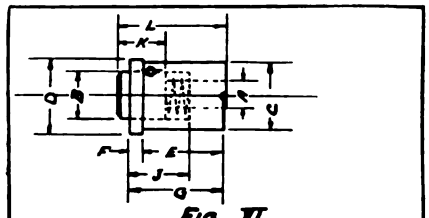


Fig. VI

No.	A	B	C	D	E	F	G	J	K	L
1	1/8	1/4	7/16	1/2	5/8	1/8	3/4	7/16	3/8	7/8
2	1/4	7/16	5/8	11/16	3/4	1/8	7/8	5/8	1/2	1
3	3/8	9/16	3/4	13/16	7/8	1/8	1	3/4	5/8	1 1/8

seems to have met all the requirements of practicability, simplicity and neatness is shown in Fig. IV. The handle, which is knurled, is finished complete, except for the flat for marking, in an automatic screw machine and can be made of any cheap stock that works well at a rapid speed. The plugs likewise are made up in quantity lots and fitted to the handle and pinned to the handle by a straight pin as required.

Flush Pin Gauges

Flush pin gauges and bushings are made up and carried in stock with the upper end of the bushings left unground until assembled into the gauge. Flush pin gauges are built up to meet conditions of irregular shape, etc. These flush pin gauges have often been used

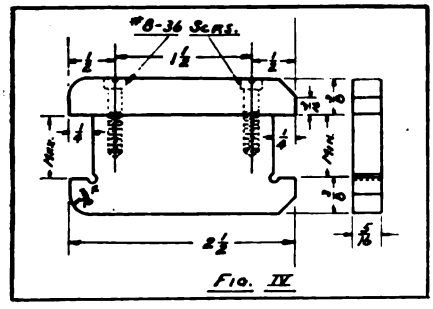


Fig. IV

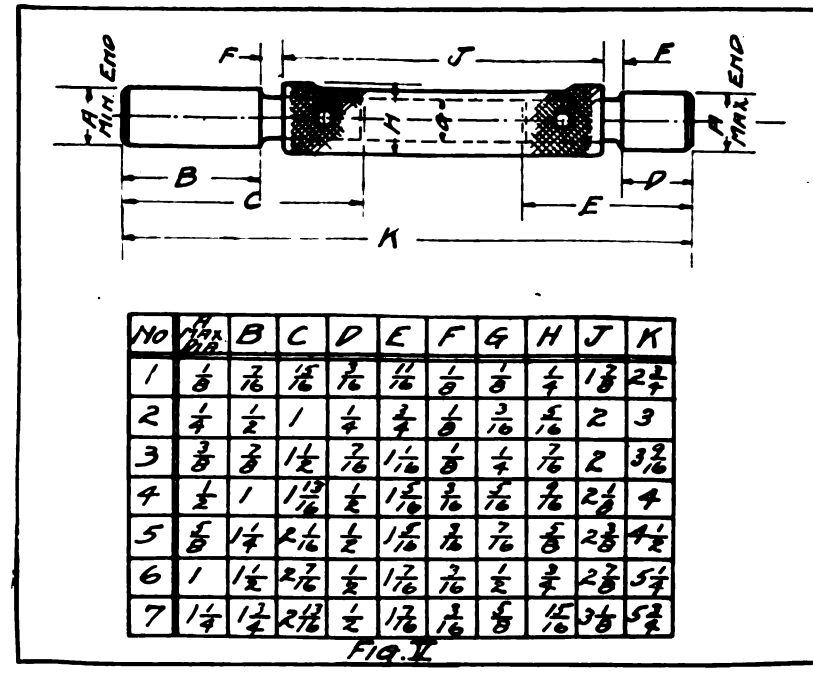
in connection with snap-gauge frames, where for lack of space a two-step gauge could not be used, instead of making two single-step gauges. These flush pins are made in three sizes, one-eighth inch, one-quarter inch and three-eighths inch, and cover the requirements of nearly all cases where flush pin gauges are required. The two larger sizes, shown in Fig. VI, are the more often used.

Flush pin depth gauges for hand use in gauging the depth of holes, slots and the like is shown in Fig. VII. This gauge is made of four parts, the body is cold-rolled steel carbonized, hardened, and ground on the ends only. The bottom end is larger than the handle or knurled end in order to secure a substantial base while using the gauge. The plunger is of tool steel hardened and ground, the projecting end is made to whatever length is required and quite often has to be flattened on the sides to meet individual conditions. The plunger is held in place by means of a small drill rod pin. The plunger is flattened to allow about one-sixty-fourth excess movement of the plunger each side of the two limits. A spring is provided inside the body to always force the plunger outward.

I do not consider flush pin gauges practical where the limits are very close unless a straight-edge is used in conjunction with them, about .004 inch is about as small as is practical for fingernail feel.

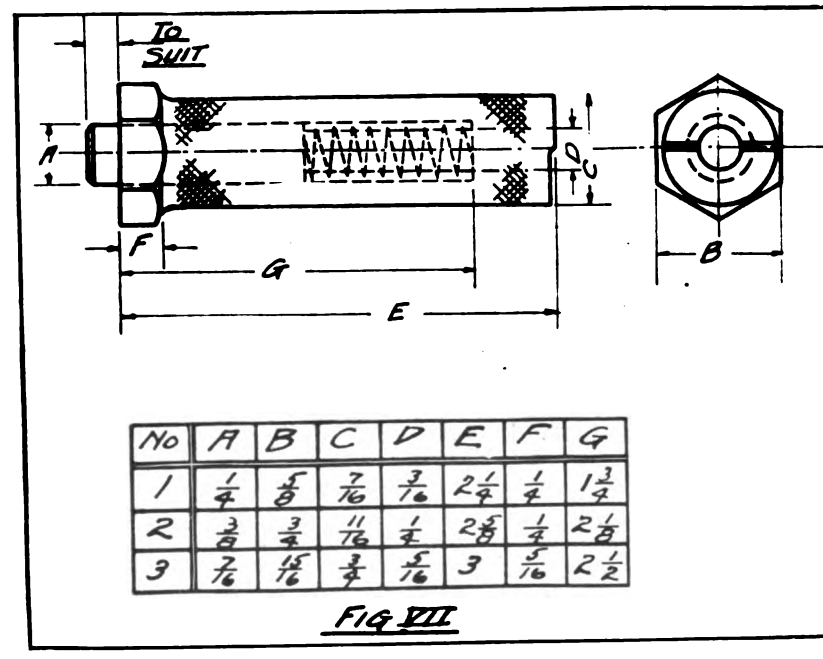
Swing Finger Gauges

Flush pin gauges are not always satisfactory for certain cuts where the clearance has to be provided between the gauging points and the work while putting the work into and taking it out of the gauging fixture. Swing finger gauges are used in such cases, in fact I prefer them to the flush pin gauge. The standard for these swing finger gauges is shown in Fig. VIII. It will be noted that the length of the wearing surface of the "go" radius is greater than the "not go" radius. This greater wearing surface is to provide for the swing coming in contact with the work to be gauged, while the "not go" swing should never pass by anyway. The handle portion is reduced in thickness a little and knurled on both sides to provide a grip for the operator. These



No	A Min & Max	B	C	D	E	F	G	H	J	K
1	1/8	7/16	15/16	3/16	11/16	1/8	1/8	1/4	1 3/8	2 1/4
2	1/4	1/2	1	1/4	3/4	1/8	3/16	5/16	2	3
3	3/8	7/8	1 1/2	7/16	1 1/16	1/8	1/4	7/16	2	3 3/16
4	1/2	1	1 13/16	1/2	1 5/16	3/16	5/16	7/16	2 1/8	4
5	5/8	1 1/4	2 1/16	1/2	1 5/16	3/16	7/16	5/8	2 3/8	4 1/2
6	1	1 1/2	2 7/16	1/2	1 7/16	3/16	1/2	3/4	2 3/8	5 1/4
7	1 1/4	1 3/4	2 13/16	1/2	1 7/16	3/16	5/8	15/16	3 1/8	5 3/4

Fig. V



No	A	B	C	D	E	F	G
1	1/4	5/8	7/16	3/16	2 1/4	1/4	1 3/4
2	3/8	3/4	11/16	1/4	2 5/8	1/4	2 1/8
3	7/16	15/16	3/4	5/16	3	5/16	2 1/2

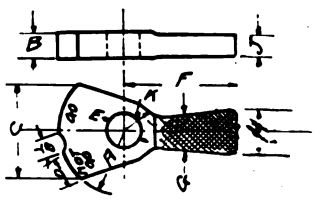
Fig VII

Digitized by Google

swings are made of a good grade of machine steel carbonized, hardened and ground.

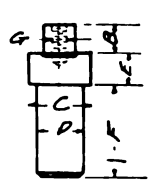
The studs upon which these swings are mounted are shown in Fig. IX. They are made of machined steel carbonized and the portion upon which the swing bears is hardened and ground. The swing fingers are held onto the studs by means of cold-rolled steel screws pack hardened and are shown in Fig. X.

FIG VIII



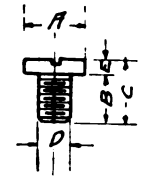
No	A	B	C	D	E	F	G	H	J	K
1	1/2	7/32	3/4	1/4	1/4	7/8	1/4	3/8	3/16	1/4
2	5/8	7/32	7/8	1/4	1/4	7/8	1/4	3/8	1/16	1/4
3	7/8	7/32	1	5/16	5/16	1 1/4	3/8	1/2	1/4	5/16
4	1	5/16	1	5/16	3/8	1 1/2	7/16	5/8	1/4	3/8

FIG IX



No	1	2	3	
A	1/4	1/16	3/8	
B	7/32	9/32	5/16	
C	1/8	3/8	1/4	
D	3/8	1/2	1/8	
E Gun	1/8	1/4	1/16	
E Arm	1	1 1/4	1 1/2	
F	3/8	3/4	7/8	
G	1/32	1/8	1/16	
TPI.	56	40	32	

FIG X



No	1	2	3	
A	3/8	7/16	1/2	
B	1/4	1/4	3/8	
C	3/8	3/8	1/2	
D	1/32	1/8	3/16	
E	1/8	1/8	1/8	
TPI	56	40	32	

Indicator Gauges

A very handy gauge for testing the alignment of one cut in relation to another cut already taken is the indicator gauge shown in Fig. XI. In this gauge "A" is the base, made of 40 per cent carbon steel carbonized, hardened and ground on the bottom and ends as indicated by the "f" marks. "B" is a tool-steel plunger hardened and ground and comes in contact with the surface to be gauged, while the ground surface on the front end of the base slides against a straight-edge which is in line with the surface on the part from which we wish to gauge the alignment of the surface upon which the plunger "B" makes a sliding contact.

The plunger "B" runs in hardened and ground bushings which are made of tool steel and held forward by means of a spring C attached to a pin D in the plunger. In the forward end of the plunger is a slot into which sets the arm E, which is pivoted on the stud F screwed into the base A. The other end of the arm E is forked. On the stud J is a pointer H, projecting from the bottom of which is a pin G and the other end, which is the pointer, projects through a slot in the cover. By this combination of levers the movement of the plunger is magnified forty times. A cover K is screwed to the base and has graduations for the indicator point, each graduation representing 1/1000 of an inch.

The only opening in the cover is the small slot for the pointer to pass through and over that is a small piece of glass which is held in place by means of a sheet steel cap riveted to the cover, this makes the mechanism entirely dustproof. Gauges of this design have a wide range of usefulness in connection with the gauging of gun work.

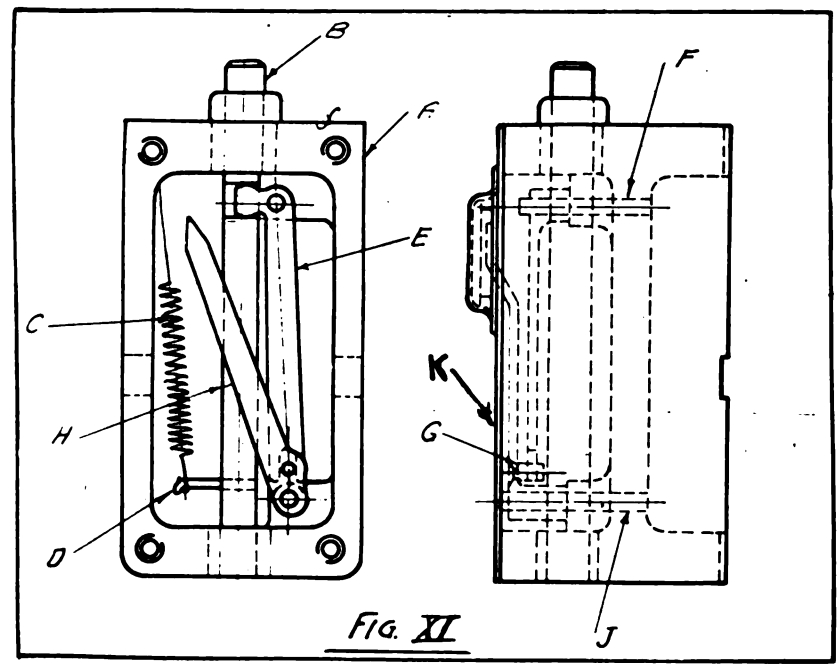


FIG. XI

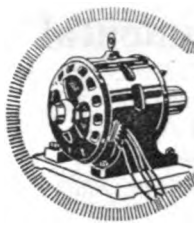
SULZER DIESEL ENGINE

THE type of Diesel engine introduced by Messrs. Sulzer Bros. in Switzerland is now being manufactured in other European countries under license from the inventors. Units varying in size from 150 to 2,000 h.p. are being built on the single-acting, two-stroke cycle principle, as recently introduced, of which more than 270,000 h.p. have already been supplied. The advantages claimed are: (1) Reduction in the number of valves arranged in the combustion chamber and exposed to high pressure and temperature. (2) A simple and strong design of cylinder head. (3) A rapid and safe method of cooling the piston. (4) A simple form of reversing gear and (5) Safety appliances for preventing false manipulation.

The exhaust ports consist of openings in the lower end of the cylinder wall which, during the greater part of the stroke are kept closed by the piston, although partly controlled by an equilibrium lifting valve. The spent gases are first allowed to escape when the further travel of the piston connects the cylinder with the atmosphere and permits air to enter the scavenging. The exhaust ports are fully closed when the exhaust ports are fully closed when the crank is in its central position of the return stroke, compression commences and fuel oil is injected through a valve in the cylinder cover. Continued compression ignites the charge and the working stroke occupies a quarter of a revolution, after which the ports are again uncovered for the exhaust. The two cycles are thus completed in a single revolution, the four quarters forming respectively the working, scavenging, compression and ignition stroke. The cooling arrangement for the piston consists of a jet of water which impinges on the front end and escapes through a telescopic tube which keeps tight without stuffing boxes.

Persistent sulphation which is indicated by a greenish deposit on a battery terminal is due to a break in the sealing compound that allows the acid to climb the binding post and attack the terminal. This break can be sealed by softening the compound. A blow torch lamp is good for this, but care must be exercised not to melt the lead straps or terminal posts. The battery should be removed from the car to avoid the danger of fire.

Digitized by Google



ELECTRICAL PROGRESS DIGEST



LONG-DISTANCE TRANSMISSION LINES

WHAT will be one of the longest transmission lines is now in the course of construction. This will extend from the city of Winnipeg to Portage la Prairie, Canada. The line is to extend a distance of 60 miles and will have towers made of steel. Aluminum wire of No. 0 gauge is being used on the first circuit which is to carry 5,000 kilowatts at 66,000 volts with a 3 per cent drop in voltage at the destination. Plans are now being laid for the installation of a second circuit.

DETECTING UNDER-WATER SOUNDS ELECTRICALLY

A METHOD of detecting sound in water has been perfected. This is one of many different systems that have been proposed during the past five years. The present system seems to possess more than usual merit. The present method, which was developed during the last days of the war, makes it possible to fix the source of disturbance with great accuracy.

A number of submerged "hydrophones" are laid a few miles apart at the proper distance from the shore. These are all connected to a central station which is provided with a very sensitive galvanometer that records the slightest disturbance. The galvanometers are made to record the disturbances upon a moving photographic film. Normally, the record on the photographic film is in a perfectly straight line. When a sound wave strikes one of the submerged phones, a variation of the galvanometer current takes place and a record of the sound is produced upon the moving film. By the proper measuring of the difference in time between the arrival of the various signals on the galvanometers, the almost exact location of the disturbance can be calculated.

ELECTRIC TREATMENT OF SEEDS

A VERY novel method of treating seeds has been perfected recently. An electrolyte of sodium nitrate is placed in a vat or cell equipped with iron electrodes. The orignators of this system claim that the yield is considerably increased when wheat, barley or oats are subjected to this treatment. It is said that 500 farmers have become interested in this method and that the work is being carried on to some extent. After the seeds are treated in the way described above, they are placed in a kiln and dried. The entire treatment must be gone through about two months before the seeds are planted.

ELECTRICAL GAS MASK

THE electrical precipitation of gaseous substances has been applied to the gas mask in place of charcoal. In the new mask a small induction coil is used to condense the fumes or gases. The new electrical gas mask has been reduced in weight by two pounds and is said to be much more comfortable than the old type. The electrical mask has not been developed to a state of perfection, but it has shown very promising results.

A NATURAL INSULATING SUBSTANCE

KELP is now being used as a source of insulating compound in Australia. After the first treatment, the kelp is pressed into shape under hydraulic pressure and then treated with formalin. The finished product can be turned on a lathe and is capable of taking a very high finish. The kelp is available in tremendous quantities along the Australian and Tasmanian shores.

NEW METHOD OF MAKING IRON CORES TO CUT DOWN HYSTERSIS LOSSES

IRON cores used in radio apparatus are generally made with the greatest number of laminations possible. These laminations are always insulated from one another with a thin layer of shellac which further cuts down the losses.

A new method of making iron cores has recently been devised which is a distinct step forward. The iron used is produced electrolytically to insure great purity. The iron produced in this way is then pulverized to a fineness that will permit of its individual particles passing through a screen with two hundred meshes to the square inch. The iron powder is then thoroughly mixed with shellac and pressed into shape under a hydraulic press. In the case of small high-frequency coils four or five iron rings of this nature are used to build up the core. Engineers have found that this still further decreases the losses.

Each of the iron particles forming the core are insulated from one another by a very thin film of shellac. Thus each tiny particle acts a lamination.

A NEW TELEPHONE TRANSMITTER

THE present type of telephone transmitter has a number of disadvantages. One of the worst is its inability to accurately transmit certain parts of speech. The new transmitter is built on the principle of an electric condenser. The impinging sound waves of the voice changes the capacity of the circuit by causing one plate of the condenser to vibrate. This variation changes the current value of the circuit and causes speech to be transmitted to the distant receiver which is the same as that ordinarily used. The new transmitter has been found to transmit all parts of speech almost perfectly.

A further development along this line is the use of a carbon or microphonic attachment with the condenser-transmitter. This transmits all parts of speech with great perfection and gives a louder indication at the receiver.

Both of these transmitters are now in a state of development and as far as experimentation has gone very good results have been produced.

THE UNITED STATES TELEPHONE INDUSTRY

SOME figures recently issued by the Bureau of Census give some very interesting information concerning the extent of the telephone industry in the United States. According to the Bureau, there are over 53,000 separate systems and lines in the country. This also includes many private lines. These 53,000 lines involve nearly 29,000,000 miles of wire. This amount of wire is sufficient to reach around the earth at the Equator 1,150 times. About 11,700,000 telephones are connected together by this great network of copper wire. It is said that nearly twenty-two billion telephone messages were handled in the United States during the year 1917. This stupendous figure means that every man, woman and child in the country called on the telephone 220 times during the course of the year. About 262,000 were employed in the industry during 1917. About 65 per cent of these were women.

Year by year the telephone messages in the United States increase tremendously. Next year will exceed the figures given above.

Digitized by Google

TO MAKE STEEL SO SOFT THAT IT CAN BE WORKED LIKE COPPER

PULVERIZE beef bones, mix them with equal parts of loan and calves' hair and stir the mixture into a thick paste with water. Apply a coat of this to the steel and place it in a crucible, cover this with another, fasten the two together with wire and close the joint hermetically with clay. Then place the crucible in the fire and heat it slowly. When taken from the fire let it cool by placing it in ashes. On opening the crucible the steel will be found so soft that it can be engraved like copper.

ANNEALING OF BRONZE

THIS process is especially employed in the preparation of alloys for cymbals, tam-tams, bells, etc. These alloys themselves are brittle, and the instruments cast from them become soft and sonorous only by immersing them while still hot, in cold water, then hammering and then finally again heating and slowly cooling. While steel requires hardness by quenching, a copper-tin alloy has the remarkable property of becoming sensibly softer and more ductile when quickly cooled, and this property is made use of by heating the alloy to a dark red, or, in case of thin objects, to the melting point of lead, and immersing in water. The alloy thus treated can be worked under the hammer and stretched without cracking or breaking.

TO HARDEN COPPER

AMONG the latest methods resorted to for hardening copper is that of melting together and stirring until thoroughly incorporated, copper from 1 to 6 per cent of manganese oxide. The other ingredients for bronze and other alloys may then be added. The copper thus becomes homogeneous, harder and tougher.

ZINC AMALGAM

ZINC amalgam is formed by mixing and triturating zinc filings with mercury at a heat somewhat below the boiling point of the latter. It is usually prepared by pouring mercury into zinc at the temperature at which the latter is just kept in a fused state. Care must be taken to keep the liquid stirred and to add the mercury slowly and in as fine a stream as possible.

The American Society of Experimental Engineers

WHO'S WHO IN THE A. S. E. E. DWIGHT SWAIN SIMPSON, M. M. E.—"By Himself"

THE gentleman so austerely pictured is not as old as he looks, having been born in the wilds of Michigan (Muskegon) in the Spring of 1883. The family silver spoon had been mislaid at the time, so he held a kit of tools in his hands.

At an early age he was transplanted to Minnesota and succeeded in reaching the University. Education (so called) was completed at Cornell University, in Mechanical Engineering and the School of Naval Architecture.

During this time every moment that could be stolen from the halls of learning was spent on the lakes and rivers of the wildest parts of the continent. It is his boast that in all the hundreds of miles of wilderness traveled he never cut himself with an axe but once and was lost but once for three days. Not really



lost, you know—just didn't know where he was.

Some months in the general shops of a little logging railroad (pattern maker, foundryman, blacksmith, machinist, boiler maker and engineer—all in one for $20.00 per) gave valuable experience that is often called upon to-day.

After escaping from college with the degree of Master of Mechanical Engineering, numerous shipyards were graced by the presence of our hero, serving in any and many capacities from fitter's helper to chief draftsman. Then a year as consulting engineer and naval architect in Philadelphia drove him back to the quiet of riveting hammers and the shipyards saw him again.

In 1914, when general manager of the Essington Shipbuilding Co., he retired from active life because of ill health, and until cured by the great war spent a long time doing nothing.

Then, as head of the newly organized firm of Palmer-Simpson Corporation, he began a strenuous two years of struggle against the Huns, the U. S. Navy Department and its inspectors in a more or less successful attempt to build flying boats and seaplanes. "A mistake may cost a brave man's life" was the oft-repeated slogan in those days, and although it was necessary to train many green men in this new work, no coroner has yet indicted the Palmer-Simpson Corporation.

In a careless moment of his youth this prodigy had his "bumps" felt by a man calling himself a phrenologist, who allowed that the subject could write things. The bump that caused the decision had been made recently by a baseball, but that baseball is a great factor in American life is proved by the fact that some editors have for a long time been good enough to agree with that old fakir and the typewriter has been busy at odd times for many years. Camping, canoeing, woodcraft, yacht building and handling, engineering topics and shopwork have been the subjects that from time to time have engaged his literary talents.

In order to have something to write about it was occasionally necessary to do things, and a little shop grew up in the home. As no man is a prophet in his own country, however, the shop was confined to the vicinity of the coal bin or some equally useless place until recently it was moved to a little factory building with the dignity of an office all its own. In its new form "The Experimenter's Shop" is becoming so well known that we can close this history right here.

To conclude this laudatory sketch we can do no better than to make use of that form which has become so well and widely known during the war.

Nationality—American (four generations on this continent).

Father—Canadian, naturalized.

Mother—American.

Color—White.

Married—Once.

Dependents—Two (wife and small daughter).

Calls himself a naval architect and engineer.

Sings a sort of barytone.

Plays no musical instrument (used to, but hasn't the time). And, like the well-known Rajah of Bong, thinks "He can do almost any old thing."

Digitized by Google

Motor Sleds for Winter Sport

MOTORING enthusiasts cannot be prevented from enjoying themselves by inclement weather and a large number of interesting motor bobs have been built, using small gasoline engines for power. A number of designers utilize the propulsive thrust of air propellers and attain good speeds over ice or hard snow.

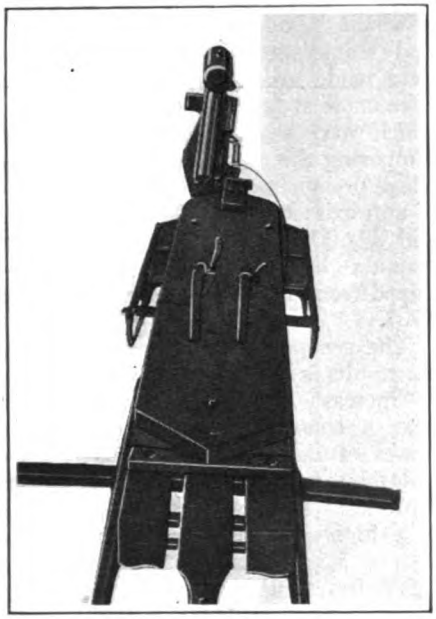
An interesting adaptation of a Smith motor wheel to a sled is shown in accompanying illustrations. Two flexible flyers are fastened together by a board about eight feet long, the first sled being held by a King bolt so that it may be used as a guide sled. A set of handle bars from an old bicycle were cut off and fastened to the plank so the operator could install the motor speed regulating levers. The speed of the engine is controlled by a throttle on one of the bars and there is also an exhaust valve lifter so the motor may be easily started. As shown in the side view, the motor wheel is attached to the rear sled by three one-half-inch bolts which firmly hold the wheel retaining bracket to the board fastened to the rear sled. As in bicycle practice, the wheel clamp is hinged to permit the wheel to play up and down and allow for road surface irregularities. Several men can be carried by this outfit. The steering is easily accomplished by means of a foot bar attached to the front sled. It is claimed that this outfit is capable of a speed of thirty miles per hour over hard snow or icy streets.

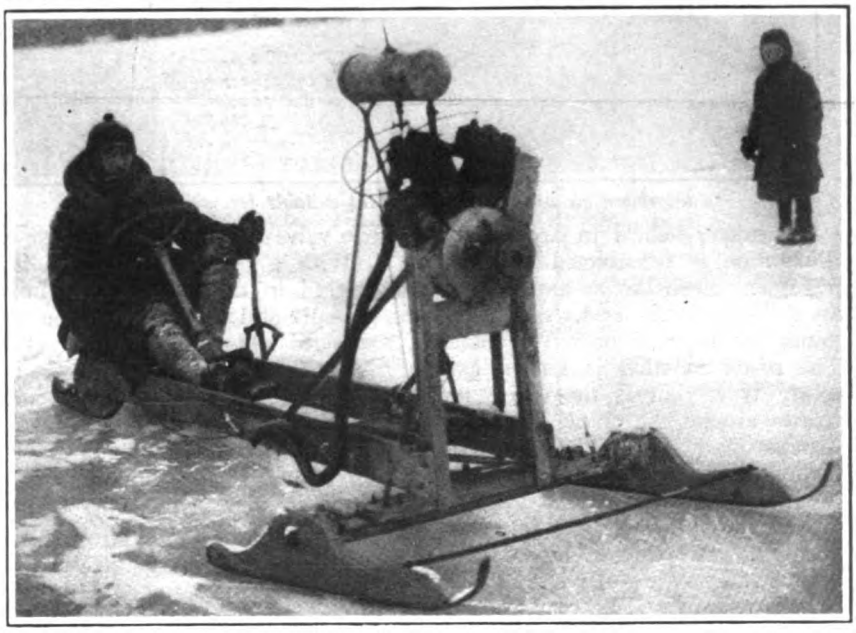
The general details of the construction of the types depicted should be clearly grasped by any one who might desire to duplicate any of the outfits shown.

The Aero Sled depicted at the right uses a very compact power plant of double opposed form and a suitable aerial propeller, the entire outfit being suited for boat propulsion also

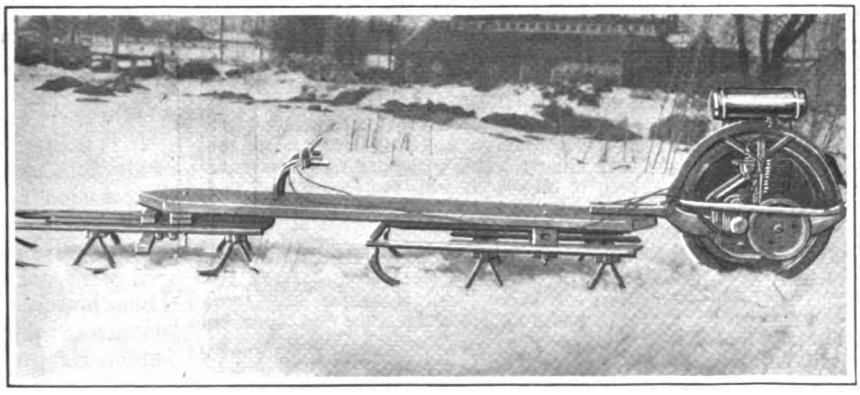


The craft shown below is capable of a speed of sixty miles per hour and is powered with a standard motorcycle engine driving an air propeller. The outfit is home-made





The motor bob shown above is made of a board, two sleds and a motor wheel for power



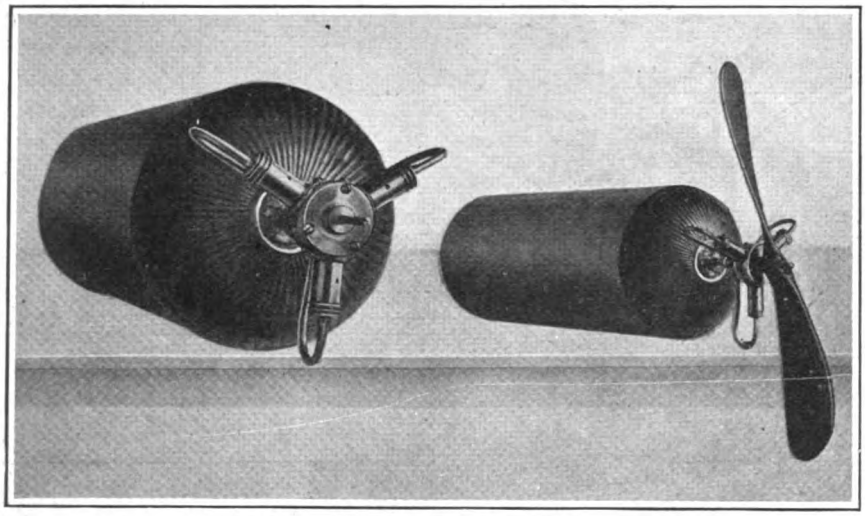
How the motor wheel and its control members are installed to push a bob sled at good speed

Digitized by Google

Compressed Air Motor for Model Airplane Propulsion

By H. C. Ellis

FOR the past few years builders of model airplanes (particularly scale models) have been looking forward to some source of power other than rubber band motors. The advantages of the compressed air engine are numerous. In doing away with the rubber motor it gives the model airplane a still higher position in aeronautical research. Scale models which hitherto could only fly about 100 feet, will now, equipped with an air motor, easily attain the 500 to 800 feet mark. The mass of the motor and tank is small and compact, so that models can be constructed after scale of man-carrying aeroplanes.



Compressed air operated power plant suitable for model airplanes

The motor shown in accompanying illustration is constructed as light as possible. Steel, bronze and aluminum are the only metals used. All necessary joints are screwed or silver soldered. The motor is what is known as the rotary type, that is the entire motor rotates around the crank shaft, which remains stationary. The cylinders of the motor are turned from a solid piece of steel. Pistons are of aluminum, lapped into the cylinders to insure a good fit. The connecting rods are of bronze and are carefully fitted to insure smooth running. The crankcase is of aluminum carefully machined to insure perfect alignment. The crankshaft is turned from a solid piece of steel rod. The complete engine, without tank and propeller, weighs but 2½ ounces. The piston stroke is ½" and the cylinder bore ½". The engine attains a speed of 1400 rev. per minute. The propeller used is 12" diameter and 21" pitch and gives a thrust of 1 lb.

The air tank shown in the illustration is 14" long and 5½" in diameter. It is constructed of sheet bronze, wound around a suitable mandrel, riveted and then soldered. The ends or caps are then put on, these being of the same material. They are riveted and soldered same as the seams in the tank. In the rear end there is a suitable tire valve for attaching the foot pump.

With a tire pump the air is compressed in the tank or container to a pressure of 150 lbs. Then the pump is removed and the model is made ready for flight. Through opening the throttle on the air container, the motor will start to run and turn the propeller for 30 to 60 seconds. Models that can be successfully flown by this motor can weigh empty up to 1½ lbs. and have a span of 4 to 6 feet. Many instructive and interesting models may be operated by the above motor. Some of these are to be described in coming issues of EVERYDAY ENGINEERING MAGAZINE.

VARIATION OF HORSEPOWER WITH ALTITUDE AND COMPRESSION RATIO

THE results outlined below were obtained at the Altitude Laboratory of the Bureau of Standards. In this, the engine under test is installed in a concrete chamber, having insulated walls, and from which the air may be partially exhausted by means of a blower, thus reducing the barometric pressure within the chamber to a point corresponding to the pressure at any desired altitude. At the same time the temperature may be regulated during the test by passing the air, as it enters the chamber over a series of refrigerating coils. The power of the engine is absorbed by an electric dynamometer placed outside the chamber and connected to the engine by a shaft and coupling.

The engine used in the experiments was a 150 horsepower eight-cylinder Hispano-Suiza, furnished with three sets of pistons, giving compression ratios of 4.7, 5.3, 6.2. The Claudel Carburetor was adjusted by hand to give the maximum power for each run. The results are based on an engine speed of 1,500 r.p.m., and the horsepowers were corrected, in the earlier tests to 0°C., while in the latter ones they were corrected to standard temperatures, corresponding to the barometric pressures at which the tests were made. The actual temperatures at which the tests were made are not given. The tests were made at four barometric pressures, which were adopted as standards for comparing the results of different tests. These pressures corresponded to heights of approximately 5,500, 11,500, 19,200, and 29,600 ft., as calculated from the formula $h=62900 \log_{10} 76/P$, obtained from the Smithsonian Tables for 1907.

The general conclusion drawn from the results is that the gain in power due to increase in compression does not bear a constant relation to the total power of the engine at different altitudes, but is greater at high than at low altitudes. The gain in horsepower due to a high compression ratio of 6.2 as against 5.3 amounts to 2.8 per cent at 5,000 feet, while it increases to nearly 5.8 per cent. at 30,000 feet. Likewise the decrease in horsepower due to the low compression ratio of 4.7, as against 5.3, while only 3.3 per cent. at 5,000 ft., amounts to about 7.3 per cent. at 30,000 ft.

It is pointed out that any comparison of absolute horsepowers for the different compression ratios may be misleading, as the engine conditions, such as fit of piston and rings, condition of valves, etc., were not the same in each case. This, however, should not affect the manner in which the power varies with barometric pressure for a given compression ratio.

A curious discussion has been going on in one of our contemporaries on the subject of the effect of motion east or west along the equator on the weight of a body so moving. If a body is motionless on the equator its weight is diminished by centrifugal force; if it were to move westward at the rate of the earth's rotation, it would be unaffected by that force and would lose weight. If it went eastward, it would add its motion to that of the earth and the centrifugal force would be increased and the weight correspondingly diminished. It is calculated that a motion of sixty miles an hour would change its weight one twenty-fifth of one per cent.

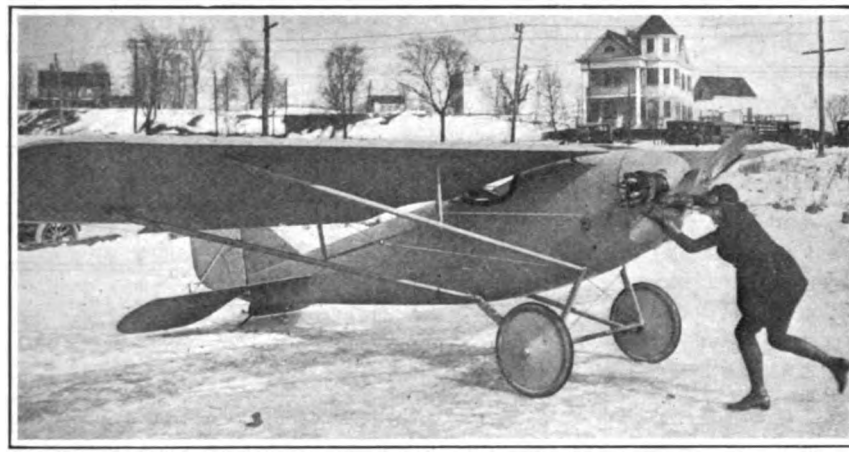
Housekeepers have long been familiar with glass baking dishes and cooking vessels which resist heat. Now the same kind of glass is being offered to chemists for use in the laboratory, as beakers, flasks and the like. Quartz ignition trays and capsules have been in use by chemists for some years, and the high price of platinum renders them particularly acceptable.

Totem poles can now be bought by the foot. In British Columbia the Haida Indians of Masset, sell them for $1.50 and $2.00 per foot. Considerable care must be exercised in packing them for transport. It is said that they are decaying and otherwise depreciating.

Digitized by Google

A Practical Small Airplane

AMERICA'S smallest flying craft —the "Butterfly" monoplane of the L.W.F. Engineering Corporation, took the air in a successful trial flight at College Point, Long Island, the afternoon of February 18. It fulfilled all of the predictions made for it after wind tunnel tests of a model. The Butterfly, a veritable aerial flivver, will make its bow to the public at the Aeronautical Show of the Manufacturers Aircraft Association in the Seventy-first Regiment Armory, New York, March 6 to 13. It will be put on a quantity production basis and it is said it will sell for $2,500.



The Butterfly Monoplane. An L. W. F. type that has made successful flights

The two cylinder opposed motor with which it is engined, started on a half spin of the propeller and the plane rolled across the snow. It gathered speed rapidly and went into the air at about seventy-five feet from the starting point. Pilot Foote sailed off toward the sound made a wide turn, came back to the field and landed. The plane stopped within sixty feet of the point at which its wheels first touched the ground. Additional trial flights will be made for speed gasoline consumption and climbing ability before the exposition. Laboratory tests give the plane a maximum speed of 72 miles per hour and a minimum without losing altitude of 22 miles.

The "Butterfly" weighs 595 pounds—two strong men can lift it from the ground. It is only twenty-nine feet and nine inches wide and nineteen feet long. The motor is smaller and weighs less than the motors in even the lowest powered automobiles, yet it develops 68 to 70 horsepower. The maximum carrying capacity is 383 pounds. The Butterfly was designed to satisfy the desires of sportsmen for a machine of low first cost, low operating expenses and low garage cost. Its wings ailerons and tail surfaces are detachable and many of the parts are interchangeable. The specifications of both motor and airplane are appended.

SPECIFICATIONS
L.W.F. Cato Motor
(Power Plant of the "Butterfly")

Type—2 cylinder horizontally opposed, 4-cycle, air cooled, valve in head.

Horse Power—72 at 1825 R.P.M.

Cooling—Air.

Bore—5 inches.

Stroke—6 inches.

Total Weight ready to run—154 pounds.

Area of Piston Head—19.635 sq. in.

Swept Volume—one cylinder 117.88 cu. in.

Total Volume Including Clearance Volume—152.97 cu. in.

Compression Ratio—4.33 to 1.

Piston Displacement—235.62 cu. in.

SPECIFICATIONS
MODEL "L"
"BUTTERFLY"

General Dimensions:		
Wing span	29′ 9″	
Depth of wing chord	84″	
Height overall	5′ 10″	
Length overall	19′	
Areas:		
Ailerons (each)	10.5	sq. ft.
Wings (without ailerons)	166.0	sq. ft.
Elevators (each)	6.5	sq. ft.
Rudder	6.5	sq. ft.
Stabilizer	6.0	sq. ft.
Fin	3.75	sq. ft.
Wing Curve	Cato No. 4	
Weights and Loading:		
Net weight of machine (empty)	595	pounds
Gross weight	918	"
Useful load	383	"
Loading per sq. ft.	4.9	"
Weight per H.P.	13.5	"
Motor:		
Cato, air cooled	68-70 H. P.	
Performance:		
Speed, maximum horizontal flight	72 M. P. H.	
Speed, minimum horizontal flight	22 M. P. H.	
Climbing speed	4,800 ft. in 10 min.	
Radius of action (full throttle)	6 hours	

FILL HOLES IN TIRE CASINGS PROMPTLY

THE motorist does not realize the great increase in tire mileage made possible by prompt attention to the many cuts and bruises to the tire tread which are apt to be neglected because they do not cause deflation. Water and sand works in between the plies through the cuts, causing sand blisters which in turn usually result in a "blow-out." For general use of motorists and in small shops a combination vulcanizer which is composed of a large hollow cast-iron body filled with water and heated with a spirit lamp, is marketed. In this the curved face and the flat face may be used simultaneously and an inner tube patched at the same time that the outer casing is being treated. As very complete instructions are furnished with these small vulcanizers, any motorist may become familiar with their use without much difficulty. In some vulcanizers, the heat is furnished by electricity passing through resistance coils imbedded in the device and are similar to an electric flat iron in action. In vulcanizing, the most important precaution is to maintain a proper temperature. Too great a degree of heat will burn the rubber, while a proper cure cannot be effected if temperature is too low. The temperatures recommended for vulcanizing vary from 250 to 375 degree F. The lower degree of heat is used in working material previously cured, while the higher temperature is best for new rubber.

Digitized by Google

DIMENSIONED DRAWING
OF
CHANUTE TYPE GLIDER

DESIGNED BY
PERCY PIERCE
LATE FIRST LIEUTENANT
U. S. AIR SERVICE

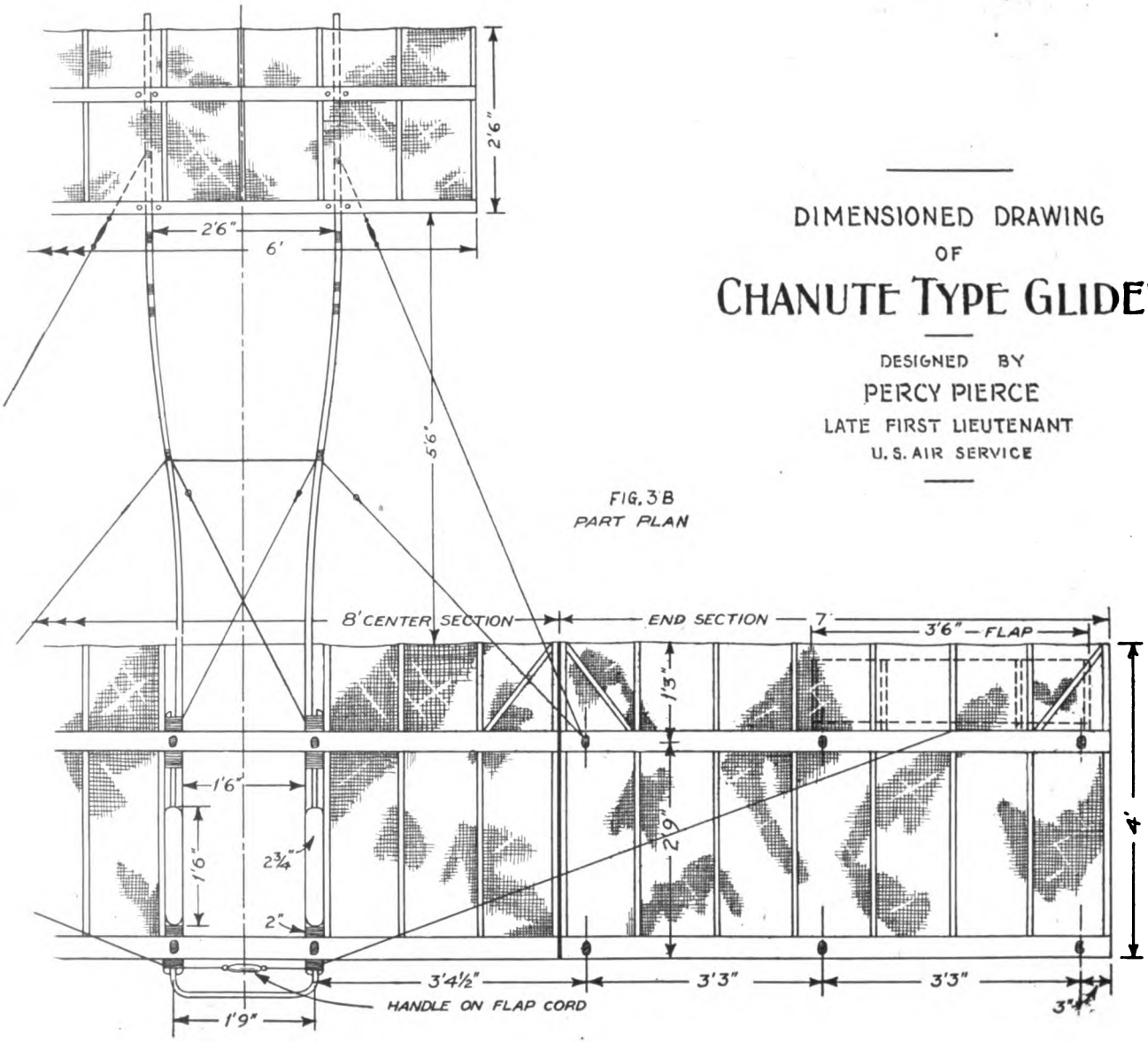


FIG. 3 B
PART PLAN

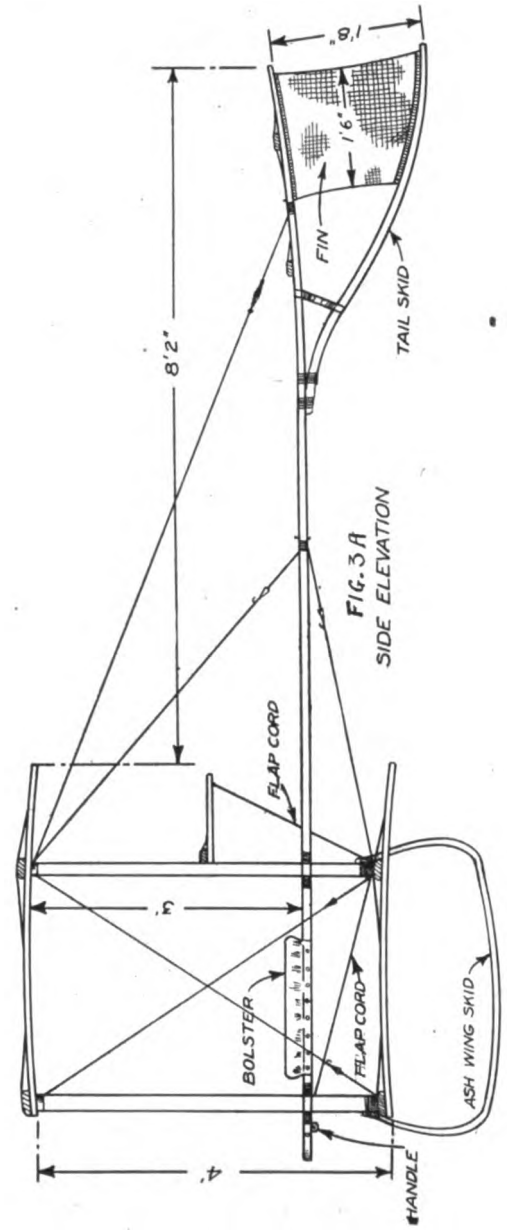


FIG. 3 A
SIDE ELEVATION

Digitized by Google

The Construction of a Chanute Glider

By Percy Pierce

Late First Lieutenant, U. S. Air Service

PART I.

THERE is perhaps little need for any lengthy description of the historical machines from which the glider shown in the accompanying illustrations has been evolved. By this, I do not mean to imply that the sketches show any great advancements of my own on the original machines of the apparatus designed years ago by the late Octave Chanute, that great and revered pioneer in the art of flying who carried the credit of devising the first powerless airplane of the biplane type —a machine with two superimposed planes or surfaces, one above the other.

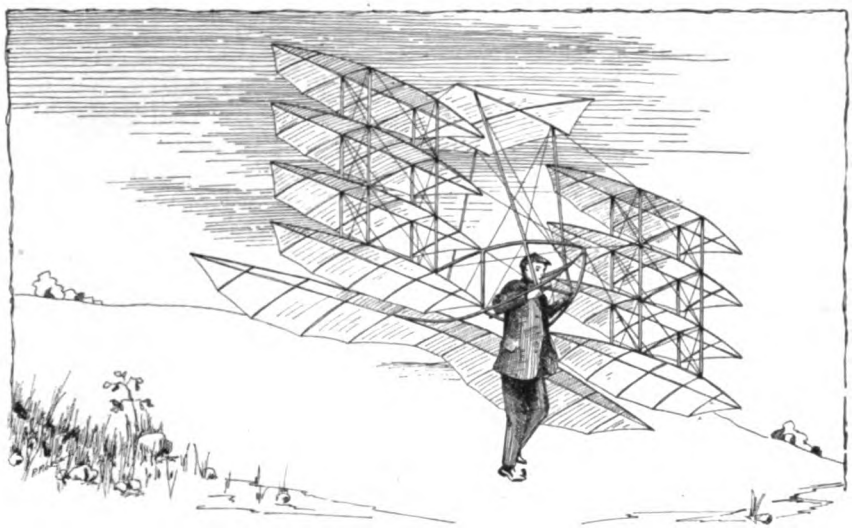


Fig. 1. Chanute's first glider was a multiplane form

Chanute's first glider or powerless airplane was a modified Lilienthal (Germany's Wright) type monoplane with a tail, later he built a quadruplane with tail, see Fig. 1, each deck divided at its center longitudinally both in main and tail planes. Later he abandoned this and came to the conclusion that two main surfaces superimposed were nearly all that was required and a biplane with cruciform tail, one vertical and one horizontal, was the result. The machine appears to have had but a single outrigger spar (the member connecting the tail surfaces with the main supporting surfaces) to carry the tail and here I think the machine could have been improved upon. No landing skids were provided, nor yet any sort of supports on which to rest the glider upon the ground. Such details as these I have introduced in the glider herein dealt with.

In Fig. 2 is illustrated the rear view of the glider in the air with the pilot "on board". It may appear from the drawing that he does not look real comfortable, but it may be taken for granted that he is, the bolsters by which he is supported under the arms, being nicely padded. The pilot is placed fairly close to the leading edge of the main planes, and with the center of gravity about on level with or a little below, the lower plane. Extending backward on a level with the center of gravity of the whole are two outriggers to carry the tail, and from beneath these, near their rear ends, are two skids curving downward and backward. Between these skids and the outriggers fabric is stretched to serve as vertical tail vanes, by means of which the head of the machine is kept well up to the wind.

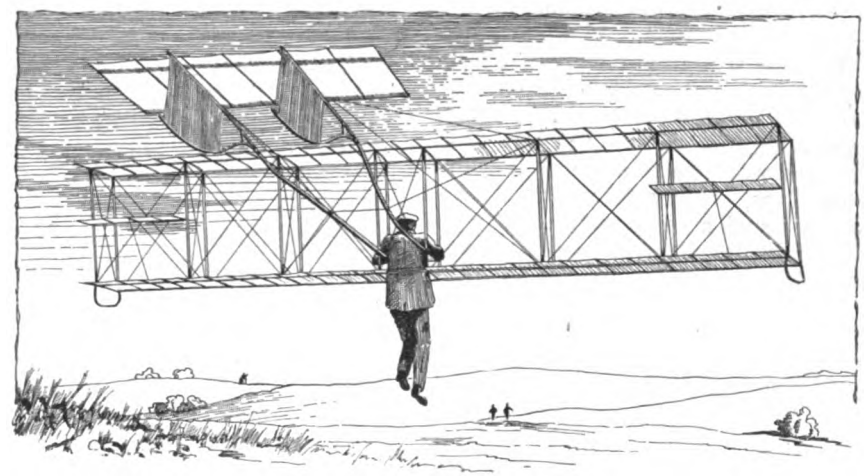


Fig. 2. Rear view of Pierce biplane glider in flight.

No Elevator Needed

It will be noticed that no elevator (a movable surface to glide the machine upward or downward) is arranged for, but could easily be rigged up. However, I do not consider, and have never found it necessary, to use an elevator in this type of glider, since it is so easy to move the center of gravity of the machine by moving the body longitudinally, a small amount of swing to the pilot's legs either backward or forward being sufficient to control the machine. The correct angle of the tail plane—which, by the way, should be negative to the main planes—can be adjusted by means of the turnbuckles showing in the side elevation drawing, Fig. 3, the flexibility of the outriggers permitting this.

Stabilizing Flaps Provided

With regard to the lateral balance, this can either be accomplished by the movement of the pilot's legs from one side or to the other or by the movement of the center of pressure—caused by the actuation of the control cord to the ailerons shown in the plan and side elevations in Fig. 3. If ailerons are used they can be pivoted on the two outermost struts on the trailing edge of the planes at each end. These are merely flaps, and hang vertical when the machine is not in flight. When in use they make the same angle of incidence (the angle at which the planes advance through the air to give lift) as the main planes for normal flight, being restrained at that angle by the tension of the control cord. If they require to be operated for correcting an undesirable list or for the purpose of steering, their action is as follows:

Digitized by Google

Supposing the glider assumes a cant over to the left—that is, with the right-hand side higher than the other, the right-hand flap would be pulled down, thus disturbing the air currents between the right-hand ends of the planes and so rob them of their lift. At the same time the flap puts a brake on the rising side. The consequence is the left-hand side commences to travel faster relatively to the wind velocity, with the result that the left-hand side rises to the normal level. If flaps are not used the center of gravity is then moved by swinging the legs over toward the high side—which in this case is the right-hand side. Restoring the glider to its normal position as with the use of the flaps will be the result. If it is desired to steer the machine, say, to the right, the right-hand flap is pulled down; this produces a list to the right, the effort of which is to cause the left side to rise and the machine to swing round on the air banking.

The control cord is attached to the center ribs of the flaps and passes through eyes on the rear spar of the lower plane, meeting in the center of the machine in a handle placed immediately in front of the pilot, as shown in the plan view, Fig. 3.

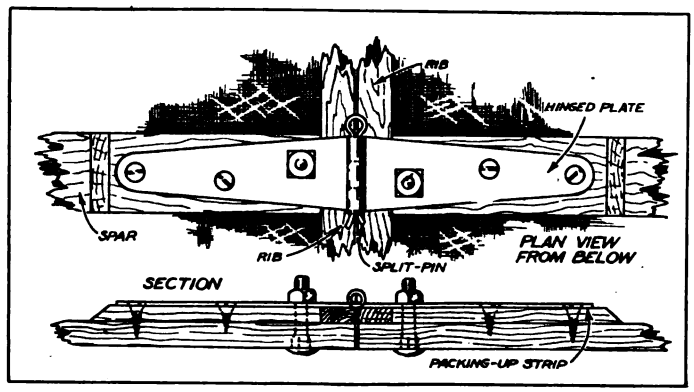


Fig. 4. The hinge coupling for the plane cellules

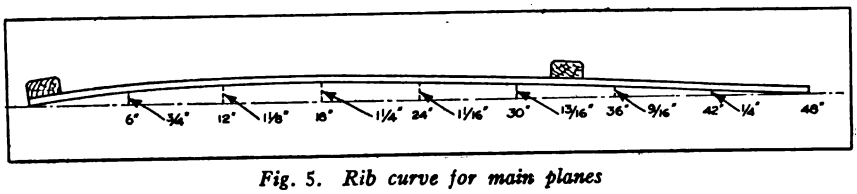


Fig. 5. Rib curve for main planes

Main Planes in Section

It will be seen from the drawing last mentioned that the ends of the main planes are arranged to be made in sections, a length of seven feet at each end being removable *en bloc,* complete with struts, flaps, bracing wires, etc. This will be found a very great advantage indeed when the question of storage for the glider comes up for consideration; it also means that the glider can be built in a much smaller workshop than would be the case were the planes each in one length of 22 feet.

The arrangement for coupling up the sections is shown in Fig. 4. It is simply a pair of hinged plates, the two halves of the hinge being united by a stout split-pin passing through the eyes in the plates. One of these hinges is screwed and bolted in the manner shown on each of the two main spars of the planes—one-half on the spar of the end section and the other on the center section; they should be put on the underneath side of the planes. Owing to the fact that the ribs are screwed to the underside of the spars, the hinges will have to pass over the two ribs at the ends of the two united sections; it two cases on full-sized power machines. will therefore be necessary to glue on to the spars some packing-up strips of equal thickness to the ribs.

This method of attaching the sections has been found quite simple and perfectly efficient in practice; in fact, I have used it on much larger planes than those on the glider herein described—To detach an end section after using the machine, it is only necessary to undo the four bracing wires by means of the motorcycle spoke turnbuckles, draw the four split pins, and the end is off.

Main Plane Curve and Construction

In Fig. 5, I have drawn the form of the main planes in section; the maximum versed sine is 1¼ in. at 18 in. from the leading edge. All the ribs, after cutting and planing to size—which, by the way, is ½ in. by ⅜ in. in section—should be steamed and bent over a templet, being afterward set carefully to a full size drawing copied from Fig. 5. The ribs and spars may all be of spruce or clean straight-grained pine. By spruce, I mean, of course, silver or Oregon spruce, not the common white variety. The trailing edge of the planes are wired as shown in Fig. 6. This should be No. 20 gauge music wire. Each rib is notched slightly across its end to receive the wire, which is then bound in place by a few turns of fine soft iron wire, passing it through a hole bored about half an inch from the end of the rib. Before finishing off the main wire on the rib ends, it will be necessary to introduce short struts as shown in Fig. 6; these serve to transfer the pull of the wire to the main spar and generally distribute the stresses through the structure of the planes. To terminate the wire, it should be bound into a notch in the rib in the same way as was done all along in the other ribs, and then bent sharply round the end of the plane and cut off about ¾ in. from the bend; this length is then bound into the end, or rather side, of the rib. When one end has been made off, the wire should be pulled fairly taut and the other end finished, then all the binding gone over with a soldering iron.

(To be continued)

MATERIAL IN AN AIRPLANE

THERE is a surprising amount of material of various kinds necessary to build an airplane of the conventional type. Materials involving metals of various kinds include the following:

Nails	4,326	
Screws	3,377	
Steel Stampings	921	
Forgings	798	
Turnbuckles	276	
Wire	3,262	feet
Aluminum	65	pounds

The various kinds of wooden material mount up as follows:

Spruce	244	feet
Pine	58	feet
Ash	31	feet
Hickory	1½	feet

Other materials necessary for the finished plane are:

Veneer	57	sq. ft.
Varnish	11	gallons
Dope	59	gallons
Rubber shock absorber cords	34	feet
Linen	201	sq. yds.

This list of material is exclusive of everything necessary for the engine alone and is used in a well-known make of biplane tractor of about 40 feet spread built for training purposes during the war and now used in a modified form for many commercial purposes.

Two-thirds of the cobalt of the world is produced from the mines of Cobalt, Ontario, and at that it is only a by-product. One hundred and fifty-five tons of nickel, 337 tons of cobalt, 2,592 tons of arsenic are the annual production of the district along with over 19 millions ounces of silver.

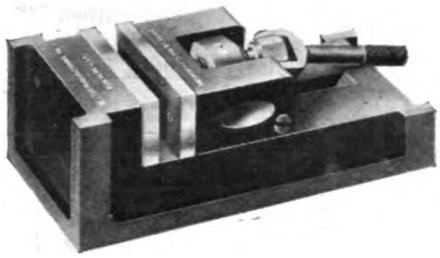
In Shanghai, China, a trackless trolley is credited with the transportation of about 5¾ million passengers in the year 1918. It has been in operation for four years.

Digitized by Google

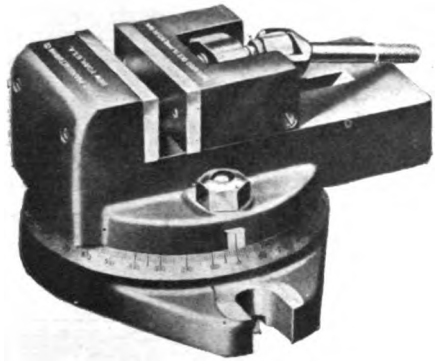
SHOP PRACTICE

A WELL-DESIGNED VISE

A NEW vise possessing many new features of a practical nature is shown in the photographs. This type of vise is made in several different sizes suitable for different classes of work.



Each vise is provided with a projected edge by means of which it can be clamped tightly to a drill press table, lathe face plate or milling machine. This is a feature that has not been included on ordinary vises. The edge also makes it possible to mount the vise on its side. The edges are milled perfectly accurate. By the use of an especially patented clamp, the moving jaw of the vise can be rapidly adjusted and finally tightened by a few turns of the screw at the back.



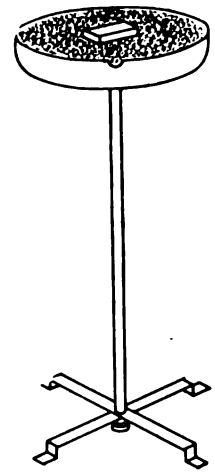
The vise is also manufactured on a swivel base accurately graduated from 1 to 360 degrees. This particular type has been developed entirely for machine use. It embodies the same adjusting clamp as the plain type.

The smaller sizes of these vises are admirably adapted to small shop use.

AN EASILY CONSTRUCTED SOLDERING STAND

A STAND like the one described, comes in very handy for hard soldering, annealing and similar operations in conjunction with a blow torch.

The pan is an old frying pan drilled through the center to accommodate a supporting rod. Instead of sawing off the handle it should be bent up, this making a convenient support for the blow torch when not in use. The rod is anywhere from ¼ to ½ in. in diameter and is threaded at both ends. The feet or legs are bent as shown from some 1 in. width heavy gauge iron and drilled to hold the rod. Both pan and feet are fastened to the rod with nuts,



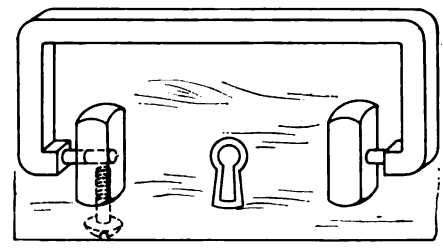
as per drawing. The completed stand should be about three feet high or adjusted to the height of the builder.

The pan should be filled with sand, gravel, etc. The brick, shown in the drawing, is used to support work while soldering.

The builder may easily fill in any other details to suit himself, bearing in mind, however, that rigidity is of prime importance.—W. G. Voss.

TOOL BOX OR DRAWER HANDLE

QUITE often the "handy-man" has occasion to use a hinged handle on a tool box or drawer, but in most cases, if he goes to the hardware or



furniture store, they will show him either the fancy stamped brass handles for dressers, or he will find heavy handles, such as used on trunks and heavy tool boxes or chests, and it then devolves upon him to make a handle of the proper shape and size to go with the thing that he is building. Below is given a sketch of a handle that is easily made, that is plain, and that will look well wherever used. The stock for making the handle should be square, the size depending on the size of handle wanted. The material should be able to stand a right angle bend without cracking. The two uprights are made of stock preferably slightly larger. A hole is drilled in the base. This hole is then tapped for a bolt to hold it to the box or drawer. A hole is drilled in the side of this upright, as indicated, and into this hole the rounded end of the handle proper is placed, so that the handle will lie down out of the way when not in use.

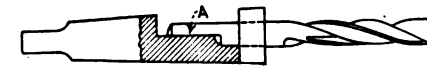
The above handle is very easily made, and if the work is carefully done, a very neat appearing handle will be the result.—Frank A. Sahbaum.

SAVING OLD DRILLS

NEVER throw away a drill, because of a broken tang. Remember a drill is valuable, for it can be easily fixed and used once more, although this is not generally known.

Like all real solutions, the idea is simple when once explained.

Simply grind the broken tang to the shape shown at A and make a socket

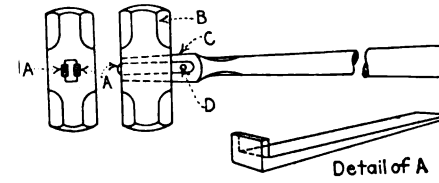


to suit drills of such nature. One socket will accommodate all sizes of drills, merely make the size of the next tang a standard size.

Considerable money can be saved by adopting this idea.—J. H. Moore.

SAFETY WEDGES FOR A SLEDGE

MANY an accident has been caused by the head of a sledge-hammer flying off, and any scheme to stop such a danger is worth adopting. The solution is very simple and effective.



Make two steel tapered wedges A (see detail view) and place on each side of C as shown on the sketch. These wedges should be slightly longer than the head of the hammer B. Now drill a hole through the shaft of the hammer and wedges, after which put the pin D in place.—J. H. Moore.

Digitized by Google

CARE OF A SLIDE RULE

A SLIDE rule, even though it will stand rough usage, requires intelligent care if reliable and consistent results are to be obtained. At frequent intervals the A, B, C and D scales should be checked against each other, and the sliding portion should fit snugly between the guides. The fit between slide and guides will vary with the weather, that is, whether it is dry or moist, since the wooden part of the rule absorbs moisture.

In case of a new rule, it will be found very easy to get it "broke in", if the guides of the rule are sprinkled with talcum powder and the slide worked back and forth several times.

If the glass runner is attached to metal blocks which serve as guides or slides, the glass is easily broken if the rule is dropped or severely jarred. To overcome this difficulty, place a piece of very thin paper between the metal blocks and the glass, and between screw-heads and glass. This makes a cushion between the glass and the metal, and it is surprising how much longer the glass will last when so protected. The paper should be trimmed off along the edges of the metal guides, and around the screw-heads. If so protected, the rule will need a new glass only at very infrequent intervals. —FRANK A. SAHBAUM.

BUFFING AND POLISHING WAX

OCCASION arose where some buffing and polishing was to be done on a polishing wheel, but no polishing wax or buffing wax, as ordinarily used, was at hand. The writer attempted to make a wax to meet the emergency by melting some paraffine, and then adding powdered pumice stone, till the paraffine was very thick and sluggish. The mass was then allowed to cool, after constant stirring. When quite hard, this was rubbed on the polishing wheel and very good results were obtained in the way of a finish. It takes more of this material to do a given amount of polishing than of the regular wax, but this was well suited in case of an emergency.

Several different qualities of this might be made, by making a mixture of fine emery dust and paraffine, and by mixing rotten-stone or some other polishing powder and paraffine. Which of these materials would be used would depend on the finish required and on the rate of polishing, for it is evident that the emery would do the work more rapidly, although it would not give the gloss that a finer grade abrasive would give.—FRANK A. SAHBAUM.

USE OF SOLDERING

A DENT in a closed metal cylinder can be repaired by first soldering a small strip of metal to it. By this means the dent can be pulled out and the solder that holds the strip melted off.

OPTICAL APPARATUS FOR TESTING SCREW THREADS

OPTICAL methods are coming into use more and more in the field of mechanical measurement. By optical means an accuracy can be obtained that cannot be approached by any other method. The wonderful Johanssan blocks that are accurate to the hundred-thousandths part of an inch are produced by the aid of optical measuring instruments. In fact, this system is so perfectly accurate that precision blocks have been made with an accuracy of .000001 inch.

The optical method of testing screw threads rapidly has recently been introduced and is coming into wide use in all of the large manufacturing establishments in the country. Its advantages over the conventional gauge system are numerous. Great accuracy and greater speed are probably the most important factors.

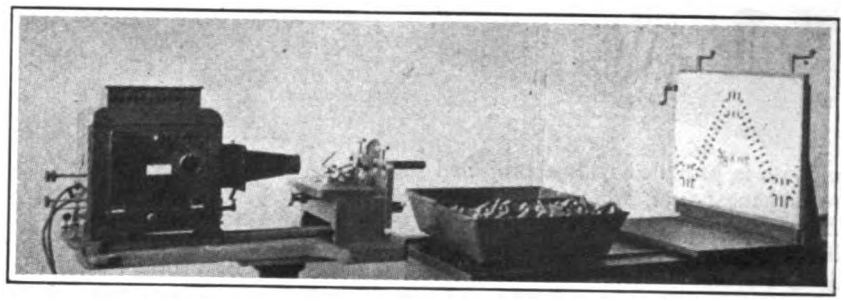
In the case of testing screw threads, the profile shadow of the screw is thrown upon a small screen known as a tolerance chart by means of an especially constructed projector. The profile of one thread at a time is projected and the screw can be revolved so that its entire thread may be inspected. The screw is held in an especially designed holder as shown. This is so made that any inaccuracy in the lead of the screw will be evident upon the screen.

One of the photographs shows the projected profile of a screw with a correct lead. The zone between the dotted lines represents the limit of tolerance. The screw shown in the photograph is just at the limit of tolerance. If it was just a trifle smaller it would be necessary to reject it. Any profile that extends above the upper dotted lines represents a screw with too great a diameter. This system tells at a mere glance what is impossible to determine by the sense of feeling. The method is absolutely unfailing and unlike the gauge system it can be depended upon.

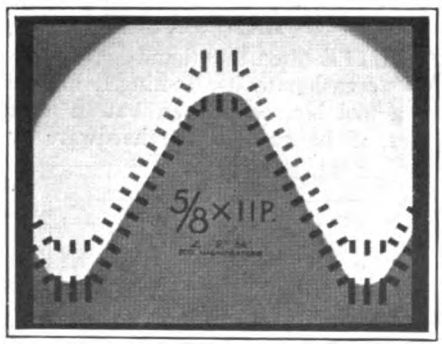
The projected screw is magnified 200 times and all of the irregularities of the surface are plainly visible. The tolerance zone is so measured off that it will indicate a tolerance of .004 inch at a magnification of 200 diameters.

When the apparatus is set up it is necessary to employ a standard gauge to set the screen the proper distance from the projector. Adjusting handles are provided on the screen so that it can be brought to the proper position.

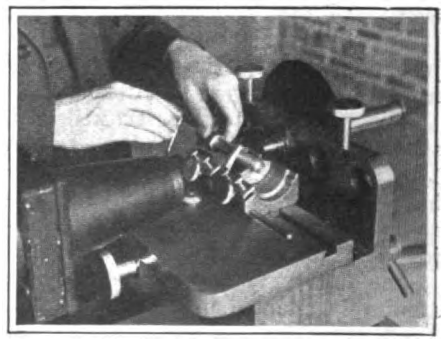
A perfectly dark room is by no means necessary for the operation of the screw testing machine. A moderately lighted room does nicely.



The complete projecting apparatus together with the tolerance chart



The profile of a screw upon the tolerance chart is shown



Placing a screw in holder for testing

Mr. James Hartness, the inventor of the optical method of testing screw threads, claims that the present system of gauging, as outlined in the previous lines, will eventually reject all lead errors in screws of minimum diameter. The conventional system of gauging permits a larger lead error in the smaller screws than is tolerated in the larger screws.

Digitized by Google

Our Readers' Workshops Page

THE shop pictured on this page is owned and operated by Mr. H. Willhagen, who has derived no end of benefit and pleasure from his equipment. He had added to his shop from time to time until it is now very complete. Mr. Willhagen's description follows:

"I use my workshop as an aid to my hobby and incidentally I make quite a bit of money working in my spare time for my friends who see my work and who want something done which they are unable to do on account of lacking shop facilities. This work keeps me very busy at times, but on the other hand it adds considerably to my income. My bench, which is six feet long, has drawers in it and is provided with a quick-action vise at one end and a vise for metal work at the other end. One end of the bench is used for metal work and the other for wood work. From an old gas stove and bread toaster I made a very serviceable furnace which is used in heating soldering coppers and glue. Aside from this the shop is provided with fourteen planes of all shapes and sizes for matching boards, beading, etc. A multitude of dies and taps are on hand ranging from 2-52 to 9/16. Drills from the very smallest to ¾ in. are also provided. I have reamers from ¼ to 7/16; also two Morse taper reamers. I have a rip saw, cross cut, coping and back saw. I also have a key-hole saw, hack saw and a power driven rip saw. Some time ago I made a table out of 2 x 4's and an old saw spindle. I am able to cut grooves on this device and also use it largely for cross-cut work.

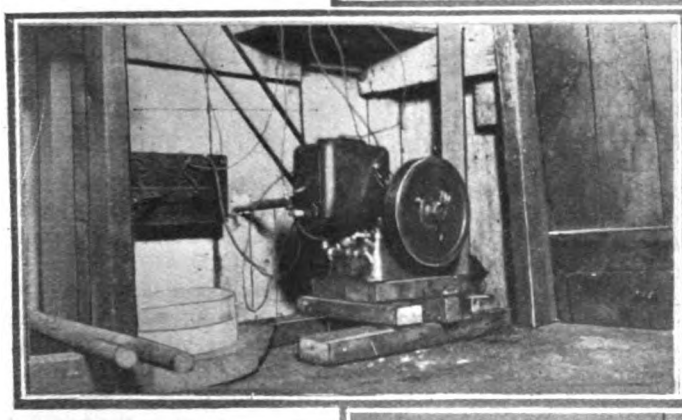
"Paints and varnishes of all shades, colors and hues are on hand and this is considered to be a very important part of the shop equipment. Carving chisels, gouges and clamps of all sizes make the wood working part of the shop very complete.

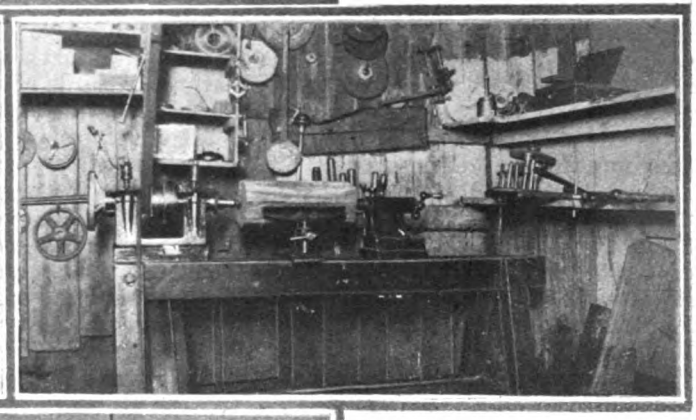
"Cigar boxes full of screws, nails, bolts, nuts, washers and 'junk' (as we call it) are stored under the benches where they are very accessible.

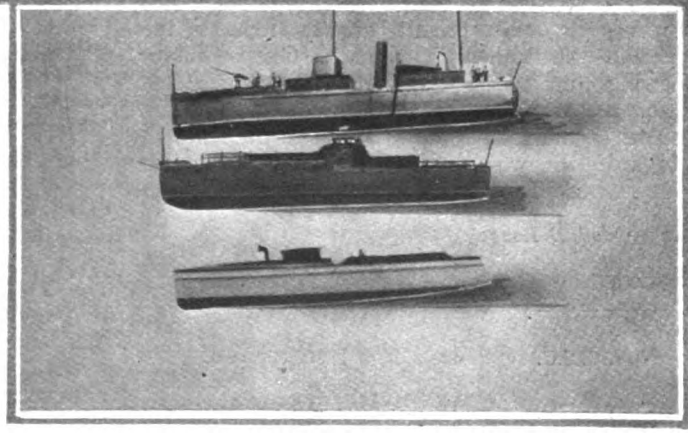
"Some of the work I have done in spare time has brought me good returns. In one instance I was paid $5.00 for a medicine cabinet. I have made a number of Kiddie Cars for my own little girls. A total of six lamps have been made in my little shop. I have recently added an old lathe which will be used especially for turning long lamp posts.

"The lathe shown in one of the photographs was made by me and it is very serviceable. I had a friend turn the spindle and all of the pattern work and assembly was done by myself. I have a face plate fixed up for a disc grinder and sander which is a very useful piece of equipment. The lathe parts include buffing wheels, grinding wheels, chucks, saws and centers. I also have a set of dogs and a cross feed for light metal work. It is my intention to install a good screw-cutting lathe before long. The lathe I have at the present time is run both by foot and gas engine power. The gas engine power plant, which is part of the shop, is illustrated in one of the photographs.









"I have made four boats, one of which was praised very highly by my friends who saw it. Two of these crafts were made from directions that appeared in EVERYDAY ENGINEERING MAGAZINE. It was through the magazine that I turned my attention to model construction. Before long I intend to start building a small flash steamboat.

"I have obtained much pleasure from working in my small shop and I must say that it has put me where I am today. When I started to read your little five-cent magazine I was a 'sticker' machine hand working for 50 cents per hour. Today I am a pattern maker getting 85 cents per hour and was recently offered $1.20 per hour. I have had six wage increases during the last few years and this I attribute to my little shop."

Digitized by Google



THE JUNIOR EXPERIMENTER

B Range Loose Couplers

Beginners Will Have No Trouble in Building 200- to 600-meter Couplers if They Follow This Data

"CAN you suggest a type of loose coupler for 200-meter work?" This question is often asked in letters from the radio experimenters. Since the query requires an answer too long to put in a letter, it has been made the subject of this article, that the problem can be cleared up once for all. Specifications are given here for a B range type, that is, one which tunes from 200 to 600 meters.

The dimensions of the primary coil depend upon the antenna capacity, as it is not intended that a primary variable condenser be used, nor is it necessary. This capacity value will vary according to the dimensions of the antenna, but we will consider here the three standard types known as the Short, Long, and Super Range aerials, of 0.0002, 0.0004, and 0.0005 mfd. respectively. These were taken up at length in the November - December, 1919, issue.

While there are any number of ways to build loose couplers, we shall consider only those with single layer windings, having the secondary slide into the primary. Below is a table showing the dimensions of the primary for a loose coupler to give a B range, operating on any of the three standard antennas.

Primary Coil, B Range

	Diam.	Length	Wire	Turns per in.	Inductance
Short Range Antenna—	3½ ins.	2 ins.	No. 24S.S.C.	42	600,000 cms.
Long Range Antenna—	3½ ins.	1¼ ins.	No. 24S.S.C.	42	300,000 cms.
Super Range Antenna—	3½ ins.	1 in.	No. 24S.S.C.	42	250,000 cms.

Sliders or switches can be used to vary the inductance, according to the plans of the builder. If the slider is carefully made, it will be satisfactory. Taps should be taken off every second or third turn, if a switch is employed.

The size of the secondary coil depends upon the variable condenser connected across it. As can be seen from the table below, two variations of inductance are required with a 0.0005 mfd. maximum condenser. A two-point switch is all that is needed.

Secondary Coil, B Range

	Diam.	Length	Wire	Turns per in.	Inductance
0.0005 mfd. Condenser—	3 ins.	1⅜ ins. Tap ⅝ in.	No. 24S.S.C.	42	250,000 cms.
0.001 mfd. Condenser—	3 ins.	13/16 in.	No. 24S.S.C.	42	120,000 cms.

The advantage of the 0.001 mfd. condenser is that no adjustment of the secondary coil is needed, all the tuning being done with the variable condenser.

If the secondary is to slide in and out of the primary, wooden discs can be fastened inside the ends of the secondary tube, to take the supporting rods. It is advisable to use two ⅛ in. brass rods, mounting them on small wooden blocks secured to the base of the loose coupler.

The method of making connections to the secondary winding should be considered carefully, as high resistance in this circuit greatly reduces the strength of the signals. One way is to use the suporting rods for connections. If this is done, brass tubes, ⅛ in. inside diameter, should be put in the holes in the wooden coil discs, and the wires soldered to the tubes. Thus a sufficient area is in contact between the tubes and rods to give a good connection.

Another way is to bring out flexible leads from the coil. When this is not done correctly, the leads soon break off at the connections. If, however, at both ends, the wires are run from the joints through small screw eyes placed ½ in. away, the bending strain does not come directly at the joints, but is distributed.

Either a crystal detector or audion can be used with a loose coupler of this type, according to the range required.

Diagrams of various types are given in Radio Hook-ups, to which the reader is referred.

TESTING A. C. RECTIFICATION

A CLEVER method for testing the rectification of alternating current has been suggested by Mr. H. B. Trombly, of Pasadena, Cal.

When a horseshoe magnet is held near a lamp operating on alternating current, the filament vibrates rapidly. However, if a rectifier, of the type using only one-half of the cycle, is connected to the supply, the output of the rectifier will be in the form of a pulsating direct current, the other half of the cycle being cut out.

Consequently, a magnet held near a lamp carrying the rectified current should cause the filament to vibrate at one-half the speed first obtained.

CUTTING BAKELITE

OCCASIONALLY it is necessary in cutting out a piece of bakelite to remove quite a little of the material, but not enough that a saw can be used. A spoke shave, well sharpened, is an excellent tool for such work, as it makes a clean cut and removes the bakelite much faster than is possible with even a very coarse file. The latter is not good because it breaks the edges of the piece.

Don't try to polish bakelite—rub it down with a piece of No. 2 sandpaper, making the strokes all in the same direction and clear across the piece.

Digitized by Google

The Chemistry of the Common Metals

By Henry L. Havens

PART 1

Sodium

SIR HUMPHREY DAVY first prepared metallic sodium from sodium hydroxide in the year 1807. Previous to the date of its preparation by him, sodium hydroxide was regarded as a chemical element and the decomposition of the compound surprised the scientific world at the time. The chemical experimenter can very easily reproduce this classical experiment by carefully examining the diagram. The surface between the sodium hydroxide is kept well moistened with water and as the process continues the mercury will become thoroughly impregnated with metallic sodium. In this way the sodium is prevented from reacting with the water.

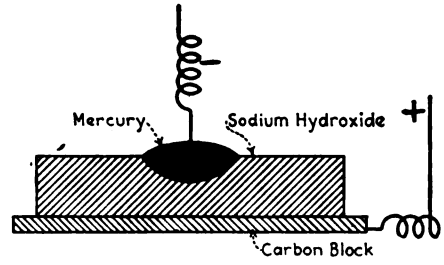
Sodium is one of the most abundant elements on the earth. It appears chiefly in the form of the chloride. It has been calculated that the ocean contains over 4,500,000 cubic miles of saline substances. A number of other sodium compounds also appear in nature, the more important being sodium carbonate (Na_2CO_3), sodium bicarbonate ($NaHCO_3$), sodium nitrate ($NaNO_3$), cryolite (Na_3AlF_6), and borax ($Na_2B_4O_7$). A number of silicates also appear in nature.

Sodium is a soft, pinkish-silver metal that tarnish or oxidizes immediately upon exposure to the air. It has a melting point of 97.6 deg. and boils at the temperature of 878 deg. The vapor passing off from boiling sodium is very active. Exhaustive experiments tend to prove that sodium has a molar weight of 23, which is exactly the same as its combining weight. The great activity of sodium vapor makes it extremely difficult to obtain the molar weight, but results tend to prove that it is very close to, if not, 23.

A very interesting experiment can be performed with sodium by dissolving a freshly cut piece of metal in amhydrous ammonia. The change is purely a physical one; a new compound is not formed. A solution of sodium is produced and this solution conducts electricity in much the same way as a metal. Upon the evaporation of the anhydrous ammonia pure metallic sodium is left as a residue. Sodium is also soluble in mercury as has been mentioned before. It was this fact that made Sir Humphrey Davy's experiment successful. Sodium - mercury amalagam is used largely in commerce in places where pure sodium would be objectionable owing to its extreme chemical activity.

When sodium is brought directly into contact with water a very vigorous chemical reaction takes place. The products of the action are sodium hydroxide and hydrogen as will be seen by the equation: $Na + H_2O = NaOH + H$. The escaping hydrogen from a small piece of sodium in contact with water will cause the sodium to skip about the surface rapidly. If a large piece of sodium is brought in contact with water the heat of the reaction is sufficient to ignite the hydrogen and a violent explosion will occur. Amateur chemists are cautioned not to try this experiment as sodium hydroxide is liable to be blown into the eyes which would in all probability destroy the sight. Upon the completion of the reaction of sodium with water, the sodium hydroxide can be obtained by evaporating the solution to dryness.

When sodium is heated in air it quietly burns with a yellow flame. The only way sodium can be preserved for a great length of time is by placing it in a perfectly air-tight receptacle such as a tin can with the cover soldered on.



It can also be preserved indefinitely by immersing it in petroleum which excludes the presence of air.

Sodium is so soft and pliable that it can be easily cut with a knife. When mixed with other metals that have a low melting point it assists in the formation of an alloy with a very low melting point.

Sodium Compounds

One of the most common compounds of sodium is its chloride (NaCl). This can be prepared by the interaction of moist chlorine and the element. It has been found that perfectly dry chlorine gas will not react with sodium at any temperature up to the melting point of the latter. The action of the water seems to be catalytic in every respect. By neutralizing sodium hydroxide with hydrochloric acid the chloride can be obtained by evaporating the solution to dryness.

Sodium chloride is nearly as soluable in cold water as in hot water. At 0° 100 parts of water is capable of dissolving 35.74 parts of sodium. At 107°, which is the point of saturation, the water is only capable of dissolving 39.65 parts of the chloride.

Sodium chloride crystals do not contain any water of crystallization in a true sense. They do, however, enclose a certain amount of water which causes the crystals to explode when heated.

Sodium monoxide (Na_2O) is prepared by adding metallic sodium to sodium nitrate according to the equation.

$$2\,NaNO_3 + 6Na = 4Na_2O. + N_2$$

Sodium monoxide is a decidedly gray compound which reacts violently with water, causing the formation of the hydroxide (NaOH).

Sodium peroxide (Na_2O_2) is produced by heating metallic sodium in an excess of air freed from carbon dioxide. The resulting compound is a white powder about 93% pure. It reacts violently with water, forming sodium hydroxide and hydrogen peroxide (H_2O_2). Upon formation, the hydrogen peroxide breaks down rapidly into H_2O and free oxygen. The free oxygen is immediately available when the water comes in contact with the sodium peroxide. This makes sodium peroxide an abundant source of free oxygen and it is used largely in commerce as an oxidizing agent. In most cases a small quantity of some copper compound is placed in the commercial sodium peroxide which acts as a catalytic agent for the decomposition of the hydrogen peroxide. Sometimes sodium peroxide appears on the market in a fused condition under the name "oxone."

Pure metallic sodium can be produced in the laboratory by heating the peroxide with carbon. This results in the formation of sodium carbonate and metallic sodium. The temperature necessary for this reaction is between 350° and 400°.

Sodium carbonate (Na_2CO_3) is found in nature to a considerable extent. A number of lakes in the United States contain sodium carbonate which is obtained by solar evaporation. A double salt of the carbonate and the bicarbonate is produced ($Na_2CO_2NaHCO_32\,HO_2$). These salts can be very readily changed to the simple carbonate by heating. Previous to the recovery of sodium carbonate from natural lakes, it was obtained from the ash of sea plants.

The Solvay Process for the preparation of sodium bicarbonate consists of saturating a solution of ammonical brine with carbon dioxide (CO_2). As

(*Continued on page* 427)

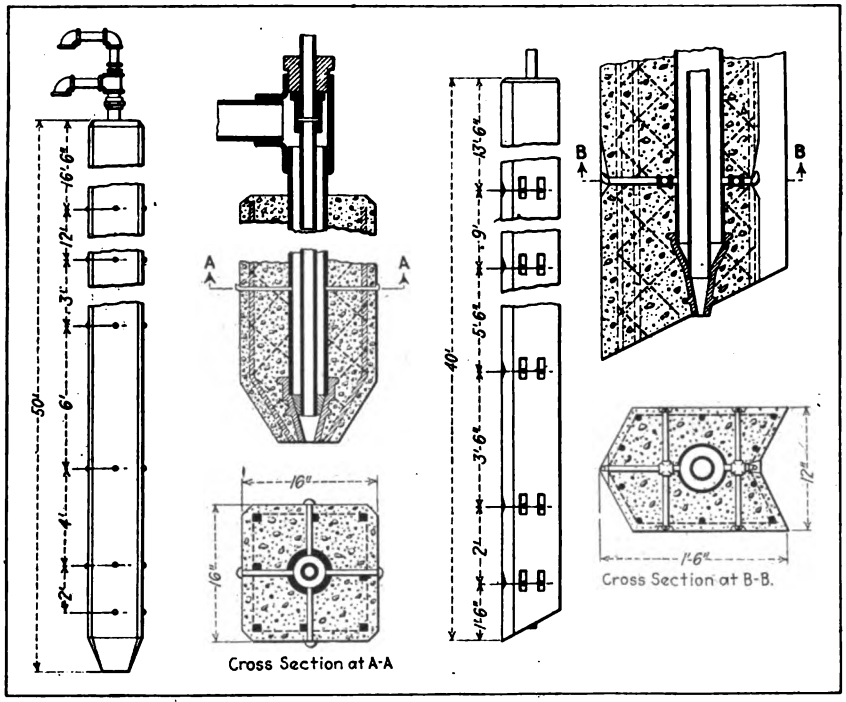
Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

The Bignoll-Jones Concrete Pile

The pile, designated from the names of the originators, is made of reinforced concrete. The reinforcement is shown in dotted lines in the cut. The reinforcing can be distributed as desired; the feature of the structure to which attention is to be directed is the jetting arrangements for sinking it. At the partly pointed end of the pile is a funnel-shaped shoe, with a 1 1/16 inch nozzle. At its upper end the opening of the nozzle expands so as to be large enough to receive a 5-inch pipe. This pipe is fixed in the axis of the pile, and seats itself practically water-tight in the nozzle. Concentric with it there is a smaller pipe, 2 inches in diameter, which also seats itself water-tight in the nozzle. Thus the larger pipe is cut off from connection with the bottom opening of the nozzle.



The Bignoll-Jones Concrete Pile in Pillars for supports and sheet piling for caisson work

From the larger pipe small pipes are carried horizontally out to the surface of the pile; they are fitted with upwardly directed openings. Each pipe has its own independent water connection. The smaller pipe passes through a water-tight packing at the top of the 5-inch pipe.

To sink the pile water at a pressure of 150 lbs. to the square inch is forced into the larger pipe whence it escapes through the lateral jets, which may be from 3/8 to 3/4 inch in diameter. Simultaneously a second stream of water at much higher pressure is forced into the central pipe; the pressure may be from 200 to 300 lbs. to the square inch. The pile sinks very rapidly, one case is cited where it sank at a rate just exceeding one foot per minute. The lateral streams of water are said to remove the spoil and to lubricate the passage through the soil.

The sheet piling is quite interesting. It is built on the same lines, is reinforced, and its cross-section is such that the piles interlock, somewhat like tongued and grooved planks. It will be noticed that in the sheet-piling the lateral jets are set in recesses so as to provide a smooth exterior surface, or better, one free from projections. In the elevation of the piling, the location of the lateral jets can be seen. The spacing is closer near the bottom, where there is the most work to be done.

This system of piling, sheet and plain piling has been extensively used on the Chicago, Burlington and Quincy R. R., under the direction of E. Bignoll, the superintendent of the road. It is in use by the dock department of this city also.

When the pile has sunk to the required depth, and this it does without any blow, as it is pure jet-sinking, the smaller pipe is removed. If thought desirable the larger pipe is filled with concrete. As it is held by the concrete it is quite impossible to successfully remove it. It may be taken as a contribution to the reinforcing. The fact that the lateral jets are turned upwards is an important feature as it makes them many times more efficient than if they were directed horizontally outward. The cuts show the various sections and elevations of the two kinds of piles described.

The heating phenomena of large steel ingots has been recently investigated. A 24-inch ingot it was determined may be at a temperature of 2370° at the surface and in the interior 2287°. After fifteen minutes' cooling the surface temperature was 2125° and the interior at the center 2280°. All temperatures were Fahrenheit. It shows how steel is strained in the heating and cooling phases. Chrome steel was noted as being particularly tender.

The combustion, spontaneous probably, of coal in bunkers, has given much trouble in the past. In Dortmund, Germany, to prevent it coal is stored in steel bunkers, which are kept filled with carbonic acid gas. The bottom doors and any openings below the top are closed gas- and air-tight. The upper openings do not need such careful sealing, on account of the high specific gravity of the gas. A certain amount of gas is lost when coal is withdrawn, but it is not expensive and is easily replaced. The particular bunkers are of 2,500 tons capacity.

A short note on the Pointolite lamp, an English product of the Ediswan Company has been published. The lamp was originally exhibited some years ago. It is a bulb lamp, with tungsten terminals within the bulb, between which an arc is maintained. A sort of deflector at the top and within the bulb acts to prevent blackening of the interior of the bulb. A lamp was shown at the November 25, 1919, seance of the British Illuminating Engineering Society of 4,000 candle-power. The efficiency is very high, 0.42 watts to the candle. Its life is short, only 250 hours, but it is hoped to increase this. The lamp has been made with a quartz bulb to give ultra-violet light.

Steam tenders are a well known feature of present day engineering practise. The Southern Railroad has utilized old engines for the purpose. The boilers are taken off so as to leave only the subframe or chassis, with the engine and connections. The steaming capacity of the regular engine is increased by the use of fire-brick arches and feed-water heater so that it can generate steam for its own engine and for that on the tender frame. The cylinders on the tender are bushed or lined so as to reduce their diameter by an inch. Steam tenders have been used on the compound Mallet engines on the Erie road and also in England.

The utilization of kelp, a kind of seaweed, for the production of potassium products and also for iodine and ammonia is being carried on on the coast of California. The kelp is cut about four feet under the surface of the sea, is retorted, incinerated and the ash, which is properly kelp, although the name is applied to the seaweed itself, is lixiviated and treated so as to give its products. The kelp industry in Europe is of very old origin and is one of the classic operations of industrial chemistry.

The discovery of pitchblende is reported from the Nipissing region in Canada. This is the second report of the finding of a radium ore in Canada, since the Ontario government offered a reward of $25,000 for the discovery of a source of radium in the Ontario province. It has recently been calculated that radium contains over two million times the energy in an equal weight of tri-nitro-toluol.

It has been estimated that an average American family spends $24 per annum on light. This is about the same that a similar family would spend a hundred years ago, but the family of to-day gets twenty times as much light for the same money.

M. Georges Charpy in a paper presented to the French Academy of Science developed the theory that the cause of the fracture of rails on railways was the production of

Digitized by Google

minute surface cracks; these as they increased brought about the destruction of the rails. To overcome this he proposed to surface anneal the rails in situ. A welding acetylene flame is to be moved along the rail as it lies on the sleepers, and its rate of travel is to be such as to give just the requisite amount of heat to soften the surface and deprive it of its tendency to form these minute cracks. He thinks it possible that the life of rails might be doubled by this treatment.

In France a vast project has been outlined to utilize the water power of the Rhone, the Rhine and of the Pyrenees. Water from glaciers and snow-clad mountains, forming waterfalls and harnessed by engineers to servile power production has long been termed "white coal", and now that its black sister is failing, the government proposes to establish a great number of power stations and to distribute the power of waterfalls by electric lines to the smallest towns and even to farm-houses. Private enterprise in this direction is to be encouraged by subsidies, and anyone owning a water power site is to be required to utilize it. At the same time the use of heavy oil for fuel is being fostered by the French government.

To remove titanium compounds from the hearths of blast furnaces the injection of powdered iron oxide has been successfully tried. It is blown in through the tuyeres; it produces no chilling effect but on the contrary as it oxidizes the titanium compounds tend to increase the heat.

A method of obtaining day-light effects from incandescent lights has been introduced in which the lighting is done entirely by reflection from a surface covered with a mixture of colors in checker-board pattern. The lower part of the bulb is screened so that there is no direct light received from it. The modern high efficiency incandescent electric lamps enable reflection to be used advantageously; a few years ago it was quite out of the question to get economical results, or even satisfactory ones, by indirect lighting.

By the use of a thermopile in the focus of a fourteen-inch parabolic reflector, whose current was detected by a D'Arsonval galvanometer, it was found that the heat from a man at the distance of 600 feet could be detected. It was designed for use in war to detect the approach of the enemy in night operations. It is also suggested as being applicable to short-range signalling.

In the year 1819 the steamship Savannah crossed the Atlantic. This is credited as the first steam passage across the ocean, and a century later, in 1919, the passage was first made by the air route, by aeroplane and by dirigible.

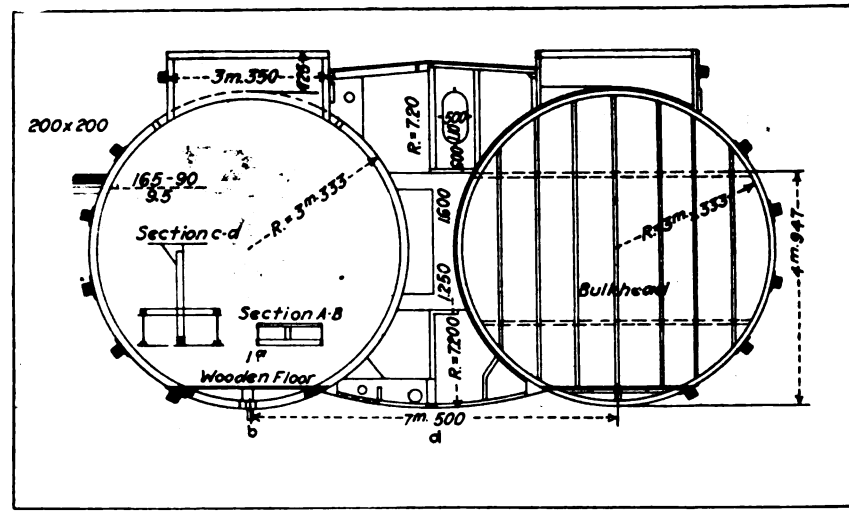
In war the usefulness of heliographic signalling was impaired by its visibility. The same applies to the same method carried out with electric light. Messrs. Bell and Mercadier employing electric light screened the visible rays with a black screen and transmitted the messages with the invisible rays, which were received by a thermo-electric battery. Messages could be transmitted over twelve miles.

Considerable attention is now being given to the production of silk from spiders. The Paraguay Indians, it is said, made tissues from the spider's thread, and similar accounts are given of China and Africa. At the close of the nineteenth century an English investigator, Rolt, drew the thread or filament directly from the spider, winding it directly upon a reel. In twelve hours he got between three and four miles of thread from 22 spiders. The spider of Madagascar, the Halabe, is the only really available arachnid known at present. It is a huge creature, and active work is being done on the island at Tamarive, where it is very numerous, in the production of silk from the living spiders. An instance is cited of the reeling off from 10 living spiders of some 400 yards of thread at one operation. Twisted and doubled it gave a 24-fibre thread. In practise the spiders are subjected to the operation once in ten days, and they survive four or five operations. They need the tropical climate; there is no chance of naturalizing them in France.

The Laparmentier Ship

We illustrate a new type of ship, of French invention, due to the Laparmentier brothers. The ship is almost a twin-hull ship, but the hulls are so interconnected and built together that the result is a single hull. The original inspiration was due undoubtedly in great part to the submarine menace—the Laparmentier ship is supposed to be almost non-sinkable by a single torpedo.

The construction is perfectly clear from the cut. There are two parallel cylinders, which constitute the freight carrying part. These are connected by a curved bottom, extending from cylinder to cylinder, and by a corresponding deck. At the point of nearest approach the cylinders are several feet apart, the distance depending on the size of the ship. The central portion, between the two hulls, is used for water ballast. According to weather and load conditions the ship is ballasted, or the space between the hulls is left quite empty. The water-ballast space is fitted with bulkheads to restrain the motion of the water-ballast. At the same time every bulkhead may be taken as an element of additional safety, in the case of the central compartment, in case of striking a mine or even a rock.



The Laparmentier twin hull steel ship construction

The cylindrical portions are the freight-carrying divisions. These also it was proposed to bulkhead, with complete divisions, without doors. If close enough a torpedo would do much damage, but there would always be an excellent chance of the ship surviving. A single torpedo could hardly damage both cylinders, especially as they are separated by a considerable space, the ballast compartment.

Bow and stern are worked to shape, as in the case of any ship; our section only shows the cross-section as it is amidships. The main feature of the larger 7300-ton type are:—Length overall, 393 ft. 8 in.; greatest beam, 55 ft. 9 in.; depth to deck in center, 28 ft.; draught in salt water, 19 ft. 6 in.; carrying capacity at this draught, including coal, oil, and provisions, 7300 tons; volume of holds, approximately 316,000 cubic feet. With 2500 horsepower a speed of 9 knots is obtained on 19 ft. 6 in. draught and 11 knots with a reduced cargo of only 2400 tons.

It is claimed that there is a saving of 30 per cent. of steel in these vessels, that the time of construction is much less than for the usual type of ocean carrier, and that the cost is much less. Owing to their light draught, reduced by pumping out any water from the central compartment, the ships can ascend rivers. It is calculated that the 7300-ton ship could go up the Seine as far as Rouen, and the 1200-ton ship could go up the Rhine to Strassburg.

Quite a strong point is made of the capacity of the ballast compartment between the two cylinders. In a sea-way heavy ballasting may be imperative, while the entering a harbor will be facilitated by reduction of draught. In the case of some harbors the harbor or pilotage dues are based on depth, so that in many cases there is an economy to be effected by reduction of depth of water required by the ship.

A ship built on this system is approaching completion at New Orleans. The cylinders are 20 feet in diameter, and as it is an oil-burning ship, the fuel oil is to be carried in the space between the hulls. There are eight transverse bulkheads, dividing cylinders and intervening compartment. The ship is 328 ft. 4 in. overall, 46 ft. 5 in. wide, and is to draw 16 ft. 2 in. It has a 700 h.p. triple expansion engine, with boilers in the cylindrical hulls.

In France there are four works making radium. Basing the production on the weight of the metal in the salts manufactured, they are credited with the production of 18 grams, about 275 grains, per annum. On the same basis the price just before the war was about $50,000 per grain. It is now about $60,000. One works making mesothorium, produces a little over 30 grains in a year. A radio-active gas is also produced and caught from springs. The United States is France's most serious rival; from the mineral, Carnotite, uranium vanadate, over 400 grains are produced annually. France is hoping to get radium ores from her colonies, especially from Madagascar. In 1918 Portugal produced 75 grains. England and Italy are all producers.

The Germans during the war planted quantities of barley in the vicinity of Verdun. On investigation it proved that the grain was of such superior quality that the French authorities proposed to keep the crop, or a part of it, for seed.

Recent investigations have shown that there are one million of acres of coal lands in British Columbia. They are situated in the southwest region.

Digitized by Google



RADIO
TELEPHONE AND TELEGRAPH APPARATUS



Construction of a Portable Receiver, B-C Wavelength Range

This 200- to 2,000-meter Portable Set Is Also Well Adapted to Stationary Use

By M. B. Sleeper

A PRACTICAL portable receiving set for field work or use in the country is not one that fits in the hip pocket, nor one which requires a small cart to trundle it along. In the first place, the electrical circuits must be designed; then they must be worked out in instruments which will withstand any one set of conditions. Signal Corps apparatus fell down alarmingly in the field because it was intended to do a little of everything and actually accomplished not much of anything.

In other words, the first thing to do as a preliminary to building a portable set, or any set, for that matter, is to decide exactly how few things it can do, yet meet the essential requirements. Ideas in this respect will vary widely. However, an average has been struck in the set described in this article.

Dependability is an important factor in any portable equipment, since in the field, laboratory facilities are lacking. Therefore, an audion detector was chosen for the foregoing reason and for its sensitivity.

Tuning circuits were the next consideration. Loose couplers meant extra coils, moving parts, additional space, and more difficult tuning than with a directly coupled circuit. These factors were responsible for the decision to use the latter. Moreover, sharp tuning was not of great importance.

The necessity for highest efficiency under the limitations called for high frequency cable on the inductance, with a banked winding to conserve space. To get the sharpest tuning, it was decided to use a variable condenser with a small number of taps on the coil. Experimenters who have used cable realize the difficulties of cleaning the separate wires to make soldered connections.

Before anything could be done on the coil or condenser, it was necessary to determine the size antenna to be used and its approximate capacity. This

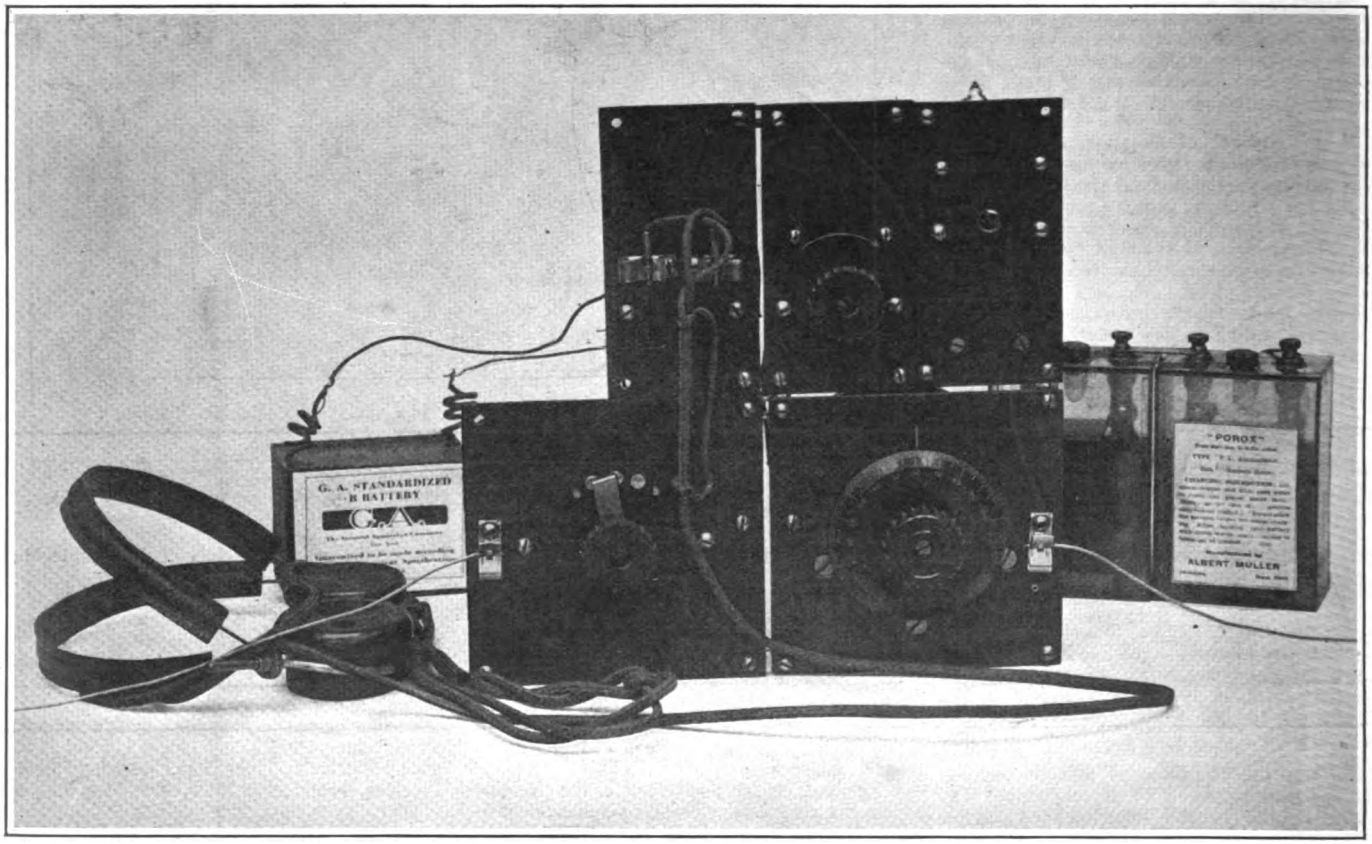


Fig. 1. The complete receiver, ready for use at the laboratory. For portable work, it is fitted into a carrying case

use; these instruments must be grouped properly in a small space; and, of course, the arrangement must provide an easy method of control.

Requirements of Electric Design

The Signal Corps of our Army used portable type apparatus almost exclusively during the war. One lesson that they must have learned is that one portable set cannot be designed for too broad a range of conditions if it is to operate at maximum efficiency under

Digitized by Google



Fig. 3. Using the jig for laying out a panel

factor varies according to the situation in the field. For general work it seemed best to have a 75 ft. single wire 20 ft. high, with a 75 ft. length of annunciator wire laid on the ground under the antenna wire for the earth connection. This is better than metal rods driven into the ground, as the use of the latter means that a mallet must be included in the equipment, while the annunciator wire can be rolled off on a small spool.

The capacity of such an antenna was 0.0001 mfd. circuits.

While thinking of these points it was necessary to keep in mind the wavelength range. A B-C range, 200-600, 600-2,000 meters, covered experimental and the most important commercial stations.

Here, then, was the first data on which the electrical circuits were designed.

Mechanical Design

Weight and space had to be kept down to make the set light enough to be carried comfortably. The instruments outlined already were of such design and number that their weight was small. As a matter of fact, the weights were as follows:

Receiving instruments..	3.25 lbs.
Carrying case.....	1.50
Telephone receivers....	0.75
Storage batteries.....	4.00
B battery.....	1.00
Antenna and ground wires	2.25
Total weight.....	12.50 lbs.

To carry the instruments it was decided to have two 5 x 5 in. panels, and three 5 x 2½ in. panels, all ⅛ in. thick. It can be seen from the photographs that they were used in this way:

5 x 5 in. Panels—
- 1 inductance coil
- 1 variable condenser

5 x 2½ in. Panels—
- 1 audion and grid condenser
- 1 rheostat
- 1 telephone and B battery connection

This arrangement left an opening into which a box was built on the side of the carrying case, in which a screwdriver, pair of pliers, and short lengths of wire were kept. The case is not shown here, as brackets were fitted to the panels to support them vertically. The set, however, can be used as well in a horizontal position.

Since there were no amplifying circuits, the arrangement of the separate panels were not of great importance.

Inductance Panel

To minimize space and weight, it was decided to have a 0.0005 mfd. condenser in shunt with the tuning inductance. The G.A. Standardized type was chosen because the minimum capacity was practically zero, and the maximum 0.0006 mfd. (See Everyday Engineering, February, 1920, for calibration curve.)

This condenser, in shunt with the antenna of 0.0001 mfd., give a capacity range from 0.0001 to 0.0007 mfd. Then the inductance steps, to cover 200 to 2,000 meters, were:

Capacity 0.0001 to 0.0007 mfd.
90,000 cms.—179 to 473 meters
400,000 cms.—377 to 997 meters
1,800,000 cms.—800 to 2,116 meters

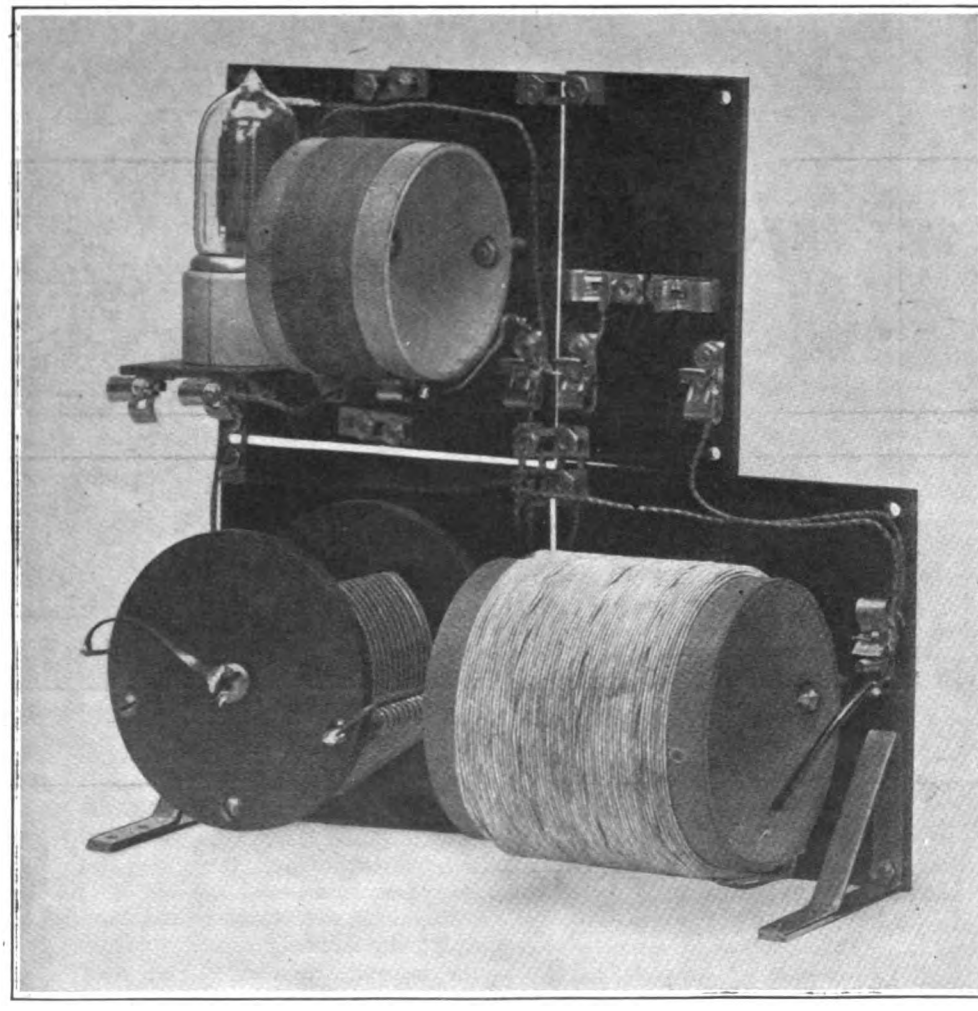


Fig. 2. Showing some of the constructional details of the set, all wired except for the batteries. Note the slotted links which allow an adjustment of the spaces between the panels.

The flexible connection to the moving condenser plates permits a variation of the tension of the bearing screw, by means of which the plates are kept from turning, even tho they are not counterbalanced.

The simplicity of the circuits can be judged by the small amount of wiring required to connect the instruments.

When this photograph was taken, supporting brackets had been fitted to the panels so that the set could be used for work in the station. These are removed and the set fitted into a carrying case when it is taken out for experiments in the field.

Digitized by Google

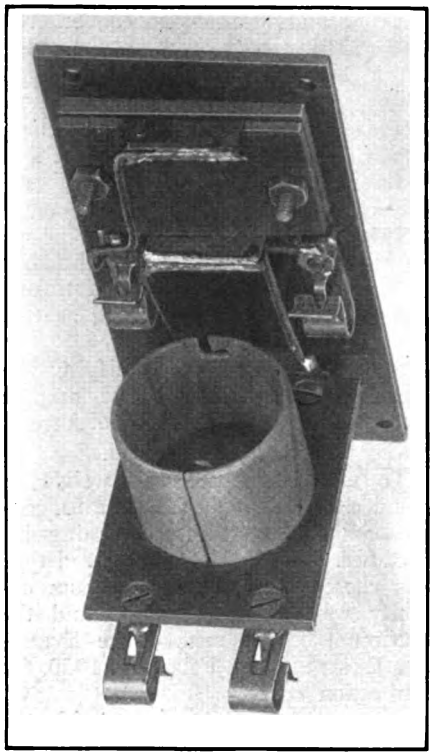


Fig. 6. The mounted socket and grid condenser

A little figuring showed that with a three-bank winding of 3 x 16 No. 38 D.S.C. high frequency cable, 18 turns per inch, on a tube 3½ ins. in diameter, the tapping points were:

90,000 cms., 22 turns
400,000 cms., 57 turns
1,800,000 cms., 157 turns

The length from the start of the winding to the taps were:

90,000 cms., 0.40 in.
400,000 cms., 1.05 in.
1,800,000 cms., 2.90 ins.

When the coil was mounted, the zero end was put at the left, looking at the front of the panel, so that, to increase the inductance, the switch was turned clockwise.

When the coil was wound, the panel was laid out and all holes drilled before anything was assembled. Fig. 3 shows a very useful fixture made to insure the accurate location of the holes at the corners. A sheet of No. 30 sheet brass was carefully marked with a 5 in. square, and punch marks made ¼ in. in from the sides at the corners. When the panels were laid out it was only necessary to clamp the brass sheet on a panel and punch the centers. This was important, for, otherwise, the panels would not have fitted together properly.

The coil mounting was very simple. Two lengths of brass tubing 3/16 in. inside diameter and ¾ in. long were cut up and placed on 8-32 machine screws which go from the front of the panel to the coil. Washers were put on the screws inside and outside the tube so that the brass tubing and the nuts would not cut in.

Other details can be seen from the illustrations.

Condenser Panel

Fig. 4 shows the condenser mounting. To secure the condenser to the panel, the screws were removed which originally held the upper end plates to the fixed plates, and longer ones substituted, so that they could be put in the front of the panel. Washers were used to separate the rear of the panel and the top of the end plate.

Connections were made to the movable plates by a thin brass strip soldered to the bearing set screw. The other side was soldered to one of the screws holding the fixed plates.

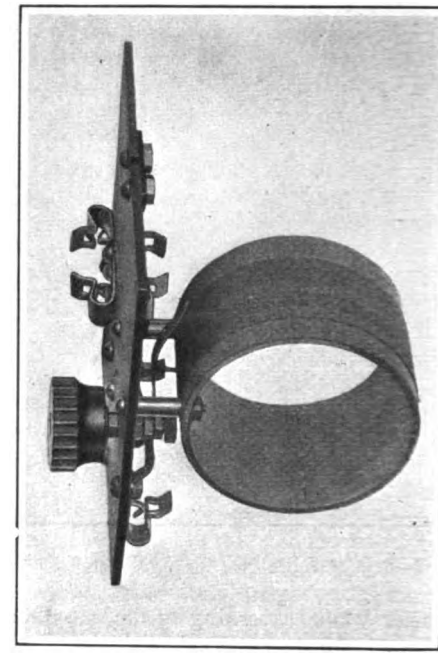


Fig. 5. A side view of the rheostat with the connection panel linked on

An A. H. Corwin dial, slightly modified, was put on the shaft. A hole 3/16 in. in diameter was drilled part way from the back toward the front, ⅝ in. deep. Then the hole was continued with a No. 26 drill, and countersunk at the front of the handle. The condenser is made with a hole in the end of the shaft threaded 6-32. When a 6-32 screw was put in the handle and turned into the shaft, it drew on the handle, clamping it securely. The depth of hole must be determined accurately so that the handle will not go on too far before it is stopped at the smaller hole.

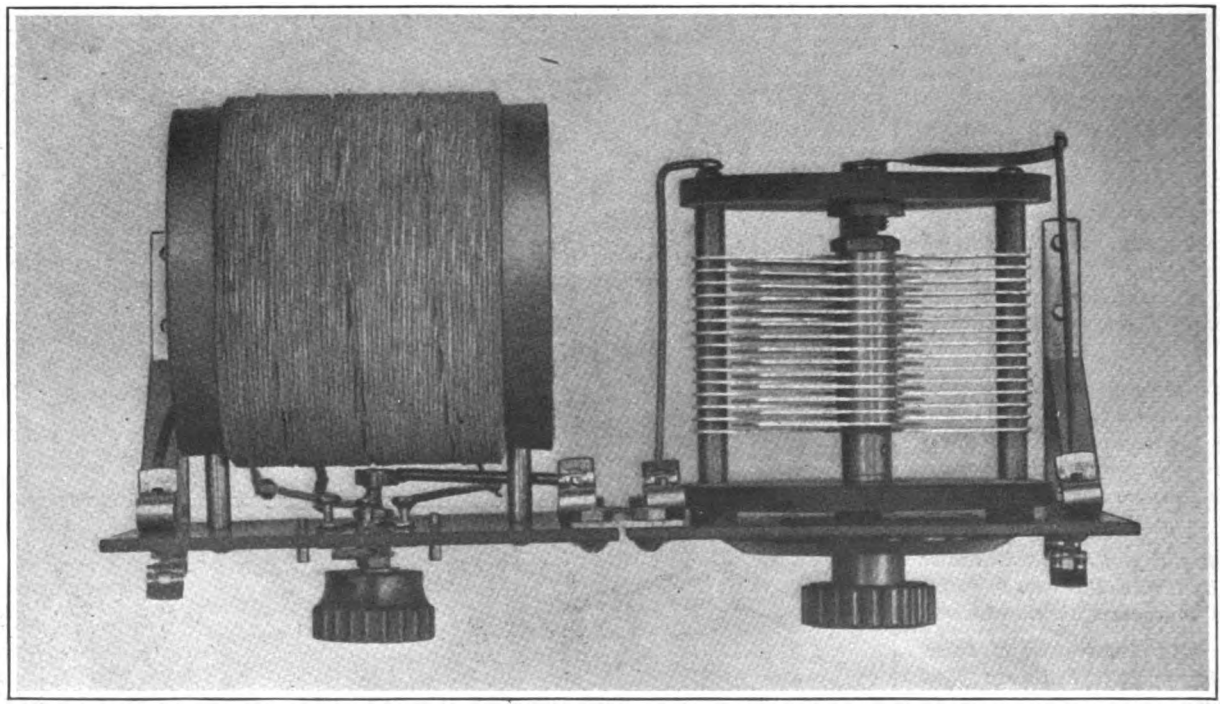


Fig. 4. Looking down on the completed condenser and inductance panels

Digitized by Google

The unusual strength and permanence of the design of this type makes it particularly well suited to portable work.

Rheostat Panel

A departure from the usual rheostat was employed in this set, principally because the porcelain base type was too large for a panel 2½ ins. wide. The resistance element was simply No. 24 s.s.c. copper wire wound on a tube 3 ins. in diameter. The coil was 1¼ ins. long. To make it non-inductive, the direction of winding was reversed every ¼ in.

A spring washer was put on the shaft of the adjusting handle, with a nut soldered to the shaft to keep a tension on the handle. Two more nuts held a brass contact which, at the maximum resistance end of the coil, slipped off the winding and opened the circuit.

Socket Panel

The audion mounting and grid condenser were put on a 5 x 2½ in. panel. Any type of socket could have been used, but the one shown was employed because it had been made up already. Two small angles of ⅜ x 1/16 in. brass strip held it to the panel.

Connections to the filament were made by Fahnestock clips put on the screws which held the tube contacts. The plate contact was wired to another clip, and the grid to one side of the condenser.

The condenser was made up of five sheets of No. 30 brass, 1½ ins. long and 1 in. wide, separated by paraffined paper. Two small bakelite plates secured the condenser in position.

Connection Panel

Fahnestock clips were mounted at the front of the connection panel to take the telephone cord tips. Another pair at the rear were for the B battery.

This section is shown clearly in Figs. 1 and 2.

Batteries

Obviously, it was not practical to use a 5-lb. Navy size B battery with this set. The small Signal Corps type gave results entirely satisfactory and saved 4 lbs. in weight.

Two 2-volt 10-ampere-hour Porox storage cells were decided upon, as their weight, filled, was only 2 lbs. each. The dimensions of the batteries shown in Fig. 1 were 3½ ins. long, 1½ ins. wide, and 4¾ ins. high over the binding posts. These cells operated the audion for 9 hours at a charge, and have stood up so that they promise to last indefinitely.

Connections

The wiring of the audion plate and filament circuits were of the usual sort. With a Marconi or VT1, no adjustment of the plate voltage was needed, operating the tube on a 22.5 volt battery.

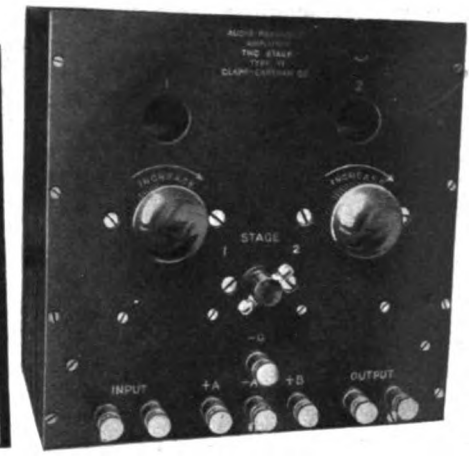
Looking at the rear of the set, the antenna was connected to the right-hand post wired to the coil, the ground to the condenser post at the left; then a wire was run from the left condenser post to the left of the coil, and the right condenser post to the right of the coil. Finally, a wire from the grid was run to the antenna connection, and one from the filament to the ground post.

Any further information regarding this set will be supplied upon request.

Two New Instruments

A TEN-STEP inductance has been brought out particularly for experimenters who are working with new circuits. The advantage of this type of inductance shown in the accompanying illustration is that, while it is easy to couple it to any other coils by placing it in their proximity, it is portable and easy to set up for various purposes. The maximum inductance is 254 millihenrys.





The case is of oak, carrying an engraved bakelite panel. The dead end switch eliminates losses due to the connected unused turns. The panel measures 6 x 6 inches, a size sufficiently small to be readily used in many ways around the laboratory.

When this inductance is used with a variable condenser of 0.001 mfd. maximum capacity, the wave length is from 1,000 to 30,000 meters.

This inductance is the product of the Clapp Eastham Company.

Compactness of design is a feature of the Clapp Eastham two-step amplifier. Particular attention has been given to the location of the various instruments with the view of eliminating feed back effects.

An innovation is the provision for a C Battery by means of which the strength of amplification and the quality of reproduction can be greatly improved. Only 1½ volts are required. This set, however, operates very well without the C Battery.

Two rheostats are provided for the control of the filaments. A telephone type switch is also mounted on the panel to allow a change from one to two steps of amplification.

The oak case carries a panel 7 x 7 inches on which all the parts are mounted.

AN ADJUSTABLE PLATE BATTERY

THE Richter and Byrne Company has brought out an innovation in the plate battery design, in the form of a plug and socket adjustment incorporated in the block battery.

Tubular rivets are soldered to the negative or zinc sides of the individual cells, the tops of which are just flush with the sealing compound. Connection can be made to any cell by means of a plug which fits the rivets. If connections to the points of a battery switch are desired, several plugs can be inserted and soldered to the switch.

An advantage of this construction is that, if one cell gives out, it can be short circuited. In this way, the remaining cells can be used still. If voltages greater than 22.5 are required, one of these batteries can be put in series with a non-adjustable type.



Digitized by Google

The Radio Department

AT a recent dinner where a number of radio men were present, there was a well-known financial expert from the Wall Street district of New York. The subject of conversation turned to radio magazines and the articles they contain. With the ponderous manner of one who attaches great weight to his own conclusions, the financier explained that in a short time the magazines would go out of business. "The reason is simple," he told us. "In a year or so, all the phases of radio will have been so exhaustively treated that there will be nothing more to write about."

You will not take this seriously, but the man spoke with great conviction. When the developments of the last year, the year of 1919, are considered, it is evident that the radio field is moving with an ever increasing speed that indicates no possibility of reduction. Commercial expansion has been held in check by the peculiar attitude of the Navy Department, but the experimental field has broadened beyond the expectations of the manufacturers and dealers in equipment.

ONE of the Government officials in New York recently stated that he estimates the number of radio experimenters owning sending and receiving, or only receiving stations in this country to be over 200,000. In no other pursuit is there one-half of this number actively engaged in experimenting on the development of a single art. To be sure, this figure includes men of all ages and degrees of proficiency, but the possible results from such concerted effort promise an unlimited expansion of the radio field. It seems very doubtful that, with any army of 200,000 men working on the development and extension of wireless, the magazines will run out of material for articles.

The estimate of the number of radio experimenters in the United States offers interesting contemplation to the manufacturers and dealers. Neglecting the expensive stations equipped with transmitting apparatus, and the many elaborate receivers with their amplifiers and other high priced instruments, let us put an average value of thirty dollars on each station. This shows an investment in experimental outfits of $6,000,000.

If 200,000 experimenters is a high figure—the origin was an authorative source—the valuation of thirty dollars is low, so that the investment estimate is not far wrong. The more important consideration, however, is the amount spent yearly.

No one who owns a station is satisfied with it longer than it takes to plan something new. In the course of a year, the most restricted purchaser spends twenty-five dollars. At the lowest figure, this shows $5,000,000 worth of radio business a year.

WHILE we are on this subject, there are two other things which should be brought to the attention of radio experimenters. There was a company, back in the old days, whose slogan was, "An antenna on every housetop." That condition has never been reached, but it is a good ambition. Some of you Relay Leaguers may not enjoy the prospect, but, if necessity is still the mother of invention, it is not too much to expect that, when the time comes, or as it approaches, interference will be overcome.

What are you doing to increase the number of stations? Are you interesting your friends, helping them through the difficulties which are always encountered at the start? A true experimenter is also concerned with the expansion of the art, and not confined entirely to his own work.

Another thing: Radio Experimenters who have come here from the smaller cities say, "We have several excellent stations in our town, but the people who own them are so secretive about their apparatus and circuits. They get something good, and then won't let anyone know about it."

This is obviously the wrong attitude. If we are going to work for the good of the art, we must have a free exchange of ideas. The man who keeps his experiments secret is not doing his share. It sometimes happens, too, that the mystery is only for effect.

AN interesting controversy has been started in one of the contemporary magazines on the question of transmitter spark frequency for 200-meter work. Some operators of extensive experience claim that a set working on a low note can transmit farther than a 500-cycle outfit. The conclusions were based, however, on personal opinion which exact science has so often set aside. To say that high notes are not good for long distance because one has never heard strong, high pitched signals is like claiming that 500 meters is a poor operating wave-length because one has not heard anyone going on that wave.

With a given transformer operating on 60 cycles, the output is varied when adjustments are made to change the spark frequency. Because there are only two or three makes of transformers on which any sort of data can be obtained, exact information on this subject is not available. However, we expect to give next month some quantitative results obtained with the Acme transformer.

At the receiving end there is some indisputable evidence of the superiority of the high note. Measurements have been made of the audibility of signals of different frequencies, with a given input in watts. This test shows a maximum audibility at 800 cycles. In addition, high notes are easier to read through static and low pitched interference. Other opinions on this subject will be welcomed.

INQUIRIES have been coming in from experimenters who want to purchase Audiotrons and Western Electric VT 1's. The impression has been spread about that the only vacuum tube which has been purchased lawfully is the Marconi VT.

It appears impossible to make any statements regarding the vacuum tube situation in general which will hold good for more than a month or two at a time, but here are at least some established facts.

The Marconi Company, in attempting to obtain entire control over the manufacture and sale of tubes, found that, by any means they might employ, they could not convince the courts that a Fleming valve was an amplifier or oscillator. Judge Mayer of New York, well known for his opinions which so sharply conflict with those of radio experimenters and engineers, did go so far as to say:

"Stripped of technical phraseology, what Fleming did was to take the well-known hot and cold electrode incandescent electric lamp of Edison and use it as a detector of radio signals. No one had disclosed, nor even intimated, the possibility of this use of a device then long known in another art."

No one begrudges the Marconi Company their Fleming valve, for no experimenter would swap a good crystal for it. The claims involved in the suit, during the course of which the statement quoted above was made, were numbers 1 and 37, which read:

"1. The combination of a vacuous vessel; two conductors adjacent to, but not touching each other in the vessel; means for heating one of the conductors, and a circuit outside the vessel connecting the two conductors."

"37. At a receiving station in a system of wireless telegraphy employing electrical oscillations of high frequency a detector comprising a vacuous vessel, two conductors adjacent to, but not touching each other in the vessel; means for heating one of the conductors; a circuit outside of the vessel connecting the two conductors; means for detecting a continuous current in this circuit, and means for impressing upon the circuit the received oscillations."

Digitized by Google

Claim 1 describes the Edison device, and would be void if not limited in its use. Therefore, the following disclaimer was filed:

"To the combination of elements set forth in Claims 1 to 6, inclusive, and 10 to 15, inclusive, respectively, of said Letters Patent, except as the same are used in connection with high frequency alternating electric currents or oscillations of the order employed in Hertzian wave transmission, and to the words in the specification: 'Whether of low frequency or' at page 2, lines 32 and 33; 'either' at page 2, line 98; and 'or low frequency alternating currents of,' at page 2, lines 98 and 99."

This patent and disclaimer, No. 803,684, dated November 7, 1905, can be obtained from the Commissioner of Patents, Washington, D. C., for ten cents in cash.

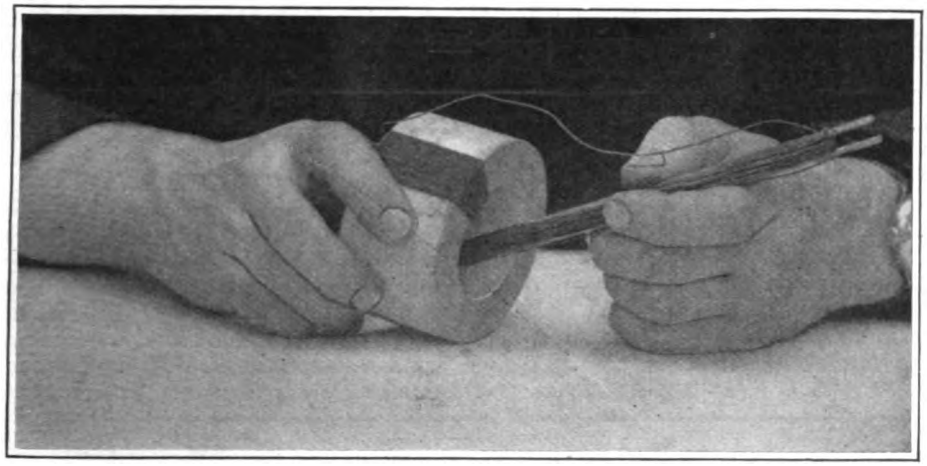
Claim 37 limits the Fleming valve use as a radio detector. It does not cover the amplifier or oscillion, nor can the Fleming valve operate as such.

All this means that three-element tubes, although they may be excellent detectors or oscillators, if licensed for use as audio frequency amplifiers, can be sold and bought when also licensed to use the third element, the grid.

Winding Toroidal Coils

EXPERIMENTERS are generally ready to try anything once. However, they have shown very little interest in the toroidal coil, possibly because of the difficulty in obtaining cores or the trouble of winding.

In the February 1919 issue, formulas for the inductance of a torus were given, although very little was said about this type of coil. In form, the core is in the shape of a doughnut or ring, the cross section of which may be round or rectangular. The wire, as shown in the illustration, is wound around the ring.



Using the needle to wind a torus

The particular advantage of the torus is that there is no external magnetic field. When two ordinary coils are connected in series and placed close together, the effective inductance also includes the mutual inductance, as shown by the familiar formula

$$L = L_1 + L_2 + 2M$$

or

$$L = L_1 + L_2 - 2M$$

To reduce the mutual inductance, M, to zero, the coils must be put at right angles to each other or widely separated. Toroidal coils, however, can be stacked up on top of each other, yet because the mutual inductance is zero, the effect inductance is simply the sum of the individual inductances.

In this way, individual tori can be made for the separate steps of the primary and secondary inductances of a receiver. Then, with dead end switches, there is no loss whatever due to currents set up in unused coils. A separate set of ordinary coupling coils can be made for the coupling between the two circuits.

Inductance of a torus of circular section; that is, of a doughnut shape, is given by the formula

$$L = 12.57\ n^2\ (2.54 - \sqrt{6.4SR^2 - 2.54\ a})$$

where L = inductance in cms.,

n = total number of turns,

R = the average radius of the torus, measured from the center of the ring, to the center of the cross section, in ins.,

and a = radius of the circular cross section, in ins.

A coil of rectangular cross section has an inductance

$$L = 11.7\ n^2 h \log 10 \frac{r_2}{r_1}$$

where L = inductance in cms.,

n = total number of turns,

h = height of cross section, measured at right angles to the plane of the torus, in ins.,

r_1 = inner radius of the torus, in ins.,

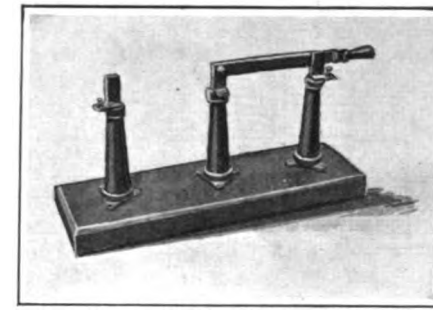
and r_2 = outer radius of the torus, in ins.

Maximum inductance is obtained by making the coil of large cross section and as small inside diameter as possible. More than one layer can be used, but the formulas given above become slightly inaccurate for such a winding.

The method employed in making these coils can be understood from the illustration. First, the wire is put on a needle, simply a wooden strip notched at the ends. This is passed through the center of the torus as the turns are put on. Care must be taken to keep the turns in the directions of radii, putting them close together on the inside, and spacing them slightly on the outside of the core.

A WELL MADE LIGHTNING SWITCH

IN response to a previous article pointing out the necessity of proper insulation for a lightning switch, Mr. W. A. Parks sent in the photograph reproduced here.



Instead of depending upon the inferior insulation of a slate base, he has mounted his switch on heavy pillars. These, in addition to being of electrose, providing a high grade of insulation, greatly reduce the leakage path from the antenna to the ground.

Experimenters should bear in mind that insulation at this point is as important as at the antenna or lead-in.

NOTICE

AN error was made in a formula on page 318 of the February issue, in the article on the measurement of the natural period of an antenna. The equation, at the bottom of the page, which read:

$$K = \frac{t_1 - t_2}{t_1 - t_2}$$

should have been

$$K = \frac{\lambda_2 - \lambda_1}{t_2 - t_1}$$

The effective range for a condenser with a 100 degree scale is usually taken as 5 to 95 degrees, or, with a 180 degree scale, ,10 to 170 degrees.

Digitized by Google

A Radio Frequency Amplifier Without Transformers

High Efficiency and Freedom From Limiting Resonance Effects are Characteristic of this Amplifier Which Also Cuts Down Interference

ALL things considered the tuned impedance coupling is the most satisfactory for experimental radio frequency amplifiers. The principle of this arrangement is illustrated in Fig. 1, and a complete circuit for the apparatus to be described is given in Fig. 2.

It can be seen that a condenser and inductance are connected in parallel across the plate and filament of the amplifier tube, and across the grid and filament of the detector tube. It is well known that, in a series circuit, the impedance is zero when the circuit is tuned to resonance with the alternating current flowing through it. In a parallel circuit, such as that in Fig. 1, the impedance at resonance is infinite.

At the same time, the direct current resistance through the inductance is only .3 or 4 ohms, so that the full voltage of the battery is applied to the plate.

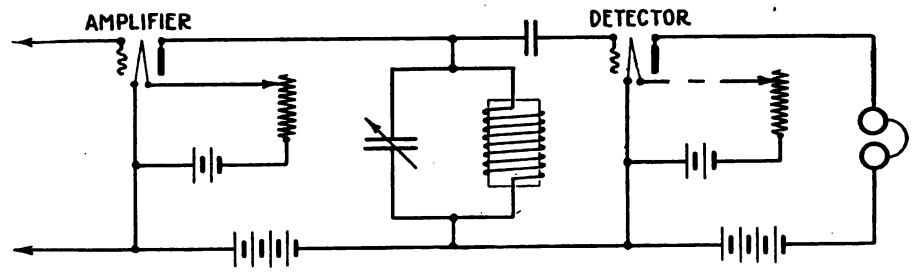


Fig. 1. A simplified circuit of the amplifier

The necessity for tuning the coupling circuit is an advantage in that interference is reduced, but, when several stages of radio frequency amplification are employed, the tuning of so many circuits makes it impractical.

However, this single step radio frequency amplifier has several distinct advantages. In the first place, it is cheaper than a single step audio frequency amplifier, containing only a coil and 0.0005 mfd. variable condenser, and particularly at long wave-lengths is easier to make function at maximum efficiency. If well made, this amplifier should produce nearly as loud signals as the usual audio frequency transformer coupled type.

Using only one step, this set is better than the resistance coupled type, which requires an extra potential battery, or the straight impedance and transformer coupled amplifiers which have such resonance effects that they must be de-

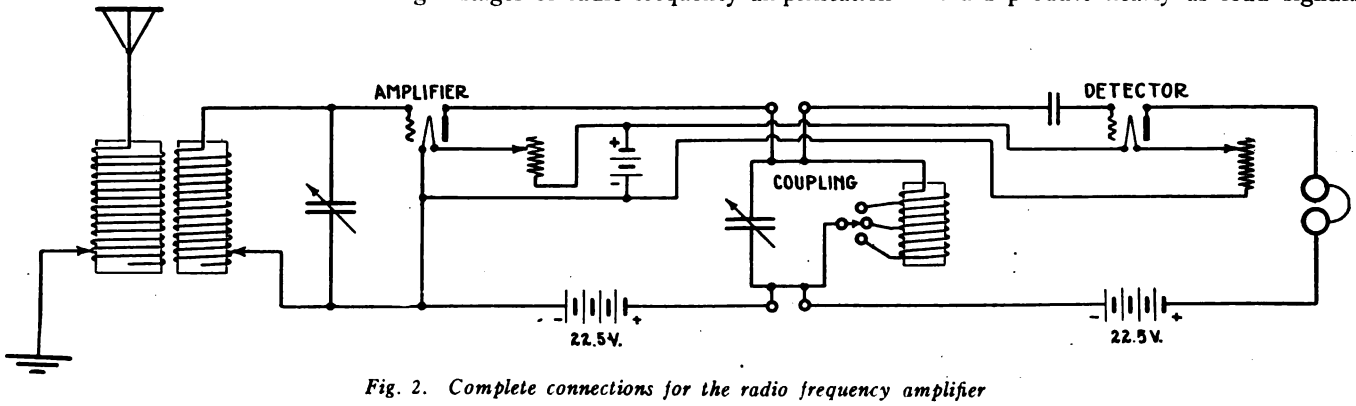


Fig. 2. Complete connections for the radio frequency amplifier

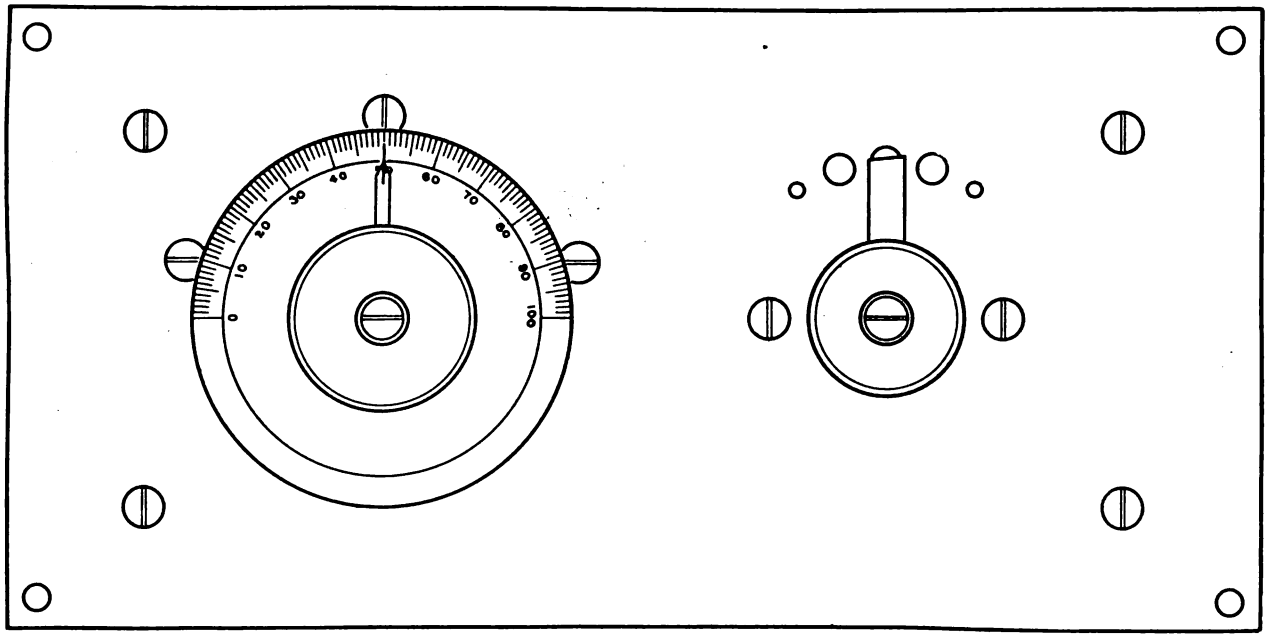


Fig. 3. There is nothing difficult about the construction of this set

Digitized by Google

signed for a limited range of wave-lengths, and cannot be made readily by experimenters.

Construction of the Amplifier

The set described in this article is for the B-C wave-length range, that is, from 200 to 2,000 meters. (See page 116, Everyday Engineering, November, 1919.) Fig. 3 shows the front of panel, with the inductance and condenser controls, and Figs. 4 and 5 the side and rear views.

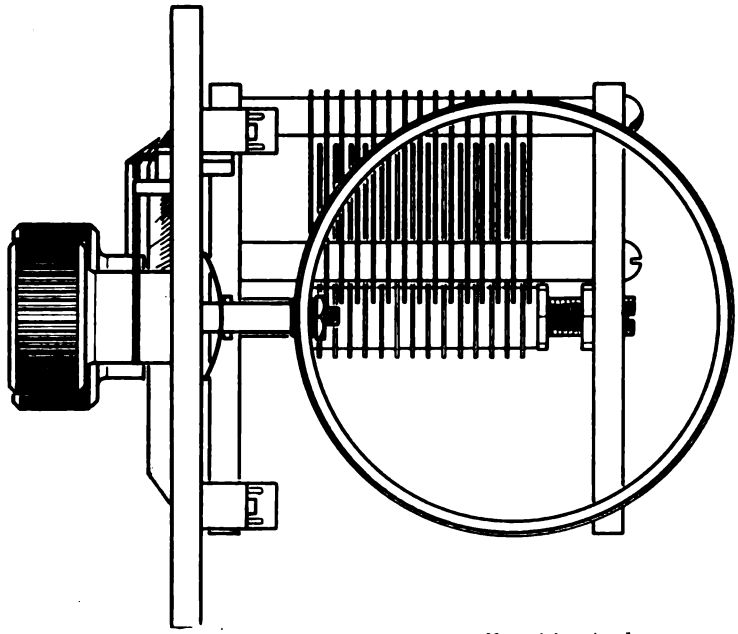


Fig. 4. A side view of the instruments. No wiring is shown

The Condenser

Any condenser of 0.0005 mfd. maximum capacity can be used, although one of the General Apparatus type is indicated here. A Corwin dial, fastened to the panel by means of two small machine screws is well suited as an indicator.

The pointer is simply a 1/8 in. brass rod, slotted at one end and threaded at the other. In the slot, a piece of No. 30 brass sheet is soldered and filed down at an angle corresponding to the bevelled edge of the dial.

For this particular condenser, the knob is made with a hole drilled part way through it of a diameter to take the shaft. Then a smaller hole is made the rest of the way to take a 6-32 screw which is threaded into the end of the shaft. In this way, the handle is held securely in place.

The Inductance

The inductance is clearly shown in the accompanying illustrations. It is made up of a two-bank winding of 10 in. No. 38 high frequency cable, on a tube 3½ in. in diameter, and 2¼ in. long. Looking at the panel from the rear the coil is started ⅜ in. from the right-hand end, and is tapped at the 27th and 58th turns, ending at 135 turns. This makes the coil 1.5 ins. long, with the taps 0.3 and 0.65 in. respectively from the start.

Care must be taken that the turns are wound closely enough to give the required number in the given space, as errors in this respect will change the inductance coil. Forty-five turns per inch were allowed for the 10 in. No. 38 double silk covered cable. Single silk covering is not good, for with such slight protection over the fine enameled wires, they are too liable to be damaged.

The inductance at the three steps, when the coil is carefully wound, is 120,000, 500,000, and 2,000,000 cms. This gives a wave-length range, with a condenser of 0.0001 to 0.0005 mfd. of

Tap 1. 200 to 460 meters
Tap 2. 420 to 940 meters
Tap 3. 840 to 1,885 meters

As a matter of fact, the G. A. Standardized condenser has a maximum capacity of 0.0006 mfd., bringing the maximum wave-length up to 2,000 meters. By adding another section on the coil, the wave-length with 0.0005 mfd. could have been brought up to 2,000 meters, but this shortcoming did not seem to warrant the additional wire required.

Connections

Four Fahnestock clips are provided for connection to the other circuits. As shown in Fig. 2, the condenser and coil are joined in parallel, and wires run from each side to two of the terminals. One set of binding posts go to the plate and filament of the amplifier tube, and the other set to the grid and filament of the detector tube.

Operation

There are two ways to use this amplifier. The first requires at least an

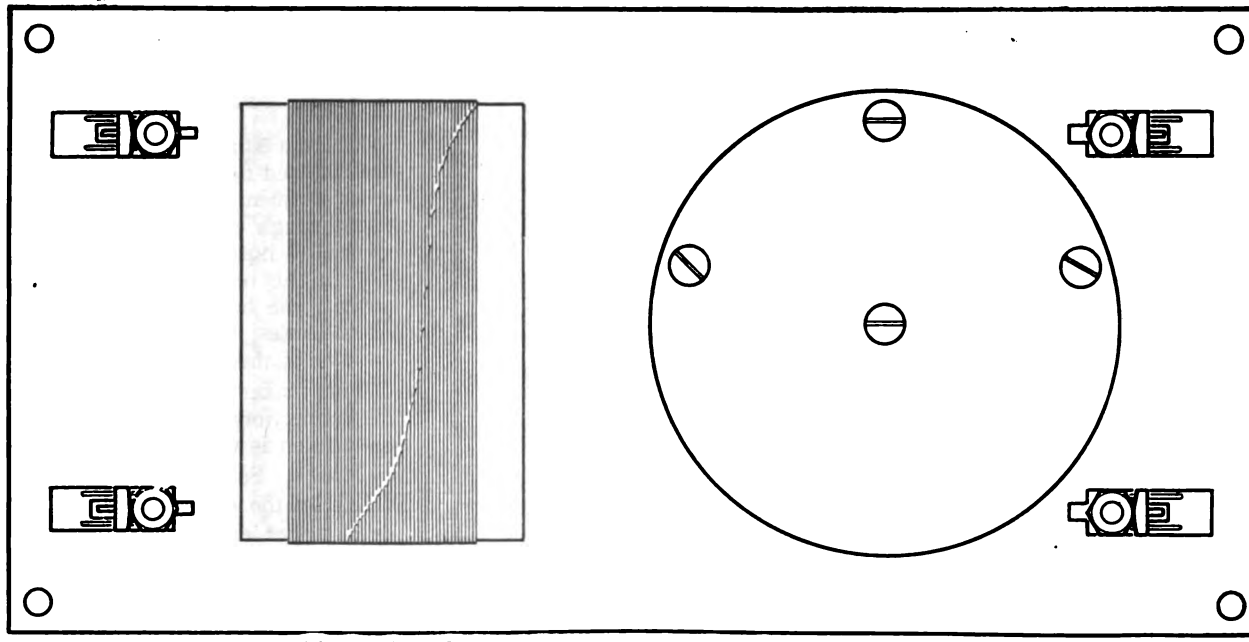


Fig. 5. A condenser and inductance are the only instruments needed

Digitized by Google

approximate idea of the wave-length adjustments of the primary and secondary tuning circuits. Then, at various settings of these circuits, the amplifier can be quickly tuned to the same wave-length.

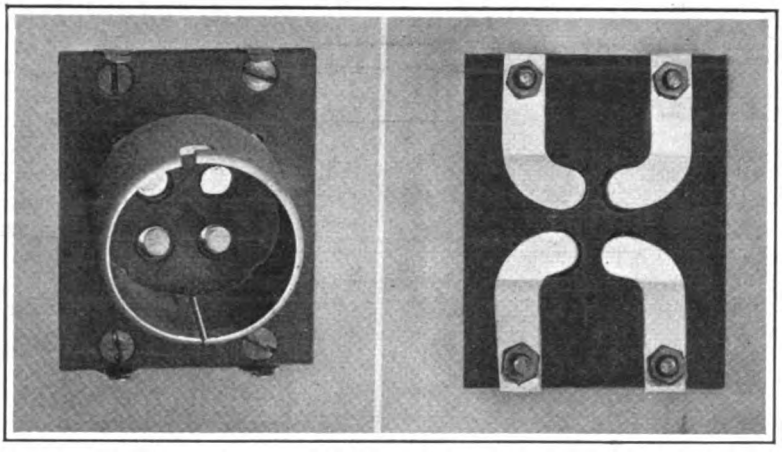
This probably sounds worse than it really is, for, with only three taps on the inductance, the amplifier is easy to tune. If the amplifier is to be used for 200-meter traffic only, the inductance can be reduced to only 27 turns. In that case, only the variable condenser will need adjusting.

The other method, used only when signals with the detector alone can be heard but are too faint to read, is to have a switch by which the secondary circuit can be connected directly to the detector for standby work, or to the amplifier for copying. This simplifies the amplifier tuning, for with the primary and secondary already adjusted, it is an easy matter to tune the amplifier to the other circuits.

This is a most interesting equipment, as well as being equal to, or more efficient than a one-step audio frequency amplifier.

Making an Audion Socket

WHILE it is possible, of course, to buy as good an audion socket as can be made, the pleasure of experimenting is in doing the work yourself. This socket also possesses the advantage that it can be set up on a large panel with any other apparatus, depending upon the way it is to be used. For an amplifier, two or three sockets can be put on one plate as is done in the Western Electric set described in the June, 1919, issue.



This socket was made from a strip of aluminum 1-5/16 in. wide and 1/16 in. thick. A wooden rod, 1⅜ in. in diameter, was turned up, and the aluminum strip bent around it to form the socket tube as shown in the illustration. An aluminum or brass tube 1⅜ in. inside will do just as well, but when this socket was made only the sheet stock was available. The bending process took time and patience, because it had to be perfectly round. After shaping the tube around the wooden rod, it was cut off to the proper length. This made the sheet easier to handle than if it had been cut to length first.

With the tube completed, four legs were cut at one end, ⅛ in. wide and 5/32 in. long. These were to be used as mounting legs in fastening the tube to the base. If a solid tube is used, the legs can be cut in the same way.

The base shown in the illustrations was cut from bakelite ⅛ in. thick, 2½ ins. long, and 2 ins. wide. At the center of the piece a circle was described 5/16 in. in diameter and four holes 3/16 in. in diameter were drilled 90° apart, to allow the contact pins to pass through to the contacts on the underside of the base. Another set of holes ⅛ in. in diameter were drilled in the base to take the legs on the socket tube.

The shape of the contacts can be seen from the illustration of the underside. They were of No. 30 spring brass, all filed to shape at the same time. At the ends they were bent up so that connections could be soldered to them. Capacity and leakage was reduced by this method of shaping the contacts. When this socket was made the mounting legs came directly under the contacts. The result therefor would have been that the tube would have short circuited the contacts when the audion was removed. Accordingly, the contacts were bent so that, in the normal position, they could not touch the ends of the legs.

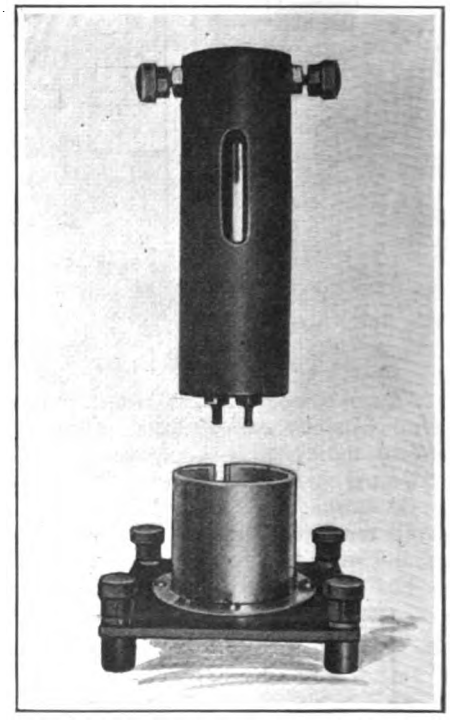
With the contacts ready to be put in place, the tube legs were put through the holes in the base and peined over. Fastening on the contacts completed the socket except for the slot to take the pin on the side of the audion base. This was filed down, between two of the contact holes, until the bottom of the slot was ⅞ in. above the top of the base, then over to the side for ⅛ in.

If the audion is to be mounted vertically on a vertical panel, two brass angle pieces can be made of brass strip 1/16 in. thick and ⅜ in. wide. The angles can be secured to the panel by machine screws, and to the socket by two of the screws which hold the contacts. For mounting to a horizontal panel, holes can be drilled through the base. In this case it is necessary to have the base held up at least ¼ in. because the pins on the audion push the contacts downward.

AUDIOTRON SOCKET ADAPTER

THE wide use of the tubular audion has called for a socket adapter by which they can be used in the regular four-contact sockets. This need is supplied by the Radio Electric Company. The new adapter is shown here.

It is made up of a tube of insulating material, carrying at the bottom a disc in which four contact pins are set. The audion is set in the tube, and the upper



wires, from either filament and the plate, are fastened to the posts at the top. The other filament and the grid wires are put through a hole in the disc, and secured to nuts on the contact pins. A slot in the tube makes it possible to observe the brilliancy of the filament. At the side is a pin which engages in the slot of the socket.

This makes an excellent adapter, for the connections are easy to put on, and the audion is well protected by the upright tube. Sufficient ventilation is provided by the observation slot and the open upper end to take care of any tendency to overheat. Wires from the upper binding posts are soldered to the pins at the bottom, preventing any loss from loose joints.

Digitized by Google

Radio Buzzer Construction

A Development Which Combines Some Features of the Buzzer, Spark Coil and Transformer

BUZZER transmitters have been widely used in the American and foreign armies, demonstrating the practicability of this sort of equipment. There are many different kinds of buzzers, good, bad, and indifferent, with special limitations for the experimenter who builds his own equipment.

The type described in this article might be called a closed core spark coil, for, unlike the ordinary buzzer, it has a primary and secondary winding. It is intended that this buzzer will work on 6 volts, the current drawn varying with the adjustment of the vibrator.

For such an output, the transmitting range is much greater than that obtained from a spark coil, as the efficiency is much higher. The voltage is low, however, so that a very small oscillation transformer can be used, and less provision for insulating is required.

Illustrations of the buzzer and vibrator or condenser are given with this article, with a diagram of connections at Fig. 2. Essentially, the buzzer is made up of an almost closed core, carrying a primary and secondary winding. When the core is magnetized, it tends to draw in the armature of the vibrator to close the opening in the magnetic circuit.

An adjustable paper condenser is connected across the break. Experimenters do not always realize that the condenser exercises a control upon the output of the instrument. By making this feature adjustable the proper capacity can be selected for maximum radiation.

Other instruments to be used with the buzzer should be the same as used on other transmitters.

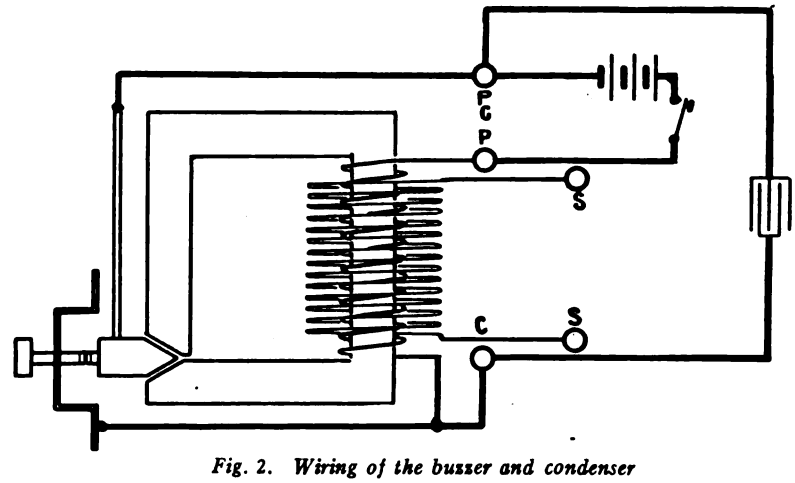


Fig. 2. Wiring of the buzzer and condenser

The Core

The dimensions of the core are 3¼ ins. long, 2¼ ins. wide, and ½ in. square in cross section. This core is made with built up strips in the manner of transformers. Regular transformer laminations are used, about 0.010 to 0.015 in. thick.

When the core has been assembled, it should be clamped between two boards and the armature slot filed out. Three holes are shown for screws to secure the core to the panel. This helps to keep the laminations tight. They should be wrapped with tape also, to make the core solid.

An additional wrapping, 3/32 in. thick, preferably of Empire cloth, should be put around the leg which carries the winding.

Primary and Secondary Coils

Ninety turns of No. 24 S.S.C. wire

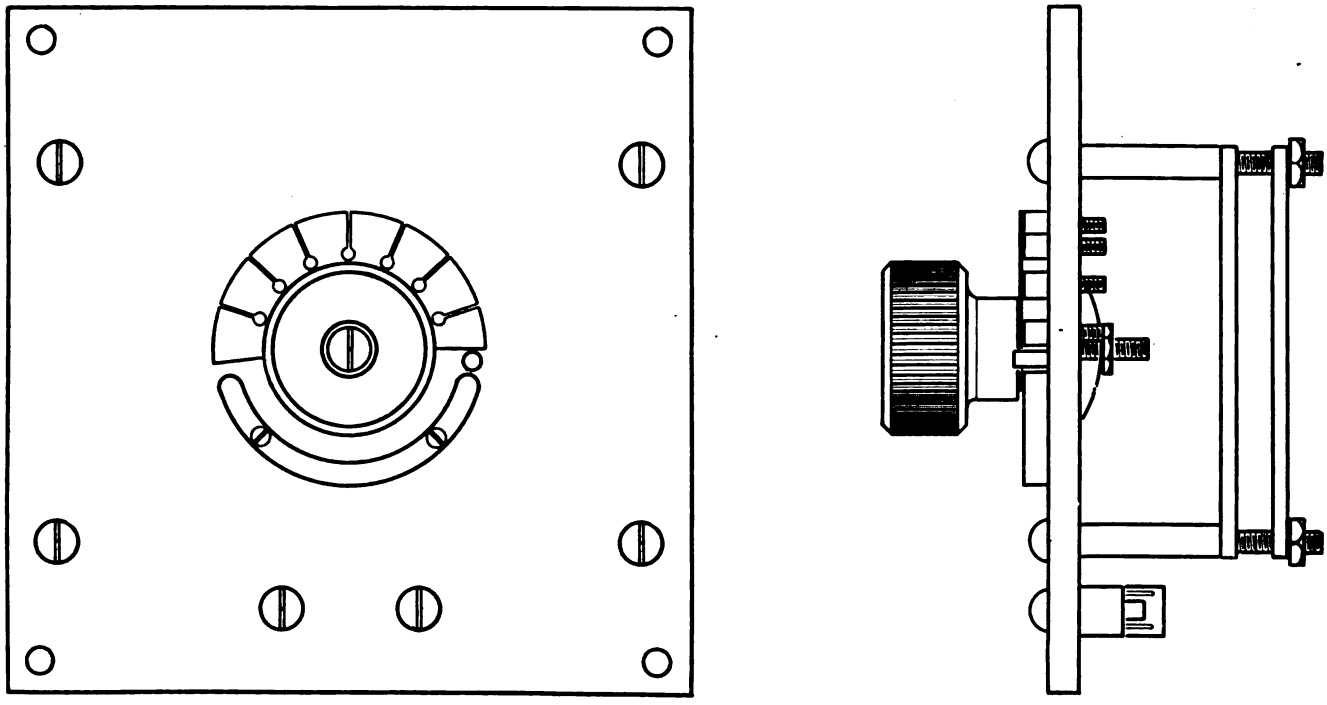
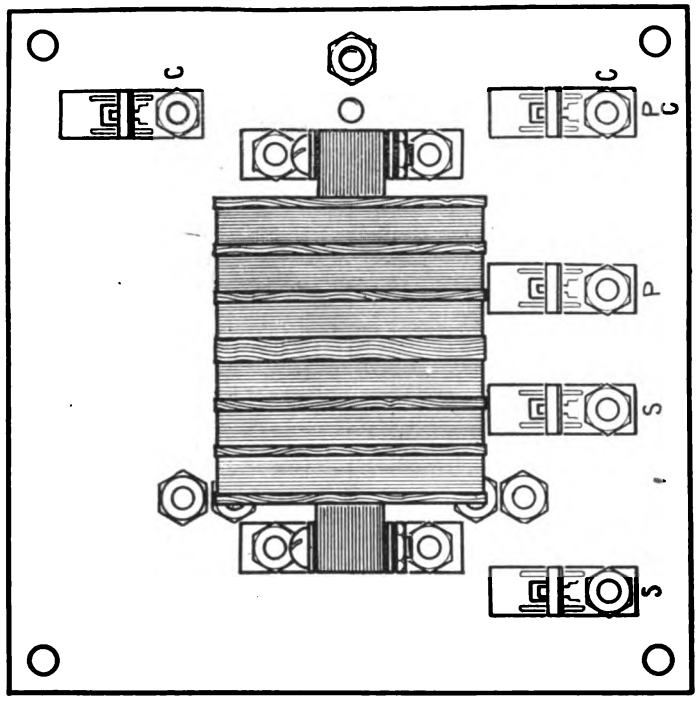
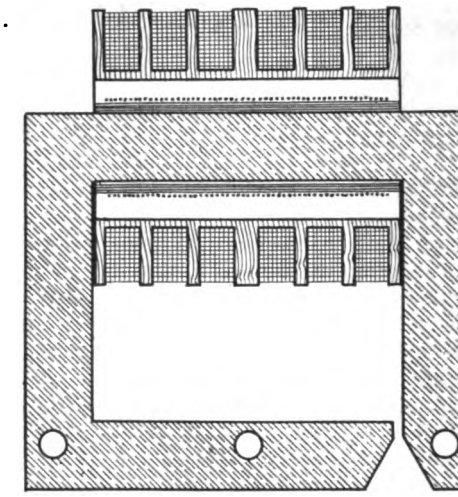


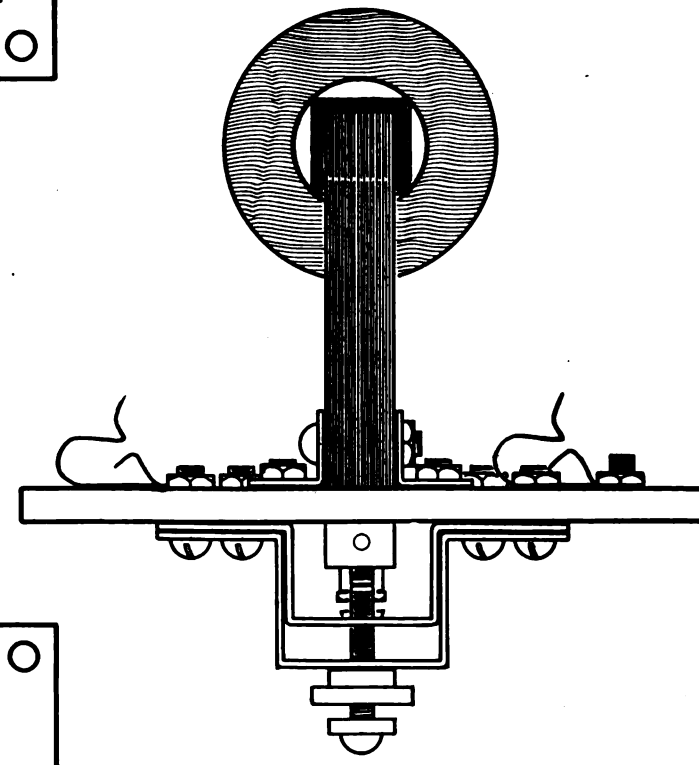
Fig. 3. Details of the adjustable condenser which reduces sparking at the contacts

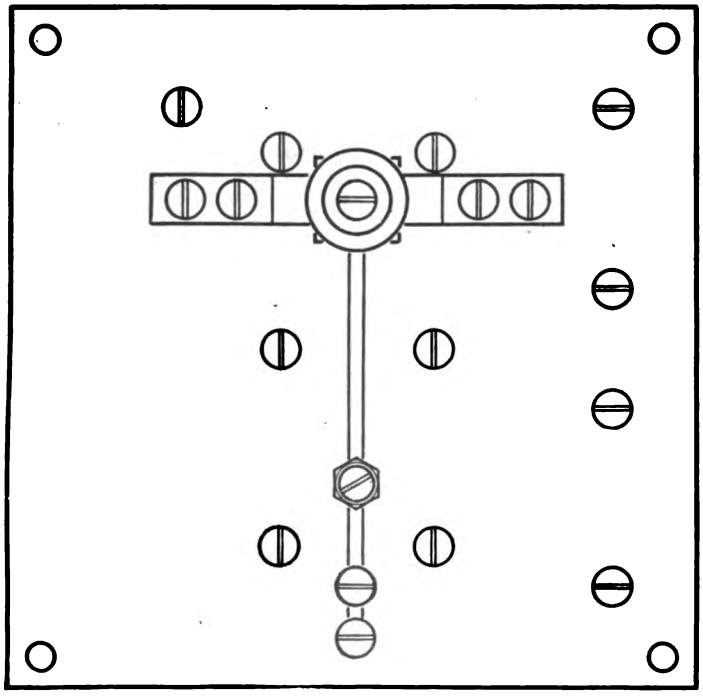
Digitized by Google











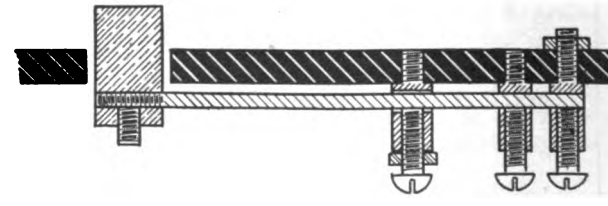


Fig. 1. *Front, rear, side, and sectional views of the transmitting buzzer*

Digitized by Google

are required for the primary coil. The secondary is wound in slots turned in a block of wood 2¼ ins. long and 2 ins. in diameter. Each slot is ¼ in. wide and 7/16 in. deep, allowing about 3,300 turns of No. 36 enameled wire per section.

The hole through the wooden support is 1 in. in diameter. This gives a clearance sufficient to allow it to slip over the primary coil.

When completed, the secondary should be put for one minute in boiling paraffin. If left too long, the wires will become expanded and loose.

The Vibrator

Because flat spring steel is so difficult to obtain, the armature is mounted on a short piece of drill rod, ⅛ in. in diameter. The rod is held by two posts with clamping screws. A third post, drilled out with a 3/16 in. hole, is fitted with a screw and locknut, by means of which the vibration of the rod can be adjusted.

The armature is a piece of annealed steel ⅞ in. long by ½ in. square filed down at the end to form a 60° point. The drill rod is threaded into it and headed over, to keep it tight.

As an added precaution, a screw is put from the top and turned tightly on the rod. Then it is cut off, and a small silver disc, cut from a ten-cent piece, soldered to the top for a contact.

The vibrator screw bridge is made of ⅜ by 1/16 in. brass strip, bent as shown. An 8-32 screw, also carrying a silver contact, completes the vibrator.

Adjustable Condenser

The condenser is made of 30 tinfoil or copperfoil sheets 4 ins. long and 2 ins. wide, separated by paraffined paper. One set of 15 plates are connected together to form one side of the condenser. Taps are run from the other side to the switch to give steps of 6, 8, 10, 12, and 15 plates.

The completed condenser is clamped between two bakelite plates 4½ ins. long, 3 ins. wide, and ⅛ in. thick, supported by four screws, and held from the panel by 1-in. lengths of brass tubing 3/16 in. inside diameter.

An easy way to make the connecting sector is to lay out the shape on a piece of No. 24 gauge brass. When the small holes have been drilled, the sheet should be clamped against a piece of wood, and, working against this wood, the slots can be sawed easily.

The sector on which the switch contacts work can be bent from a length of brass rod 3/16 in. square.

Fig. 2 gives a diagram of connections. Dimensions not given can be determined from the scale given in Fig. 1.

Commercial Stations Released by the Government

BY Presidential Proclamation, commercial stations were returned, on March 1st, 1920, to their former owners, and the regulation of these stations was again put in the sands of the Department of Commerce. In other words, so far as commercial stations are concerned, the situation is the same as when the laws of 1912 were put into effect.

In the opinion of Government officials, however, matters are not the same, for, it is maintained, the Naval stations are not brought by the proclamation under the laws of 1912. If this is so —the point is not admitted by communication interests—the commercial stations are not on the old time basis, for the Naval stations can still handle private messages.

Interest in the circumstances was greatly enhanced by the March meeting of the Institute of Radio Engineers, directly following the effective date of the proclamation, at which Mr. Hogan, in his presidential address, took up the subject of radio legislation.

His paper was on the laws of 1912 as a basis of coming regulation, pointing out the defects and advantages of those laws and the need for new ones in keeping with the advance of the art. These points were also backed up by the majority of answers to a questionnaire sent out to members of the Institute.

Government control of radio was not dwelled upon at length because the opinions of radio engineers are overwhelmingly against it. Only the Navy Department is called upon to justify its attitude in this respect. Experimenters will be interested to know that Mr. Hogan advocated the extension of amateur wavelengths to 250 meters.

Dr. Goldsmith, discussing the paper, pointed out the difficulties under which the Radio Inspectors have been working. An appropriation of $45,000 previously supported the Inspection Offices which are charged not only with the regulation and licensing of stations, but the examination of operators. In 1919, the amount was increased to $65,000, yet it was specified that this increase should not be used to raise the salaries of the men. Unless steps are taken quickly to remedy conditions, the appropriation for the coming year will be only $60,000. Admiral Bullard stated during a discussion of this point, that the Navy has taken in approximately $800,000 for radio messages transmitted.

Before the meeting was called to order, the presence of Admiral Bullard caused much comment, for it was assumed that he would present the Government's side of the subjects brought up in the paper. Nor did he disappoint the members. It seemed, that when Admiral Bullard mounted the platform, that the representatives of commercial interests were to be given an oral thrashing, but it was immediately apparent that the heavy jaw and the positive manner were attributes of a man who could go more than half way to meet the criticism so steadily directed at the Navy Department. It was also significant to find that he did not concur with the views of Secretary Daniels, who has consistently advocated Government monopoly in this field.

At the same time he felt that the Navy had not been accorded fair credit for their accomplishments. Communication had been established with England, Norway, France, Germany, Italy, Russia, China, and Japan. Thousands of words of press news have been sent out that the foreign papers might obtain American news with the American viewpoint. Radio compass stations along the coast have been tremendous aids to shipping and in several instances averted what would have been inevitable disaster if the ships had not been informed of their bearings.

He seemed a little unfair in his criticisms of commercial companies which were not able to keep up the Navy's work when the stations were turned back, although the published propaganda from some directions did promise such improved results upon release of their stations that his stand may have been well taken.

Admiral Bullard did not neglect the interests of the experimenters, and seemed to think that the 250-meter limit may come as a result of furture legislation.

Above all, he was pleased to find that the Institute has taken an interest in radio regulation. He advocated the establishment of a Radio Commission as suggested by Mr. Hogan.

Mr. Simon, among other things, proposed the licensing of receiving stations to establish their location officially as a protection against the erection of transmitters, where a remote control system is used.

It seems, too, that the registration of experimental receiving stations should be required, to provide the Government, in time of need, with information as to the available radio men in the United States.

Copies of Mr. Hogan's paper and the discussion should be obtained by every radio experimenter, as this material, when published, will be found tremendously interesting and important to private individuals as well as the commercial companies.

Digitized by Google

Benzol-Alcohol Fuel Mixtures for Internal Combustion Engines

By Kenneth Alton

IN England, where gasoline sells for fifty cents a gallon in normal times, or one hundred per cent more than the average price in this country, engineers have sought to use benzol, which is said to be adaptable to the present type of motors without change, and in cases where it has been used as much power is obtained as with gasoline. This material is a by-product incidental to the manufacture of illuminating gas and coke, and while it was formerly distilled from coal-tar and obtained only in small quantities, improved methods make it possible to produce about three gallons from every ton of coal changed into coke or gas. The former material was at one time produced by a process which permitted the gas to escape, but at the present time this is retained and condensed to form benzol. The crude product is a foul-smelling liquid which has about the same consistency and color as heavy ale. When subjected to a refining process the dirty liquid is converted to one that is about the same color as water.

Benzol is not so volatile as gasoline, but it is claimed that a motor may be started without difficulty with this fuel supplied to a carburetor of ordinary construction. Owing to the greater number of heat units it contains, it is said it will develop more power than gasoline, and as it will not evaporate so readily it does not become stale or heavy by the vaporization of the lighter constituents. A disadvantage incidental to its use has been that owing to it being richer in carbon than gasoline it would deposit more of this substance on the piston head and interior of the combustion chamber. While this may be true of a poorly refined benzol and when mixture proportions are not correct, it applies equally well when low grades of gasoline are used and when the mixture of gasoline vapor and air supplied the cylinders is too rich.

Considerable experimenting with alcohol has been done by French and German engineers, and there are many points to be considered in its favor when discussing its value as a fuel. Alcohol, instead of being derived from natural mineral deposits, which become more and more depleted as the demands increase, is derived from various plants and vegetables and is the one fuel that can be produced in quantities that could be augmented as the demand for it increased. The vegetable substances which are distilled to make alcohol are reproduced each cycle of seasons, and in tropical countries there is no cessation to the growth of the vegetation. The raw materials from which alcohol may be manufactured are found in all parts of the earth. It is derived from any substance which contains either starch or sugar, and it can profitably be produced from fruits, grains, and vegetables. It may be made from beets, sugar-cane, rice, barley, rye, corn, wheat, or potatoes, and decaying fruit or other refuse, which could not be utilized otherwise, may be subjected to a process of distillation and alcohol derived therefrom.

Alcohol differs materially from gasoline, and as it is less volatile it requires more heat to vaporize it. Alcohol vapor can be compressed to a greater degree than the vapors of gasoline, and as the heat units liberated from a fuel vary with the degree of compression even though alcohol gives out less heat when burned under the same conditions, higher efficiency may be obtained by compressing the alcohol vapor to a higher degree. While this substance has been used for a decade or more abroad, in engines designed especially for its use, it is not been applied with any degree of economy in motors designed for use with gasoline.

A motor constructed for use with alcohol must use a higher degree of compression than a gasoline motor, and a form of carburetor which will heat the mixture before it is taken into the cylinder should be used. An engine designed for gasoline will use twice as much alcohol as it does gasoline to develop the same amount of energy, though in a special motor the same amount of power will be obtained as when equal quantities of gasoline are burned in the conventional engine. One of the disadvantages of alcohol that is shared in common with kerosene is that it is difficult to start an engine when cold, as alcohol is not very volatile unless heated.

The amount of air necessary for complete combustion is roughly estimated at one-third that needed with gasoline. Twice the amount of compression before ignition can be used with alcohol vapor. The range of explosive mixture proportions of alcohol and air is much greater than that possible with gasoline and air. Various authorities have stated that a compression of one hundred and fifty pounds per square inch is possible with alcohol, but it is doubtful if automobile engines will ever be built using such high degrees of compression unless remands for extremely economical operation will result in the development of Diesel engine types which use much higher compression pressure than this because only air is compressed by the main engine piston and there cannot be any danger of preignition as when a gaseous mixture is compressed too much.

Taylor-White Process.—A process has been developed with a view of permitting one to use alcohol in engines of present design with no change except a special form of vaporizer. In this the alcohol vapor is passed through calcium carbide before it enters the cylinder. The water which is present in commercial alcohol and which lowers its efficiency as a fuel is absorbed by the carbide and the resulting chemical action liberates acetylene gas. This is very inflammable and increases the explosive value of the alcohol vapor. When the alcohol-acetylene combination is used, to obtain the same thermal efficiency as with gasoline gas, it is necessary to add water to the alcohol until a solution containing seventeen per cent water and eighty-three per cent alcohol is obtained.

This is no great disadvantage, as water costs nothing to speak of, and the increase in the bulk of the fuel nearly pays for the carbide. It is estimated that one pound of carbide is used per gallon of liquid. As the market price of carbide in lots of one hundred pounds or more is but six to eight cents per pound, the only objection that can be advanced to the process is the increased complication of the vaporizing appliance. The combination of alcohol and acetylene has proved efficient on motors employing compressions as low as sixty pounds to the square inch and running as high as two thousand revolutions per minute, but when used alone the slow burning qualities of alcohol vapor have made it most efficient on slow-speed high-compression motors.

Alcohol used for fuel purposes must be rendered unfit for drinking by mixing substances with it which are not palatable, but which do not interfere with its use as a fuel. When so treated the substance is called denatured alcohol. Among the substances which may be mixed with the ethyl alcohol are wood alcohol, benzine, and benzol, and various distillates of crude petroleum. Chemists contend that it is better to use a hydrocarbon, such as benzol, than the wood alcohol, as a denaturizing sub-

(*Continued on page* 446)

Digitized by Google

COMPLETE ENCLOSURE FOR PASSENGERS THE FEATURE OF NEW AIRPLANES

(*Continued from page 387*)

from the usual design, but which is entirely justifiable where, as compactness, simplicity in rigging and the possibility of using the airship as a free balloon are desired.

The car, also well streamlined, is a mahogany veneer construction, semi-monocoque type, being built up of bulkheads and veneer planking, which insures strength and lightness combined. Single control is provided with a sliding wheel for altitude steering which permits the pilot to control with either right or left hand, or in the center, as he may desire. Directional control is by means of a foot bar. The car is thoroughly equipped with all necessary instruments for navigation.

There has been no radical developments in the basic design of airplanes as the rules establishing design seem to be fairly well-established at the present time. The provisions made for the comfort and protection of the passengers in order to render flying more pleasurable than it is in the unprotected cockpits of the military type machines, show a disposition on the part of aircraft manufacturers to cater to the public and supply aircraft that can be used for passenger carrying aerial routes.

HEAT TREATMENT FOR STEEL

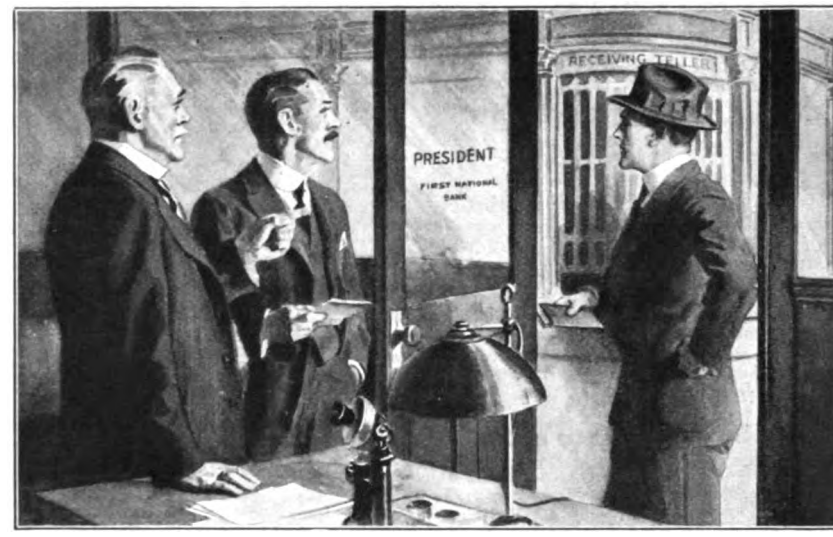
(*Continued from page 369*)

reamer or cutter is to be used in the lathe or drill press there is no more suitable or efficient steel for the purpose than tungsten.

In this connection, it will not be amiss to say that while some steel makers advise the use of water in grinding tools made of high speed steel, and others advise the use of a dry wheel, the writer has, in years of experience, noted that the best results are obtained by using a moderately coarse wheel *dry*. Never, when grinding, dip the tool in water, if it is purple with frictional heat it will not affect the tool at all, provided it is not dipped in water, but as soon as water touches a piece of tungsten steel when hot, checking or cracking will start rendering the tool unreliable. If you do use water, *flood* the wheel and do not permit the tool to get warmer than you can bear on your hand.

In conclusion, always remember that steel of any kind is at its best only when hardened clear through, and weakest when in the soft or annealed state. The drawback reduces strain and brittleness without materially weakening the steel, and is the safety valve of the treating process.

A 220,000-volt transmission line, over 100 miles long, to transmit one and a half million kilowatts of power is in contemplation.



"He Deposits $500 a Month!"

"See that man at the Receiving Teller's window? That's Billy King, Manager for Browning Company. Every month he comes in and deposits $500. I've been watching Billy for a long time—take almost as much interest in him as I do in my own boy.

"Three years ago he started at Browning's at $15 a week. Married, had one child, couldn't save a cent. One day he came in here desperate—wanted to borrow a hundred dollars—wife was sick.

"I said, 'Billy, I'm going to give you something worth more than a loan—some good advice—and if you'll follow it I'll let you have the hundred, too. You don't want to work for $15 a week all your life, do you?' Of course he didn't. 'Well,' I said, 'there's a way to climb out of your job to something better. Take up a course with the International Correspondence Schools in the work you want to advance in, and put in some of your evenings getting special training. The Schools will do wonders for you—I know, we've got several I. C. S. boys here in the bank.'

"That very night Billy wrote to Scranton and a few days later he had started studying at home. Why, in a few months he had doubled his salary! Next thing I knew he was put in charge of his department, and two months ago they made him Manager. And he's making real money. Owns his own home, has quite a little property beside, and he's a regular at that window every month. It just shows what a man can do in a little spare time."

Employers are begging for men with ambition, men who really want to get ahead in the world and are willing to prove it by training themselves in spare time to do some one thing well.

Prove that *you* are that kind of a man! The International Correspondence Schools are ready and anxious to help you prepare for something better if you'll simply give them the chance. More than two million men and women in the last 28 years have taken the I. C. S. route to more money. Over 100,000 others are getting ready in the same way right now.

Is there any reason why *you* should let others climb over you when you have the same chance they have? Surely the least you can do is to find out just what there is in this proposition for *you*. Here is all we ask: Without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6072-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Show Card Writer
Electric Car Running	Outdoor Sign Painter
Heavy Electric Traction	RAILROADER
Electrical Draftsman	ILLUSTRATOR
Electric Machine Designer	DESIGNER
Telegraph Expert	BUSINESS MANAGEMENT
Practical Telephony	Private Secretary
MECHANICAL ENGINEER	BOOKKEEPER
Mechanical Draftsman	Stenographer and Typist
Toolmaker	Cert. Pub. Accountant
Ship Draftsman	Traffic Management
Machine Shop Practice	Commercial Law
Gas Engineer	GOOD ENGLISH
CIVIL ENGINEER	Common School Subjects
Surveying and Mapping	CIVIL SERVICE
MINE FOREM'N OR ENG'R	Railway Mail Clerk
ARCHITECT	STATIONARY ENGINEER
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name_____

Present Occupation_____ 7-20-19

Street and No._____

City_____ State_____

Digitized by Google

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds The Supply

The N. Y. Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Radio Experts. Experts able to impart their practical and technical knowledge to *YOU* in an *easy* to *understand* way. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free*, will make it as easy to learn the Code as it was to learn to talk. *All you will have to do*, is to listen.

BIG SALARIES

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding position as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

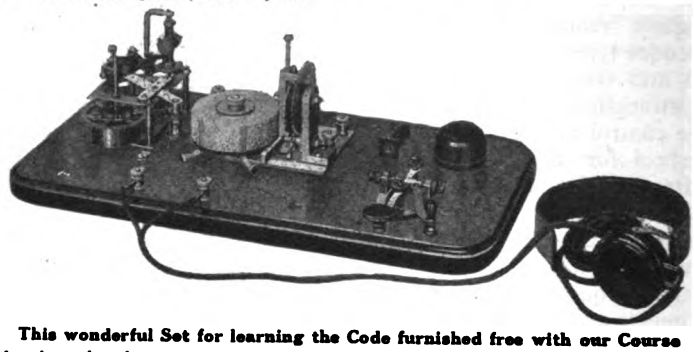
Travel The World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* This set is not loaned but *given* to all students completing the Course.

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph*, place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.



This wonderful Set for learning the Code furnished free with our Course

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to become an Expert Wireless Operator"—it is free. Mail the coupon attached, or postal or letter—*but do it to-day.*

THE N. Y. WIRELESS INSTITUTE
Dept. 21, 258 Broadway, New York City

Send me free of charge, your booklet "How to become an Expert Wireless Operator," containing full particulars of your Course including your *Free Instrument offer.*

Name .....

Address .....

City or Town.....State.....

96-Page Book Catalogue Sent Free

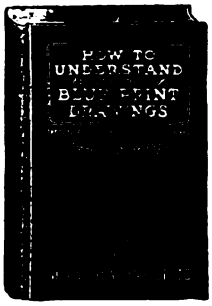
WE have just issued a 96-page Book Catalogue listing about 2,500 of the most recent Scientific and Technical books. This is all the more welcome by reason of the fact that both the publishing and importing of books have been very much upset by the war, and many books can only be supplied with great difficulty. This catalogue will be sent to any address in the world, free on request.

Manuscripts Considered for Publication

The Book Publishing Department of the SCIENTIFIC AMERICAN will be glad to give an examination of any manuscript of Scientific or Technical nature. Submit as much of matter as possible, including illustrative material. There was never a better field for books of this nature than at the present time.

Scientific-American Publishing Company

Woolworth Building **235 Broadway, New York**



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr.,
U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE. YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
169 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 134 Rowland Bldg., Detroit, Michigan



DUCK'S No. 13 264 Pages
Electrical and Wireless Catalog
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

DISCOVER YOUR TALENTS

What are you best fitted for? Why drift from job to job? Why experiment with your future? Let an expert psychologist tell you the right vocation in life for YOU. Personal analysis by Dr. S. S. George, former U. S. Army psychologist, will help you to know your mind and what career you are most suited for in life. Send for Booklet "B." Phone Schuyler 5969

THE VOCATIONAL GUIDANCE INSTITUTE
Room 27, 2255 B'way. (81st St.), New York, N. Y.

High Frequency Cable—(Litz)

10-38, 20-38, 2-16-38, 3-16-38 individual wires enameled, D.S. over all. Grey Cardboard Tubes, Bakelite and Rubber Panels. Radio Call IJF. Write for circular on Honeycomb Coil Mounting. Wholesale and retail.

A. T. HOVEY
61 Belvidere St., near Mechanics Bldg. Boston, 17, Mass. **Open Evenings**

SEND FOR OUR CATALOG OF BEST, PRACTICAL BOOKS

IT'S FREE
N. W. HENLEY PUBLISHING CO.
2 West 45th Street. **New York**

Digitized by Google

Learn COMMERCIAL WIRELESS the Gateway to the World's Commerce.



Radio Now A Stepping Stone To Big Business.

THE past four years have developed many revolutionary changes in world affairs—kingdoms have vanished to give way to new and greater democracies—millions of men have left their former homes on farms to seek new and larger fields of work in busy cities—electricity and machinery have accomplished tasks heretofore deemed impossible—and as one reflects over these past four years one quickly realizes that today we are living in practically a new age and must adjust ourselves to new conditions.

Do You Know These Wireless Facts?

That Wireless is a stepping stone to the shipping business, the import and export business, the electrical apparatus manufacturing business, the Consular service, the railroad business, Civil Service, etc.

That at a recent convention of leading American and foreign manufacturers Radio was formally accepted to replace cable transmission for export and import business.

That in addition to two thousand ships recently built, the shipping program for the near future calls for approximately thirty-five hundred more Merchant Marine vessels, each of which must carry from three to five government licensed Radio operators.

Do you know what the successful experiment with wireless by the Delaware, Lackawanna and Western Railroads and Canadian Pacific may mean later on.

That recently five hundred aeroplanes, equipped with modern wireless apparatus, were turned over to the Aerial Postal System to extend their work, each necessitating a wireless operator.

That commercial wireless telephone communication has been established between America and England by the Marconi Company, from Halifax, N. S. and Liverpool, England.

That about seventy-five new factories were recently built for the manufacture of Radio Apparatus and that these require the service of Radio Mechanics, Electricians and Designers.

That Radio Operators are now thoroughly organized and that the United Radio Telegraphers' Association, with headquarters in New York City, is opening branch offices in all large American cities, where operators can find immediate employment.

That the average beginners pay for wireless operators is now about $225 a month and that Radio Operators in some branches receive as high as $5,000 per year.

WIRELESS HERE TO STAY

Every day old methods are giving way to new but of all the marked changes which have recently taken place perhaps the greatest is the progress made in the development of Wireless Telegraphy and Telephony. As a quicker and cheaper means of world wide communication it is already supplanting the telegraph and long distance telephone in many instances, and with its gradual establishment as an important business factor in world industries, Wireless bids fair to soon take its place as the most widely used means of communication of all nations. One of the strongest arguments presented against the recent proposed government purchase of the Telephone and Telegraph systems was that of Congressman Steenerson, of Minnesota, who said that all the telephone and telegraph wires would soon be ready for the scrap heap if the present program of wireless communication is carried out. In this new and uncrowded field of work hundreds of responsible positions now await any ambitious young man or woman.

FREE BOOK A special illustrated booklet, entitled "Wireless The Opportunity of Today" has been prepared which explains in detail the many opportunities now open to those trained in this line of work, the handsome salaries paid and the bright future for those who go into this work now. It also explains how you can learn this subject at home during spare time, within a few weeks, and how this institution, the first and foremost in America, has trained hundreds of men and women to do this work. Write for it today. It is FREE. Sign the coupon and mail it at once to

THE NATIONAL RADIO INSTITUTE
Dept. 177, 14th and U Sts., N. W. Washington, D. C.

National Radio Institute,
Dept. 177, 14th and U Sts., N. W.
Washington, D. C.

Print your name and address clearly

Send me, free of charge, your booklet, "Wireless The Opportunity of Today" with full particulars regarding your famous ten weeks' home study course in Wireless Telegraphy, your special Wireless instrument offer and how I may secure your course in Modern Radio Telephony without extra charge.

Name .....

Address .....

City ..... State .....

Digitized by Google

EXPERIMENTERS!

FOR **RESULTS** USE

TRIODE

(TRADE MARK)

VACUUM TUBES

IMMEDIATE DELIVERY $7.00 EACH POSTPAID

FOR DETECTORS OR AMPLIFIERS.

WILL FIT ANY STANDARD FOUR PRONG SOCKET

TRIODE apparatus also includes Eaton Oscillators, Two Step Amplifiers, Vacuum Tube Sockets, Grid Leaks, and Audio Frequency Amplifying Transformers. When ordering radio apparatus specify TRIODE to insure receiving only apparatus and appliances supplied by the Wireless Specialty Apparatus Co. Catalog will be sent on receipt of 25c in stamps.

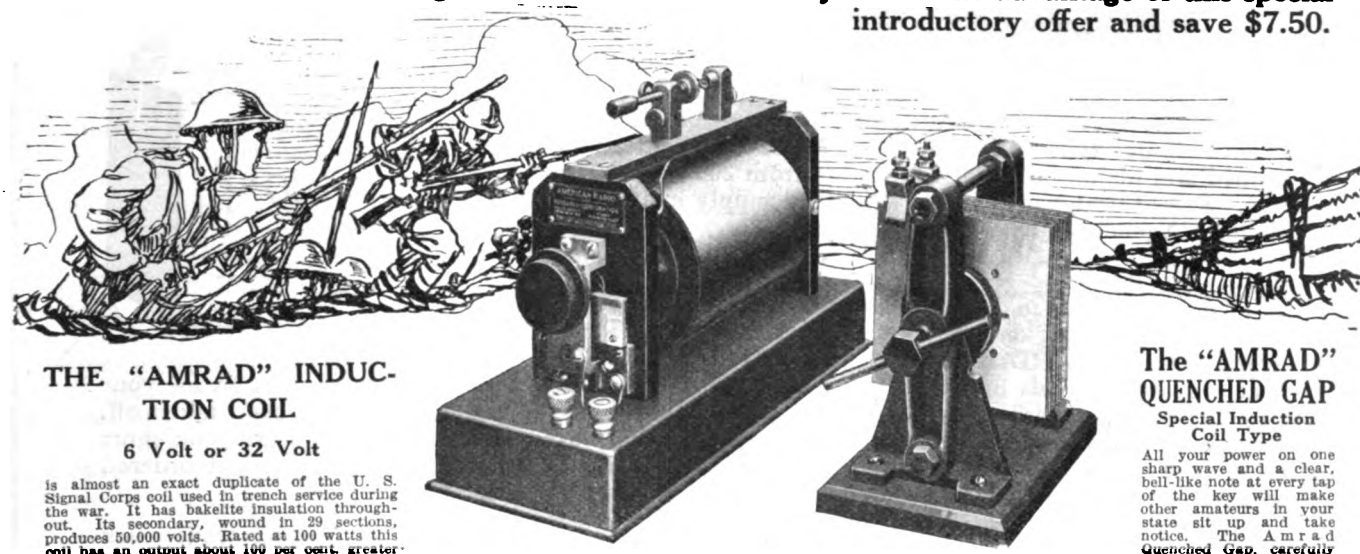
WIRELESS SPECIALTY APPARATUS CO.

BOSTON, U. S. A.

Digitized by Google

AMATEURS ATTENTION!
Send over 25 Miles on D.C.

Here at last is real "commercial type" radio apparatus designed for low power direct current. New transmitting records are in store for you. Take advantage of this special introductory offer and save $7.50.



THE "AMRAD" INDUCTION COIL

6 Volt or 32 Volt

is almost an exact duplicate of the U. S. Signal Corps coil used in trench service during the war. It has bakelite insulation throughout. Its secondary, wound in 29 sections, produces 50,000 volts. Rated at 100 watts this coil has an output about 100 per cent. greater than the average 2 inch coil. The vibrator is rugged, steady and non-sticking and designed to give a spark frequency equivalent to 100 cycles which means maximum transmitting range on short wave lengths. The 32 volt coil is intended especially for use on farm lighting circuits. When ordered separately this type is $1 extra. To get maximum results with the 6 volt coil a heavy 6 volt storage battery is the best and most economical source of current.

Price, 6-volt type $28.50

The "AMRAD" QUENCHED GAP

Special Induction Coil Type

All your power on one sharp wave and a clear, bell-like note at every tap of the key will make other amateurs in your state sit up and take notice. The Amrad Quenched Gap, carefully operated, yields the secret of long-range transmitting on low power. This special gap is identical in design to the heavy 1½ k.w. and 1 k.w. Amrad Quenched Gaps now being installed in long distance amateur stations. Not only will this special quenched gap make your transmitter as efficient, for its power, as the more costly equipment but you will be able to send more messages without interfering with other stations. For the first time in the history of amateur radio every induction coil transmitter can now be tuned to comply with Government decrement regulations. The Amrad Quenched Gap is the secret.

Price, Induction Coil Type . . . $12.50

Special Introductory Offer

If you have had limited power at your disposal and inefficient apparatus or if you are waiting to be introduced to the fascination of sending radio messages over into the next county or state here is your chance to get the two most important pieces of transmitting apparatus at an actual saving of $7.50.

"Amrad" Induction Coil, regular price . . .	**$28.50**
"Amrad" Quenched Gap, " " . . .	**12.50**
	$41.00

Special Price for the Double Buy, $33.50

Either 32-volt or 6-volt coil may be chosen

How to Order Show this advertisement to your dealer and ask him to order one of these combinations for you. If you have no radio dealer in your vicinity send us check or money order for $5 and we will ship direct to you by parcel post C. O. D., the balance plus postage. Act promptly, as the standard Signal Corps parts which we secured from the Government were only sufficient to make up a limited number of sets. If you are not ready to buy and want further information send for free Bulletin P which contains complete description and operating directions.

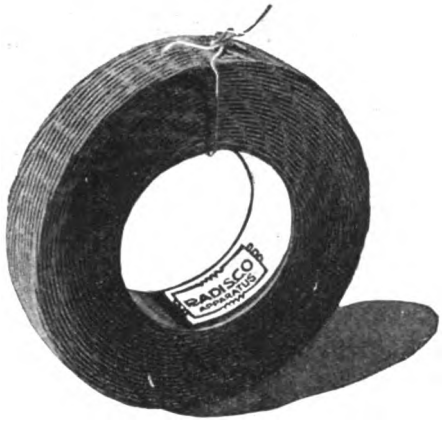
Dealers' Opportunity Write at once for short-term trade discount on this combination. No better opportunity to introduce apparatus of such high quality at such low prices will ever be had again. The offer is made especially to introduce our rapidly growing line of "commercial type" radio apparatus.

Address all communications to New York office

AMERICAN RADIO AND RESEARCH CORPORATION

15 Park Row — Factory at Medford Hillside, Mass. — New York

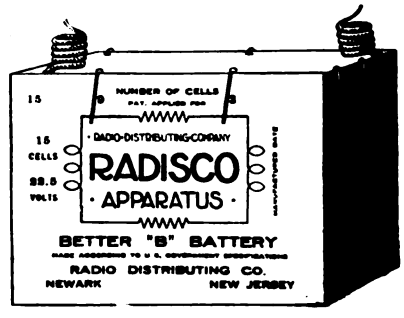
Digitized by Google



Two Famous
RADISCO SPECIALTIES

RADISCO COILS

conceded by several well-known Radio Men to be far superior to any similar type of Inductances. Made in seventeen sizes, tapped and plain. Wave length range from 200 to 20,000 meters. Priced from 60c to $4.85. Plentiful supply in stock at all Radisco Agencies.



RADISCO BETTER "B" BATTERY

is made according to Government specifications in two (2) sizes: 3¼ x 2 x 2½" and 6½ x 4 x 3". A first class 15 cell; 5 group battery; VARIABLE VOLTAGE (Pat. App. for) is a special feature of this battery which enables you to provide critical voltage regulation for your vacuum tube by means of a switch connection with cells, taps of which have been taken off. Very economical and convenient. If one cell goes bad just test each group of 3 cells and short circuit the bad one. Price: Small size $1.40. Large size $2.40. At any agency—or if ordered by mail include postage for 2 pounds on small size and 5 pounds on large size.

RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the RADISCO COILS, Better "B" Batteries, and are our Agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace.

ATLANTIC CITY, N. J.
Independent Radio Supply Co.,
118 So. New Jersey Ave.

BEINVILLE, QUEBEC, CANADA
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Co.,
34 Batterymarch St.

BROOKLYN, N. Y.
Kelly & Phillips Electric Co.
312 Flatbush Avenue.

BRONX, NEW YORK CITY
Amateur Wireless Equipment Co.,
1390 Prospect Ave.

CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.

EUREKA, ILL.
Klaus Radio Apparatus.

HAMPTON, N. H.
DeLancey Felch & Co.

LOS ANGELES, CALIF.
The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.
K. & L. Electric Co.
427 Olive Street.

NEW ORLEANS, LA.
L. A. Rose,
4323 Magnolia Street.

NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street.

NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave.
"8HA"

PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets.

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington Street.

PITTSBURG, PA.
Radio Electric Co.,
4521 Forbes Street.

SCRANTON, PA.
Shotton Radio Mfg. Co.
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street.

TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street.

WASHINGTON, D. C.
National Radio Supply Co.,
1405 U Street, N. W.

WICHITA, KANSAS.
The Cosradio Co.,
1725 Fairmount Ave.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY : Newark, New Jersey

Digitized by Google

CHEMISTRY OF THE COMMON METALS

(*Continued from page* 405)

the process of saturation continues sodium bicarbonate separates out until 2/3 of it has been transformed. The remaining compounds, carbon dioxide, ammonia and water, combine to form a solution of ammonium bicarbonate as is shown by the following equation:

$CO_2 + NH_3 + H_3O = NH_4 HCO_3$.

This product reacts with the sodium chloride to produce the bicarbonate which precipitates. The ammonium chloride remains in solution. The action is very well illustrated by the following equation:

$NH_4HCO_3 + NaCl \leftrightarrows NaHCO_3 + NH_4Cl$.

The bicarbonate is taken off, washed and heated to change it to the carbonate:

$2HNaHCO_3 = Na_2CO_3 + CO_2 + H_2O$

Sodium nitrate ($NaNO_3$) is found in great quantities in Chile. The natural product contains sodium chloride, and the nitrate and perchlorate of potassium are also present in considerable amounts.

Sodium nitrate is extremely soluble in water and is very deliquescent. Great quantities of it are used in the manufacture of nitric and sulphuric acids. Probably its chief use is as a fertilizer, imparting its life-giving nitrogen to the soil.

Sodium nitrate ($NaNO_2$) is produced by heating sodium nitrate with lead. The following equation fully describes the nature of the reaction which takes place:

$NaNO_3 + Pb = NaNO_2 + PbO$

The resulting compound ($NaNO_2$) is very soluble in pure water. It has found considerable use in the production of organic dyes.

Sodium sulphate occurs in nature in the anhydrous state. It has been known in the deca-hydrate form ($Na_2SO_4\ 10H_2O$) since the seventeenth century. Sodium sulphate is also known as a heptahydrate ($Na_2SO_4 7H_2O$).

The preparation of sodium acid sulphate can be brought about by the action of sulphuric acid on the neutral sulphates. This substance, when heated loses its water and is converted into pyrosulphate ($Na_2\ S_2\ O_7$). If the temperature is carried beyond a certain point the pyrosulphate breaks up into sulphur trioxide and the normal sulphate. Solutions of sodium acid sulphate effect acid reactions. This is because of the dissociation of the HSO_4 + ion into H + and SO_4—

Sodium sulphite ($Na_2\ SO_3\ 7HO_2O$) can be prepared by dividing a solution of sodium bicarbonate into equal parts, saturating one with sulphur dioxide. This will result in the formation of carbon dioxide and acid sodium sulphate according to the following equation:

(*Continued on page* 429)

A GOOD WAVEMETER AT A MODERATE PRICE



TYPE B. Q. WAVEMETER

is accurate, simple and rugged. Comprises a portable oak case 5¾" x 8¼" x 6½" with hinged cover, bakelite panel, balanced condenser, buzzer, detector, switch, binding posts, and two 2-unit inductance windings, range 200 to 2000 meters.

Price $27.50

These meters are in stock for immediate delivery, and are carried in stock by most good dealers.

Bulletins Z and F sent for 4c Stamps list our complete line of high grade, moderately priced apparatus for the radio laboratory. Bulletin R lists the Cambridge Rectifier for Storage Battery Charging.

CLAPP-EASTHAM CO., 131 Main Street, Cambridge, Mass.

Up—Down—or Sideways

A ACE E

No matter how you want to look at "Ace" instruments, they are ideal for an up-to-date radio installation.

Doctor "ACE' has tonic for weak signals that give them some kick and on transmitting apparatus he sure has the dope. Better get acquainted with "Doc".

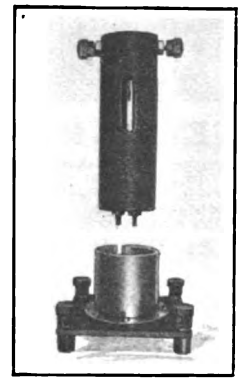
You may pay more, but you can't buy better.

The Precision Equipment Company Inc.

Manufacturing Engineers

2437 Gilbert Ave., Dept. B Cincinnati, Ohio

YOU CAN USE AUDIOTRONS IN YOUR RADIO SET, WITHOUT CHANGING THE SOCKETS· IF YOU HAVE A



Radio Electric Audiotron Adapters are the logical means for using tubular audions in standard apparatus equipped with four-point sockets. The superiority of this adapter is evident in the simplicity of construction and protection afforded the vacuum tube.

AUDIOTRON ADAPTER, $1.50, Shipping weight 1 lb.

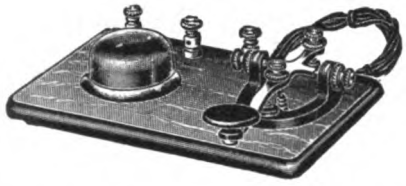
The Radio Electric Company carries a complete line of Bunnell, Radisco, Murdock, Clapp-Eastham Radio Apparatus, Federal and De Forest Instruments. Special equipment made to order. Pittsburgh experimenters are invited to visit our retail store. A 10c stamp will bring our catalog.

RADIO ELECTRIC COMPANY 4614 HENRY ST., E. E. PITTSBURGH, PA.

Digitized by Google

Wireless Receiving Ban Raised

MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No.		Price
342	Telegraph Practice Set, with Battery and Cord	$3.24

Weighs 4 lbs. packed.
Price does not include postage.

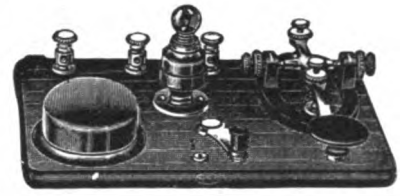
MESCO COMBINATION PRACTICE SET

For Learning the Morse and Continental Visual and Audible Codes

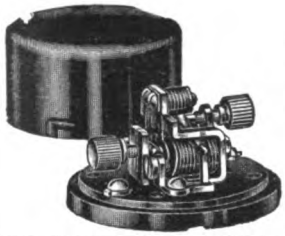
This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord $4.05

Weighs 4 lbs. packed.
Price does not include postage.



MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a bayonet joint.

List No.		Price
55	Mesco Radio Buzzer	$2.05

We carry a large and complete line of Standard Wireless Material recognized by experts as such with competent experienced wireless attendants in charge

Send for the New Edition of Our Catalog K28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarms Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Manhattan Electrical Supply Co., Inc.

NEW YORK: 17 Park Place — BRANCHES: 110 W. 42nd St., 127 W. 125th St.
CHICAGO: 114 S. Wells St. — ST. LOUIS: 1106 Pine St. — San Francisco Office: 604 Mission St.

MERACO
EQUIPMENT



YOUR OPPORTUNITY

To introduce the quality of MERACO B Batteries, we are offering them at $1.00, postpaid, for one month only. This offer closes at midnight, April 1st, after which they will be $1.20.

These batteries give 22.5 volts, with guaranteed full amperage.

Buy WHILE YOU CAN at This Price Here Are a Few Other Meraco Offers:

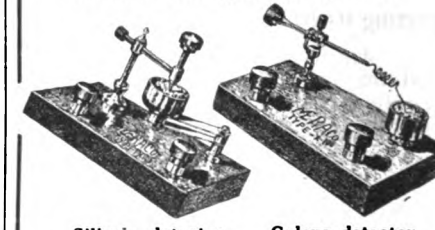
Hard rubber, ⅛, 3/16, ¼, ⅜, ½ in., $1.40 per lb.

Bakelite, grade xx, natural, $2.90 per lb.; black, $3.00 per lb.

Flexible rubber tubing to slip over leads, 4c per foot; $3.50 per 100 ft.

Note: Postage must be included, as extremely low prices prohibit shipment otherwise.

MERCURY RADIO APPLIANCE CO.
672-A Broadway, Brooklyn, N. Y.



Silicon detector, $1.50 — Galena detector, $1.50

SCIENTIFIC ELECTROTECHNICAL EDUCATION

"Bridges the Gap" between the Electrician and the Electrical Engineer. No matter what your previous education, the way is open to YOU!

By advanced and practical methods employed in the extensive laboratories, drafting-rooms, class-rooms and work-shops of the School of Engineering of Milwaukee you can quickly and thoroughly train to become an Electrotechnician, and later an Electrical Engineer with B.S. Degree.

INSTITUTE OF ELECTROTECHNICS

A Junior Division for 8th Grade Graduates and a Senior Division for students with 2 years high school, require 18 months each for completion. A good position in the Electrical or Industrial field awaits you upon your graduation, or you may enter the College of Electrical Engineering and secure your B. S. Degree in 3 years.

NEW TERM OPENS APRIL 1st.

"Earn While You Learn" system assists you with your living expenses while at school, and assures you splendid practical experience.

Write NOW for full details and latest catalog. Mention age and education.

SCHOOL OF ENGINEERING OF MILWAUKEE
171-373 Broadway Milwaukee, Wis.

WILCOX PANEL SWITCHES
TYPE 101

A beautiful and efficient standardized switch for general use. Furnished in two sizes.

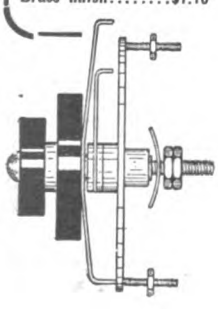
1" Radius, Brass finish....40c Nickel finish....50c
1½" Radius, Brass finish....50c Nickel finish....60c

TYPE 102 (Illustrated)

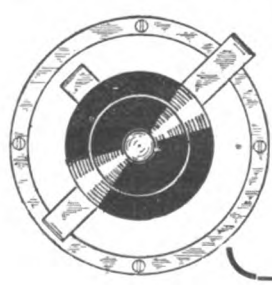
A compound switch especially suitable for the primary of loose couplers. 1½" outside radius.

Brass finish.....$1.10 Nickel finish.....$1.25





VARIOMETER PARTS



Turned from hardwood. Set as shown consisting of stator (two parts), rotor and form for winding coils.....Postpaid $2.50

Size of stator 5½" sq.
Other sizes made to order

SET NO. TWO contains all parts for the variometer including the above and knob, scale, pointer, shaft, binding posts, wire and instructions for assembly.....Postpaid $5.00

BUILD YOUR OWN APPARATUS

Our standardized parts and materials make it easy to build efficient apparatus that is beautiful and uniform in appearance.

NEW LOOSE LEAF CATALOG READY
Sent for five cents in stamps.

The Wilcox Laboratories
Lansing — Dept. D — Michigan

RADIO APPARATUS
on the
INSTALLMENT PLAN

Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.

J. DONALD VANDERCOOK
LOMBARD — Box 442 — ILLINOIS

Digitized by Google



Crystal Detector, Type WI-126A

COMMERCIAL EXPERIMENTAL wicony RADIO PRODUCTS EDUCATIONAL LABORATORY

The Quality Mark

THE Crystal Detector illustrated above is the smallest and most efficient crystal detector on the market and is not to be confused with other detectors of similar appearance but of inferior make. Our type WI-126A Detector is entirely dust and moisture proof and is designed to retain its adjustment under all circumstances. The galena crystal supplied is made of specially selected ore tested at the mine by our inspector and again tested in our laboratories after assembly in the detector stand; extreme sensitivity is thereby assured.

As in all our other products, the materials, workmanship and finish of this instrument are of the finest grade obtainable.

Overall dimensions: 2¼" x 3¼" x 3½". Weight: 8 oz.

Price $4.50

Write for our illustrated catalog 3B-7 on Crystal Detectors.

WIRELESS IMPROVEMENT COMPANY

Radio Engineers, Manufacturers and Distributors

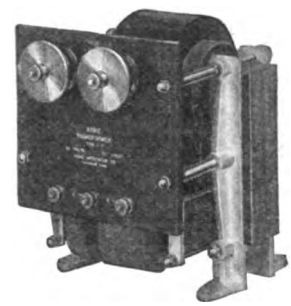
47 West Street **New York, U. S. A.**

INVESTIGATE

WHEN you buy a Radio Transformer, you should see that you get one that draws full rated power under the conditions at which it will be used.

If you order a ½ KW Transformer for 200 meter work, it should draw 500 Watts from the line, using a condenser under .01 MF.

A Wattmeter is necessary to measure the power, and most amateurs can get the use of one for this purpose. Instruments can be rented in most of the large cities, or any High School student could arrange to use the one at the Physical Laboratory of the School.



With a Wattmeter and Ammeter, the power factor can also be obtained, which is the WATTS divided by the product of AMPERES and VOLTS. This figure should not be below .70.

Many amateurs have Transformers which are rated as 1 KW or 1 K.V.A., and which only draw 400 to 600 Watts—actually ½ KW Transformers.

The ACME Radio Transformers have a high power factor and high efficiency, and will draw full rated power from a line of proper voltage and frequency using a condenser of .007 M.F. and spark gap frequency of 700 to 800 per second.

Price List as per Bulletin.

ACME APPARATUS COMPANY

24 Windsor Street, Cambridge 39, Mass.

CHEMISTRY OF THE COMMON METALS

(*Continued from page 427*)

$Na_2CO_3 + H_2O + 2SO_2 = 2NaHSO_3 + CO_2$.

When this reaction is completed the remaining part of the sodium bicarbonate solution is added, which results in the formation of carbon dioxide and the neutral sulphate.

$Na_2CO_3 + 2NaHSO_3 = 2Na_2SO_3 + H_2O + CO_2$.

Sodium sulphide (NaS_2) is usually prepared by the reduction of the sulphate with carbon. The reaction has to be carried out at high temperature. The compound, when dissolved in water, has a decidedly alkaline reaction.

The thiosulphate of sodium ($Na_2S_2O_3 5H_2O$) is produced by boiling a solution of the sulphate with sulphur. One of the most important uses of this salt is in the fixing of photograph plates and films. Since the development of the motion picture industry, the consumption of sodium thiosulphate has increased greatly.

Three sodium phosphates are known: monosodium phosphate (NaH_2PO_4), disodium phosphate (Na_2HPO_4), and trisodium phosphate (Na_3PO_4). The disodium phosphate is probably the most important salt. It can be prepared by neutralizing a solution of phosphoric acid with either sodium hydroxide or carbonate. This salt is extremely soluable and effervesces very easily.

Sodium silicate (Na_2SiO_3) is a compound well known under the name of "water glass." It is prepared by fusing together silicon dioxide and sodium carbonate. This compound is a thick, syrup like liquid.

Sodium cyanide is made by first passing ammonia over metallic sodium. This results in the formation of sodium amide:

$2Na + 2NH_3 = 2NaNH_2 + H_2$.

The product of this reaction is brought into contact with charcoal heated to dull redness. The following reaction takes place:

$NaNH_2 + C = NaCN + H_2$.

Like most of the cyanides, that of sodium is extremely poisonous.

Sodium imparts a yellow color to a Bunsen flame. By the use of the spectroscope, as little as .0000000003 grm. of sodium can be detected.

Electric furnaces for melting alloys employ as heating element a trough filled with granulated material forming a resistance. The troughs last four months, their granular filling only two weeks. They are in use in Sheffield, England, and range from 40 to 1,000 kilowatts capacity; a favorite size is 105 kilowatts. The latter is a hand-tilting round furnace. Three hundred to 350 kilowatt hours are expended in melting a ton of scrap brass. One 500 kilowatt furnace has a hearth capacity of three tons of aluminum or nine tons of brass. The loss in metal is very small, and a large furnace will melt a ton a day for each 5 kilowatts capacity.

Digitized by Google

VACUUM TUBES REPAIRED

We repair the filaments and other elements in all types of vacuum tubes and guarantee them to operate equally as well as a new tube. In most cases they operate better. We produce wonderful oscillators, detectors and amplifiers.

MARCONI VT **MOORHEAD TUBES**
DE FOREST VT **WESTERN ELECTRIC**

REPAIRED AT FOUR DOLLARS AND FIFTY CENTS EACH

ELECTRON RELAYS **OSCILLAUDIONS**
and all tubular types.

REPAIRED AT FOUR DOLLARS EACH

All foreign-made receiving tubes repaired at SIX FIFTY and power tubes, depending upon size.
WE HAVE PURCHASED A LARGE QUANTITY OF BURNED OUT MARCONI VTs AND ELECTRON RELAYS, WHICH WE OFFER FOR SALE AT FIVE DOLLARS.
REMEMBER THESE TUBES ARE GUARANTEED GOOD AS NEW.

Dealers write us.

VACUUM TUBE REPAIR CO.

511 Perry Building **OAKLAND, CAL.**

MORE THAN A STORE

At F. D. Pitts Company you will find an exposition of radio and experimenters' supplies from the foremost manufacturers of the country. No other store has such a complete line of equipment, nowhere else is such an opportunity to choose from the products of Clapp-Eastham, Grebe, De Forest, General Radio, etc. A feature which will appeal to experimenters is that we keep things in stock! What other stores do not keep, you can get at Pitts'.

SEND 4 CENTS FOR OUR CATALOG. IT HAS JUST COME FROM THE PRESS.

COME IN AND SEE FOR YOURSELF

F. D. PITTS, Dept. F. **12 Park Sq., Boston, Mass.**

"POROX"

"Trade Mark"

High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.

Special Batteries made to order also duplicating of foreign batteries.

Prices on request.

ALBERT MULLER
8758 Queens Boulevard
Jamaica, Long Island, N. Y.

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45th STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for.....years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the..... issue. I enclose $....., and according to your special offer send me copy of book checked off.

(Date of issue)

Name .....
Street .....
City .....
State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS
Check off title desired here

1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted...$1.30 Postpaid

RADIO MEN

Make your apparatus up to date. Indicating dials now available at a reasonable price.

Made of fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. Bevelled edge.

We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

NEW CATALOG JUST OUT, ready for distribution at once. 30 pages of real, live, up to the minute illustrations, NEWS and descriptions of all standard Radio parts, including the above Indicating Dial.

Sent anywhere upon receipt of 10c.

For sale at all Radisco Agencies and by

A. H. Corwin & Co.

4 West Park Street Newark, N. J.

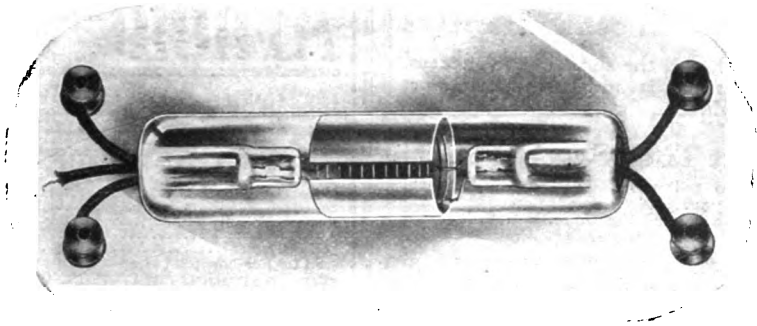
Licensed by De Forest

AUDIOTRON

The Original Tubular Vacuum Amplifier

The AudioTron vacuum tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos 841387 and 879532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.



PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

Laminated closed core, two coil type

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO., Lick Bldg., San Francisco, Calif.

"Ask Anyone Who Has Used It"

"Light and Sensitive, The Mechanical Construction is Good, and they Look Very Neat." (Name on Request.) This extract from the letter of a satisfied patron is in line with what they all say.

BRANDES WIRELESS HEADSET



Superior Type, 2000 ohms, $7

Transatlantic Type $10 Navy Type $14

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. 32 Union Square, Room 822 New York

WIRELESS RECEIVER SPECIALISTS

FOUR NEW BOOKS

WIRELESS EXPERIMENTERS

will be interested in this NEW BOOK

SELENIUM CELLS. Design, construction and use of the various makes. Illustrated with drawings and half-tones. 80 pages, 7½ x 5 in., cloth $1.50.

AUTOMOTIVE MAGNETO IGNITION, Its principles and applications, by MICH. E. TOEPEL. Second Edition, revised and enlarged. Profusely illustrated. Limp Cloth, **$2.00**

AERONAUTICAL ENGINES, by F. J. KEAN. Second Edition, revised and enlarged, 96 pages, 48 diagrams, 29 page plates and 5 folding plates. Cloth, **$2.60.**

LATEST MAGIC, The New Book, by PROF. HOFFMANN (Angelo Lewis), Second Edition revised, fully illustrated, handsomely bound in cloth—gilt. **$2.00.**

Spon & Chamberlain

122 E. Liberty St. New York City

SEE

Special Subscription Offer on pages 436 and 437

Valuable Books on Radio, Automobiles, Chemistry and Mechanics given FREE.

Digitized by Google

Useful Books

Complete Practical Machinist
by Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations
Price $3.00

Metal Worker's Handy-Book of Recipes and Processes
By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations
Price $3.00

Techno-Chemical Receipt Book
Edited with Additions by Wm. T. Brannt and Wm. H. Wahl

This well-known Receipt Book is a mine of accurate information that everyone may work to great advantage. It is encyclopedic in range, yet gives only the best formulas for each preparation or operation, and thorough tests by competent men guarantee their intrinsic merit.

A compact and reliable collection of approved receipts and processes, containing thousands of receipts covering the latest, most important and most useful discoveries in chemical technology and their application in the useful arts and industries. It is indispensable to every practical man and contains 500 pages, closely printed, giving an immense amount of matter on a great variety of subjects. Every care has been taken to select the very best receipts of each kind and there are few persons, no matter in what business or trade they may be engaged, who will not find in this volume something of use and benefit to them. The library of the laboratory, factory or home is not complete without a copy of this handy and useful book of reference.

516 Pages. 78 Illustrations
Price $2.50

Friction, Lubrication, Fats and Oils
By Emil F. Dieterichs

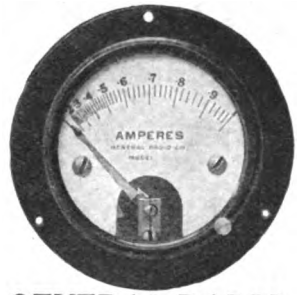
When we realize that it is no figure of speech, but a bald statement of fact, to say that lubrication alone keeps the wheels of industry turning, then we must look respectively upon this as a question of vital importance in this mechanical age. The author, himself a chemist and an inventor and manufacturer of lubricants, wrote this manual for the mechanic and manufacturer of ordinary education, that the busiest man might learn the main facts of friction, the origin and charteristics of fats and oils, their uses, their adulterations, their practical testing and the best ways to make them serve his own particular ends.

Price $1.50

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.
Publishers of Mechanical and Industrial Books
2 West 45th Street, New York, N. Y.

OF SPECIAL INTEREST TO AMATEURS!



We have a number of GENERAL RADIO CO. HOT WIRE AMMETERS range 0-2.5 amperes which were left on our hands at the termination of the war. These instruments are of the flush type, calibrated, and in good condition, exactly like a large number supplied by us to the U. S. Army Air Service.

We also have a few ammeters of the same type, range 0-1 ampere, adapted to use in measuring the filament current of vacuum tubes or low power transmitting sets.

While they last, $5.00 will bring you either range, although our regular price is $10.00.

Dealers write for our proposition

GENERAL RADIO COMPANY CAMBRIDGE, MASS.

THE STANDARD—WHEREVER "B" BATTERIES ARE USED

BEST MADE

MAXIMUM OPERATING LIFE



STANDARD VT BATTERIES give you the service you expect, and the "VARIABLE STANDARD VT BATTERY" is unequalled in efficiency, convenience and fineness of variation.

Used by leading manufacturers. Sold by the best dealers.

Send for literature, and kindly mention your dealer's name.

RICHTER & BYRNE, New York, Mfgrs.
PACENT ELECTRIC CO., Inc.
Sole Eastern Agents
150 Nassau St. New York, N. Y.

FOR CLEAR RECEIVING THE SATISFACTORY BURGESS "B" BATTERIES

B BATT +⊙ ⊙−



SEVERAL SIZES

Write for Catalogue

BURGESS BATTERY COMPANY
HARRIS TRUST BLDG. CHICAGO

Memorize Continental Code Almost Instantly

My method is the short cut to success. Complete chart and full instructions, TWO DIMES.

What They Say About It

"Wish to tell you I was certainly glad I sent for your Chart. Before getting it did not know any of the Code, and today can transmit about ten words per minute."

ROBERT ANGLEN, Detroit, Mich.
(Local address on request.)

DODGE, Box 100, Mamaroneck, N. Y.

Arnold

Loose Couplers

Combination Loose Coupler Parts and accessories.

Send 4c stamp for literature which is sure to interest you.

J. F. ARNOLD **2082 Lexington Av., N.Y.**
Established 1910

BLUE PRINTS

Laboratory Signs	$0.10
Violet Ray Machine	1.00
Honeycomb Coils and Jigs	.50
Wireless Circuits	1.00
Loose Coupler	.50

Send for free blue print of an efficient galena detector

THE BARWICK RADIO SUPPLY CO.
89 Britannia Ave.
Hamilton, Ontario, Canada

EVERYDAY ENGINEERING MAGAZINE SERVICE DEP'T

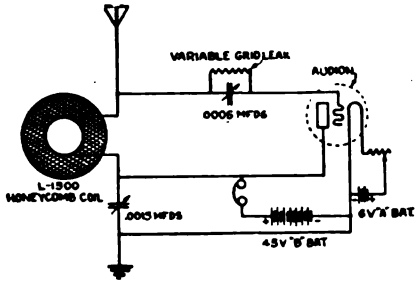
Readers of this magazine are invited to write for any information relative to procurement of supplies, technical or practical books, tools, etc., they need to carry on their experimental work most efficiently. Our Service Dept. manager can render you valuable aid if you avail yourself of this privilege. Any information on subjects covered in our magazine will be given interested readers if available. All inquiries will receive prompt attention, and to insure proper service, the writer should enclose a stamped self-addressed envelope or postal card.

ADDRESS—SERVICE DEPARTMENT
EVERYDAY ENGINEERING MAGAZINE
2 West 45th Street, New York City

Digitized by Google

DE FOREST





Nauen, Germany Copied in the Daytime

on 90 foot Antenna with **one** DeForest "Honey Comb" Inductance Coil and **one** V. T. Freak work? Not at all! Try it yourself on your own Antenna.

Here Is The Formula: If fixed Grid Condenser is used, Grid leak must be adjusted very carefully. Wave length range, 7375 to 17,500 meters with average Antenna of .0007 mfds. capacity. This circuit works equally well on short waves, regenerating the spark signals to a remarkable degree. Merely plug in a No. L-100 "Honey Comb" Coil in place of the No. L-1500 and listen to the 600 meter traffic pound in. Wave length with No. L-100 Coil, 430 to 1010 meters.

IMPORTANT NOTICE

Our production of DeForest "Honey Comb" Inductance Coils has finally equalled the demand. From now on the genuine DeForest "Honey Comb" Coils can be supplied unmounted for 50 cents less than the list prices for mounted Coils.

Send for the DeForest Catalogue C.

Contains complete details regarding "Honey Comb" Coils, and gives descriptions and prices on many articles of Receiving Apparatus, with valuable hook-ups and other information. Sent postpaid for 10 cents in stamps. Send for yours today.

DE FOREST RADIO TELEPHONE AND TELEGRAPH CO.

Inventors and Manufacturers of Amateur and Commercial Radio Apparatus of Highest Grade

1403 Sedgwick Avenue **New York City**

DE FOREST

Send for

HALCUN Radio Catalogue

Full Line of Amateur Requirements

Halcun Radio Co.

San Francisco, Calif.

Formerly Haller Cunningham Elec. Co.

FREE APPARATUS!!

You get a coupon valued at 50 cents for every subscription you receive for "Pacific Radio News." These coupons are as good as cash when presented at radio supply stores.

Your own subscription or extension of your present subscription will be credited with one coupon.

Send for a copy of "Pacific Radio News" today and learn about the FAIR PLAY contest.

15 cents per copy
$1.50 per year.

PACIFIC RADIO PUB. CO.

50 Main St., San Francisco, Cal.

IF YOU COULD

Purchase Reliable, Efficient
RADIO EQUIPMENT

Guaranteed against mechanical and electrical imperfection—strictly high grade and up-to-date on a "Money-back-if-not-satisfied" basis—would you not be enough interested to investigate further?

Our new "Bulletin 14" now in preparation will list a complete line of Apparatus, Assembled Sets, Field Signal Sets, Radio Telephones, Independent Units, etc. It will be mailed upon receipt of 10 cents. This amount may be deducted from your first order of $1.00.

ATLANTIC RADIO COMPANY

34 Batterymarch St., Boston 9, Mass.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

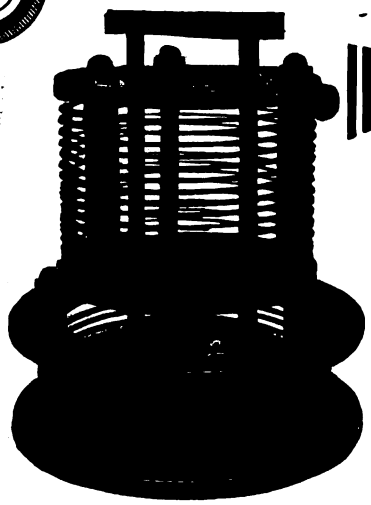
The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 33rd St. Valparaiso, Indiana

Digitized by Google



INTERNATIONAL RADIO
TRANSFORMER
Type TXL-101 A
Price $16.75 f.o.b. Factory

A Standard Transformer modified and redesigned for amateur use. Coils are 1/16" copper, edgewise wound on bakelite supports. Assembly secured to end plates by bakelite nuts. Secondary slides on bakelite rods. This elimination of metal throughout results in maximum efficiency.

PRIMARY INDUCTANCE 12 micro henrys
SECONDARY INDUCTANCE 40 micro henrys

The Transformer illustrated above is only *one* of many newly designed radio specialties which we have ready for you. Write us for descriptive bulletins which are being issued covering all International Radio Products. Address Department No. 21.

INTERNATIONAL RADIO TELEGRAPH COMPANY
326 BROADWAY NEW YORK CITY

AN ANNOUNCEMENT
OF IMPORTANCE
TO RADIOMEN

A new organization selling high class apparatus in conjunction with high class service has established its retail and mail order departments at 226 Fulton Street, New York City. Among the high class makes of apparatus which they sell, they are proud to list the INTERNATIONAL RADIO, DE FOREST, E. J. SIMON, COHEN, AMERICAN RADIO AND RESEARCH, WIRELESS EQUIPMENT, DORON BROS., RADIO SERVICE, RADISCO PRODUCTS.

"Better Quality" B-Batteries—$1.25 for the 22½ volt size —Audiotron Amplifiers, Audotron Adapters, absolutely guaranteed Galena crystals at 75c, and the best storage battery made in the world.

The International Electric Catalogue is now in preparation.

INTERNATIONAL ELECTRIC COMPANY
226 FULTON STREET NEW YORK, N. Y.
Dealers write for propositions

RADIO AND ELECTRICAL EXPERIMENTERS ARE SAVING:

$2.50 (20%) on each 6 V Storage Battery for which retail dealers ask $16.00
$1.00 on every Vacuum Transmitter Tube.
$2.50 on every Navy Type Telephone Set.

You can save substantial amounts on radio, electrical apparatus, raw material or books. This applies to almost every electrical product advertised in this magazine. We buy direct at wholesale. You receive a share of this co-operative buying. We manufacture nothing. Orders are made through the association from advertisements and manufacturers' catalogues. Hook-ups and like data is furnished free. Details by mail on request.

MANUFACTURERS:

Our radio department membership exceeds 1200, and is growing daily. We can move your stock. Submit quantity discount lists if you wish to avail yourself of this buying power. We want supply houses in several sections to deliver on telegraph order.

MUTUAL PURCHASERS ASSOCIATION
2-4 Stone Street NEW YORK CITY 21 Bridge Street
Tel. Bowling Green Tel. Bowling Green
4824-4829 6372

EVERYDAY SCIENCE NOTES

Electrically welded joints in ships' plates have been recently tested in England with excellent results, as regards strength. They are from 90 to 95 per cent. as strong as the original plate, where rivetted joints are from 65 to 70 per cent. only. In elasticity they are so far inferior to rivetted joints, succumbing more quickly to bendings back and forth than do rivetted joints. A 5,000-ton ship has about 450,000 rivets, a 9,500-ton ship has about 650,000 rivets. In the displacing of these there would seem to be quite a field for electric welding, if it can be successfully done. Sometimes a badly driven rivet occasions a leak, and such a leak is regularly treated now by electric welding. The joints between ships' plates can be made quite flush by this process.

A recent paper on the Sperry stabilizer for ships brought out some of the interesting points of the apparatus. At one time there was apprehension that the stresses of the stabilizer might operate to strain the ship, but it has been determined that the strains incident to the rolling and pitching of a ship in a sea-way subjects it to four to six times the strains due to the stabilizer. It is possible to instantly throw the stabilizer in and out of action, as far as steadying the ship is concerned, and it is said that this gives a most impressive demonstration of the work done by it. When out of action in a heavy sea, it leaves the ship to roll and pitch with the waves and the effect of turning on the stabilizer operates to bring about an impressive silence, the creakings of the ship ceasing as the stabilizer comes into action. The ship, it is said, is steadied in her steering, and economizes on power, especially if she has bilge keels. Naturally there is not the same need of slowing down in bad weather, if a ship is well stabilized. There is less water on deck in a head sea.

It is calculated that the United States consumes nearly 75 per cent. of the petroleum used in the world. The demand for petroleum is increasing; the ship program calls for about half of the domestic supply. Internal combustion engines are said to furnish about two-thirds of the prime motive power of the world, and gasoline takes care of 95 per cent. of this.

A power line operating at a potential of 100,000 volts broke in Colorado, its loose ends separating some 200 yards or more. It was delivering 3,700 kilowatts at the time. The current found its way along and through the earth, and the irregularity in the action was only observed at the power house after seven hours had elapsed. It required three hours for the earth to cool off. The siliceous matter of the soil was melted in places into glass-like cones or fulgurites, similar to those produced by the lightning stroke. These were several inches deep, and were formed with their apexes down in the soil.

A system of secret communication by ultra-violet rays has been described, which was used during the war to communicate at sea, at distances of three or four miles. The ultra-violet rays of the Cooper-Hewitt lamp were employed, and were transmitted to a receiving fluorescent screen, coated with barium platinocyanide. A focussing system was a part of the apparatus.

Georges Claude, the eminent French authority on the liquefaction of gases and on low temperature work, has been working on the synthesis of ammonia from the atmospheric nitrogen as the source of the nitrogen of the compound. He has used pressures as high as one thousand pounds to the square inch, with results exceeding those attained in the famous Haber process of Germany.

Digitized by Google

NOTES ON ALUMINUM ALLOYS

Aluminum not alloyed with other metals is used for a great many machine parts and devices. The automobile industries are large users of aluminum castings, also the manufacturers of pneumatic vacuum cleaners. Commercially pure cast aluminum has a tensile strength of 14,000 pounds per square inch, which is too low for any parts subjected to great stress as it is less than that of cast iron. In order to increase the strength of aluminum, it is alloyed with stronger metals. Aluminum bronze is an alloy of copper with from 5 to 11 per cent of aluminum, which increase the tensile strength of the copper from 28,000 pounds per square inch to an average of 85,000 to 100,000 pounds per square inch. Aluminum bronze is of a light yellow color, and is not as heavy as any of the ordinary bronzes. It has been used for automobile engine crank case and gear cases.

In machining castings of aluminum and its alloys a difficulty is frequently encountered by reason of the chips becoming so firmly embedded between the teeth of milling cutters and tools that they cannot be removed with a stiff brush, and the machine has to be stopped for their removal. This necessitates the use of a lubricant. Oil does not prove suitable, but soapy water gives good results, although it leaves a dull surface. A good cutting lubricant is kerosene, which gives a bright finish when the cutting tools are properly ground and turpentine has been used to advantage also. The cutting edges of all tools should have sharp, square corners or edges, and there should be plenty of cutting relief or clearance.

COLOR INDICATIONS OF HEAT

To determine the color corresponding to various degrees of temperature in Fahrenheit degrees, the following table is given as being approximately accurate. It may be of use to the mechanic who desires to obtain a known degree of heat in any work, such as smithing, heat treating, etc.

	Deg. Fahr.
Lowest red, visible only in the dark	635
Faint red	960
Dull red	1290
Brilliant red	1470
Cherry red	1650
Orange	2010
Bright orange	2190
White heat	2370
Bright white heat	2550
Dazzling white heat	2730
Welding or scintillating heat	2800

For very accurate heat treating work, as in hardening or tempering modern alloy steels, more accurate control of the heat is necessary and even the best trained eye does not give satisfactory results so pyrometers are used.

The machinist says:

"Sure I'm using them, the same as most of the men in the shop are doing. Some of the Starrett Tools in my kit, I bought when I was an apprentice.

"Y'see, it's like this. We got the habit when we were kids. We saw the older men, the ones that were doing the finer work, preferred Starrett Tools because they knew they were accurate, and we copied after 'em—just like our kids are doing today.

"How's that? No, I wouldn't go so far as to say that Starrett Tools by themselves will make a good machinist, but I'll say this—Starrett Tools will make it a lot easier for any machinist to do good work.

"Yes, I've got one of their 'Starrett Data Books for Machinists,' and believe me, it saves a lot of time and mistakes. If I want to know a decimal equivalent, a taper dimension, the speed of a milling cutter, or something about materials, I don't have to guess or ask — I just look in the book and find out. It set me back seventy-five cents at the hardware store, but it saved me a blame sight more than that in the first week."



Starrett Tools



The L. S. STARRETT COMPANY
THE WORLD'S GREATEST TOOLMAKERS
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

The utility and convenience of Starrett Tools are second only to their accuracy. Catalog No. 21 "M B" sent free on request.

42-980

Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $2.00.

An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO., Niles, Mich.

HANDY

THAT'S THE WORD TO DESCRIBE THIS NEW utility chest—the handiest, sturdiest, chest for garage or home use, for auto-mechanics, electricians, plumbers, linemen. Its solid oak frame, rigidly held together by lock-cornered joints—twice as strong as dove-tailing—insures tool safety against theft, rust, bangs, knocks or outdoor weather. Get the details about this chest and the other 18 Union sizes and styles. Write for Catalog, prices and name of nearest dealer and guarantee. If no dealer near you, write for special offer. **Union Tool Chest Co., Inc., 34 Mill Street, Rochester, New York**



UNION
TOOL CHESTS

WEBSTER'S NEW INTERNATIONAL DICTIONARY

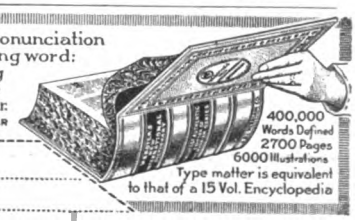
Whatever your question;—be it the pronunciation of Bolsheviki; the spelling of a puzzling word; the location of Zeebrugge, the meaning of blighty, ace, tank, etc., this Supreme Authority contains an accurate, final answer.

G. & C. MERRIAM CO., SPRINGFIELD, MASS. REGULAR AND INDIA-PAPER EDITIONS

Please send me specimen pages and FREE POCKET MAPS Per E. Eng.

NAME.....

ADDRESS.....



400,000 Words Defined
2700 Pages
6000 Illustrations
Type matter is equivalent to that of a 15 Vol. Encyclopedia

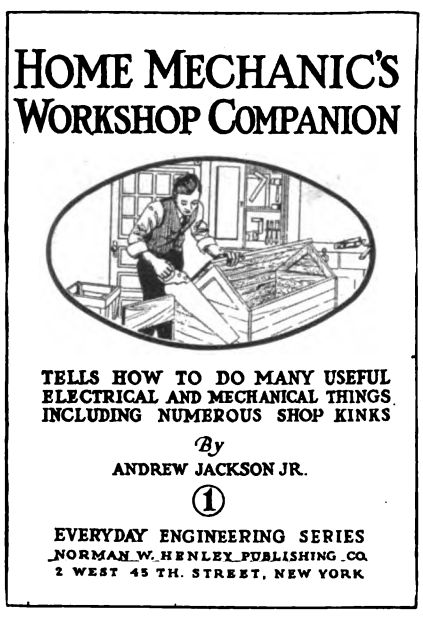
Digitized by Google

Just Published

The Everyday Engineering Handbooks

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man—the Mechanic and the Radio Experimenter

ILLUSTRATED BY SPECIAL DRAWINGS AND PHOTOGRAPHS



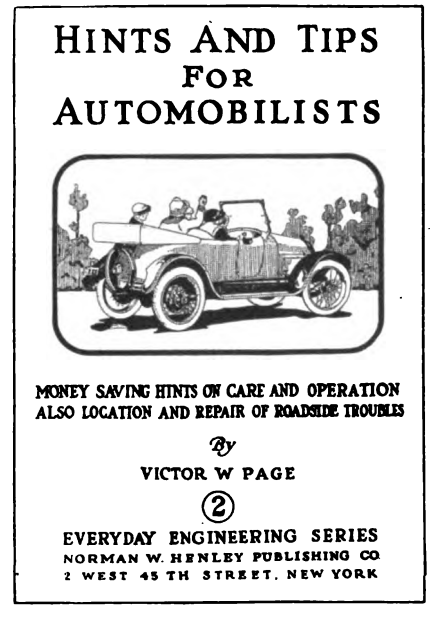
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.

This treatise includes a compilation of useful suggestions that cannot fail to interest the handy man, and while it is not intended for mechanical experts or scientists, it will prove to be a veritable store of information for any one who desires to rig up a small shop where odd jobs can be carried on.

The subject matter is divided in five parts as follows:

Chapter 1—The Home Workshop and Its Equipment. Chapter 2—Special Tools and Shop Expedients. Chapter 3—Useful Home Appliances. Chapter 4—How to Do Things Electrical. Chapter 5—Helpful Recipes and Formulae. The illustrations are especially clear and all suggestions are further amplified or made more easy of comprehension by hundreds of thumb nail sketches made by the author.

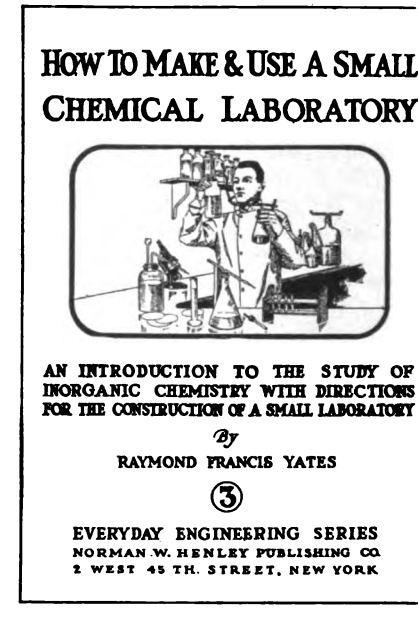


For the Automobile Owner or Driver

This volume is replete with interesting facts compiled by an expert from a mass of information furnished by the Service Departments of leading automobile makers on operation, upkeep, lubrication, location of troubles and simple repairs of automobile parts. The instructions given are concise and to the point and no information that will help in the everyday operation of automobiles is omitted.

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints and a brief simple exposition of location and remedy of roadside troubles apt to occur under ordinary operating conditions.

The permit of logical presentation, the subject matter is divided into four chapters. Chapter 1 deals with the Control and Operation; Chapter 2, Systematic Inspection and Lubrication; Chapter 3, Power Plant and Auxiliary Groups; Chapter 4, Automobile Care and Maintenance Suggestions.



For the Student Chemist and Experimenter

The treatise covers all of the essentials of elementary chemistry. The law of definite proportions, solutions, crystalloids, colloids, electrolysis, etc., are explained. The second part of the book is devoted to chemical and electro-chemical experiments. Only those experiments that will tend to broaden the readers' knowledge of chemistry in general have been chosen.

The third part of the book describes the construction and fitting out of the home chemical laboratory. Directions for the construction of the many simple pieces of chemical apparatus are given. A chemical balance, ring stand, electric furnace, etc., are described in detail, with working drawings. The manipulation of chemical glassware is also treated.

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.

A SPECIAL OFFER TO READERS OF

ANY ONE OF THE ABOVE VALUABLE BOOKS WILL BE

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YO

Fill Out the Special Blank on Page 430 of this Issue. Check Off the Title Desired and Mail with Your Remittance to

Digitized by Google

Just Published

Should be in Every Practical Man's Library

All of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest

RADIO BOOKS CONTAIN MANY WIRING DIAGRAMS

SOLDERING & BRAZING



A USEFUL HANDBOOK FOR MECHANICS

By
RAYMOND FRANCIS YATES

④

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work —something that he may heretofore have forgotten.

Hard soldering, for some reason, is not generally known. Hard soldering, however, is very important and must be used in all cases where soft solder does not possess sufficient strength. Hard soldering and solders are thoroughly covered in the book. Nothing has been omitted that will enable the mechanic to apply hard solder successfully.

Brazing and all of its important ramifications are treated in detail. Brazing, like hard soldering, is a process little understood by many mechanics. The book "Soldering and Brazing" is divided in five parts as follows: Part I—Soft Soldering; Part II—Hard Soldering; Part III—Brazing; Part IV—Heating Devices; Part V—Soldering Notes.

RADIO HOOK-UPS



A BOOK OF THE MOST ADVANCED CIRCUITS OF RECEIVERS, AMPLIFIERS AND TRANSMITTERS FOR DAMPED AND UNDAMPED WAVE WORK:

By
M. B. SLEEPER

⑤

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH. STREET, NEW YORK

For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuits for tuning coils, loose couplers, capacity coupling, variometers and other equipment for receiving long and short damped and undamped waves, damped, undamped and modulated wave transmitters using buzzers, spark coils, transformers, arcs and vacuum tubes, telephone transmitters, laboratory oscillators, vacuum tube characteristic measuring circuits, wave-meters, and audibility meters—in short, diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving constructon or operating details. Spaces are also provided for notes on the results obtained with each diagram. This arrangement, coupled with the skillful selection of the circuits, makes Radio Hook-ups an essential to every radio experimenter or operator.

DESIGN DATA FOR RADIO TRANSMITTERS & RECEIVERS



SIMPLE METHODS FOR DESIGNING APPARATUS ACCORDING TO ADVANCED AND APPROVED PRACTICE

By
M B SLEEPER

⑥

EVERYDAY ENGINEERING SERIES
NORMAN W. HENLEY PUBLISHING CO.
2 WEST 45 TH STREET, NEW YORK

For the Radio Engineer and Student

Far from being a collection of formulas, Design Data takes up in proper sequence the problems encountered in planning all types of receiving sets for short, medium, and long wave work, and spark coil, transformer, and vacuum tube transmitters operating in 200 meters.

Where formulas are difficult, tables have been worked out so that values can be found without the use of mathematics. The few formulas given are so simple that any school boy can solve them. The subjects are so arranged that, having decided upon the type of receiver or transmitter to be built, the reader can locate immediately the problems and solutions required.

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION

OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

EVERYDAY ENGINEERING MAGAZINE, 2 W. 45th ST., NEW YORK CITY

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

PATENTS

RECORD your invention, before filing application, by using my form "FIXING THE ESSENTIAL DATES OF INVENTION," sent upon request with full information. Prompt, personal services by an attorney-at-law having over twelve years actual experience. Reasonable pre-war charges.
B. P. FISHBURNE.
321 McGill Bldg., Washington, D. C.

Professional Assistance and Consultation

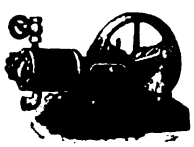
We solicit the patronage of inventors and will give prompt, confidential service in the perfection of ideas. Complete drawings and plans prepared. Specialists in steam and gas engine appliances.

Correspondence Invited.

Let Us Know Your Problem

Bell & Hoyt
1731 Broadway, New York, N. Y.

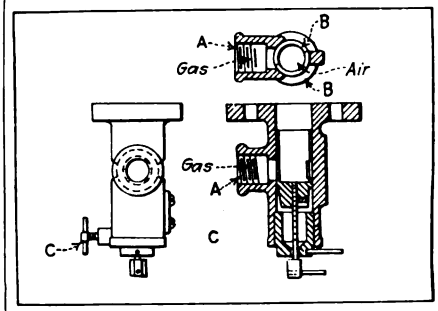
UmakeM Outfit No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.
W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.
MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.

COAL GAS FOR TESTING ENGINES

A PROMINENT automobile maker uses city gas for testing and "running-in" engines in its testing department. The company had constructed a special mixer which fits the inlet manifold and takes the place of the carburetor. This is shown herewith and will prove of value to any of our readers who contemplate using an automobile type engine for stationary power-plant purposes. The housing is a cast iron cylinder having a threaded boss on one side for attaching to the gas supply at A. Level with the gas inlet are two air ports, BB. Threaded into the bottom of the housing is a plug, the object of which is to rotate a sleeve immediately above it around in one direction or the other as may be required for the adjustment; this sleeve is connected to the threaded plug by two sliding keys (not shown in drawing).



Device for using coal gas for running gasoline motor

Running through the plug is a rod threaded at the upper end which permits of the sleeve being raised and lowered as may be required but which will not rotate it on account of the sliding keys that move up and down in corresponding slots in the plug; the plug is locked in position by the screw C. When setting the mixer in testing an engine, the sleeve is first rotated by the plug to obtain the correct proportion of gas and air, usually to a position as shown in section AA. Note that the gas supply is considerably smaller than the amount of air allowed. When this adjustment is made the plug is locked by screw C. Then the speed of the motor can be regulated by raising or lowering the sleeve with the threaded rod running through the plug. This makes a very simple and inexpensive device which is entirely satisfactory. Besides saving on the cost of fuel, it does away with the fire-risk incidental to using gasoline in interior installations.

The gas supply can be regulated by any form of shut-off valve and a rubber gas bag can be used to equalize the pressure. These bags look like a hot-water bottle but have an inlet at one end and an outlet at the other.

Genuine Armstrong Stocks and Dies



Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.

Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.

Send direct to us if your dealer cannot supply you.

Descriptive Catalog on Request

The Armstrong Manufacturing Co.
761 Knowlton Street Bridgeport, Conn.



PREVENT WASTE
Put the Grease
where it is Needed

THE BRIDGEPORT
Center Thread Grease Cup

This cup will squirt more grease than any cup of the same size made.
Equip your machine, auto or boat with this new type of grease cup, one that does not leak, that cannot be cross-threaded and that forces the grease to the bearing points.
The cleanest Grease Cup made.

Send for Circular and Price List

THE GARRISON COMPANY
348 George St. Bridgeport, Conn.

FOR THE PRACTICAL ELECTRICIAN

Wiring a House
By HERBERT PRATT. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules; in fact, just the information you need. Directions apply equally to a shop. Fourth edition. Price, 35 cents

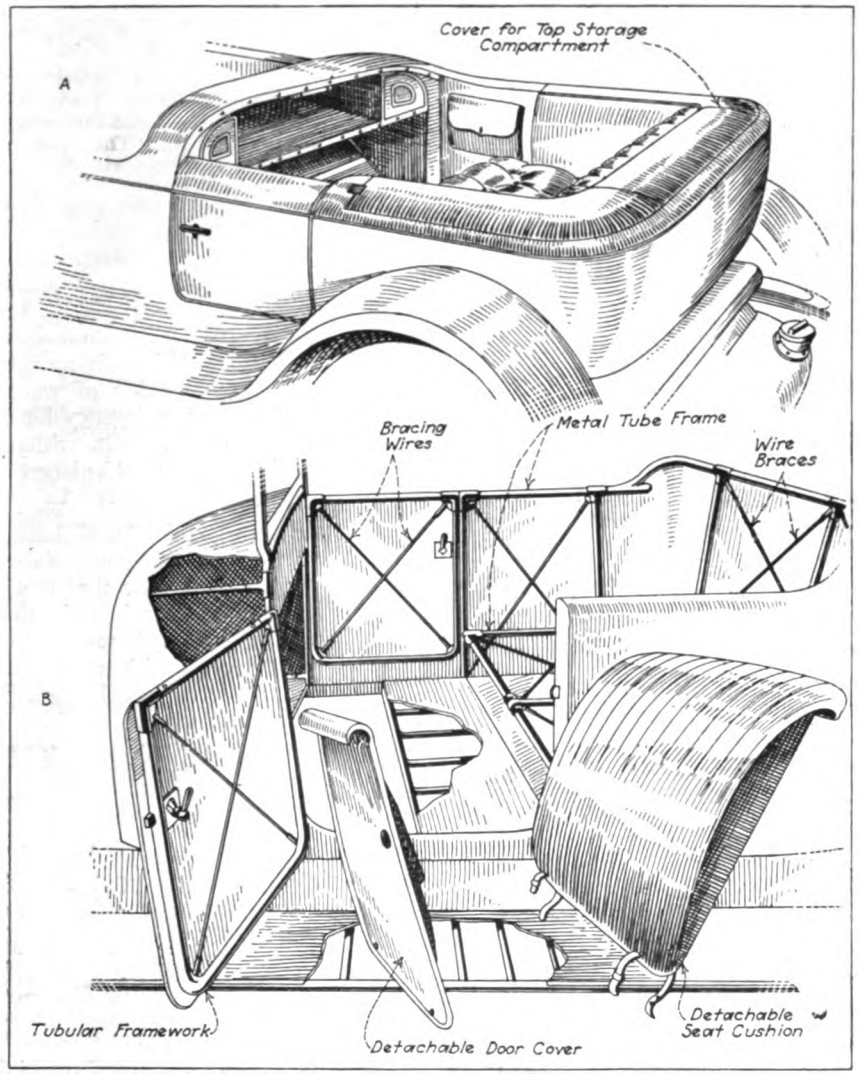
Electric Bells
By M. B. SLEEPER. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated. Price, 60 cents

NORMAN W. HENLEY PUBLISHING CO.
Dept. EE 2 West 45th Street, New York

Digitized by Google

New Foreign Auto Body Designs

TWO very interesting types of motor car bodies are shown herewith, that at A being a touring body having a special compartment built around the rear seat in which the top is stored when it is not in use. The covers provided are easily removed when it is desired to raise the top. A new light metal body is shown at B. In this, aircraft construction principles are incorporated, notably in the arrangement of the tubular metal framing and the use of tension brace wires fitted with spoke nipple ends to lend rigidity to the structure. The exterior panelling is of metal, as are the floor boards and running boards. The cushions and leather door covers are made up of separate units which can be easily attached to the framework and which can be removed very easily when it is desired to clean these members or the body interior. It is stated that this construction makes a very strong and light body for motor cars.



Interesting new foreign automobile body designs

COMPRESSED AIR AS A FIRE SCREEN

A German technical paper treats of methods employed for screening furnaces. Workers who have frequently examined what is going on in the intensely heated and glowing masses suffer much from the heat radiated and various devices have been tried for relief. Hollow, water cooled furnace doors afford protection only when closed. Devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters, the objection to these being that the workers are subjected to too great and sudden changes of temperature. The most effective arrangement is to fix immediately behind the furnace door a narrow, oblong nozzle through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is to give adequate protection to the worker, and has the incidental advantage that when the doors of the furnace are opened the escape of flame is checked and the furnace interior temperature is maintained more constant.

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6073-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BUSINESS MANAGEMENT
☐ BRIDGE DRAFTING	☐ Private Secretary
☐ MACHINE DESIGN	☐ BOOKKEEPER
☐ ELECTRICAL ENGINEER	☐ Stenographer and Typist
☐ Electric Lighting and Railways	☐ Cert. Public Accountant
☐ Electric Wiring	☐ TRAFFIC MANAGER
☐ Telegraph Engineer	☐ Railway Accountant
☐ Telephone Work	☐ GOOD ENGLISH
☐ MECHANICAL ENGINEER	☐ Teacher
☐ Machine Shop Practice	☐ Common School Subjects
☐ Gas Engine Operating	☐ Mathematics
☐ CIVIL ENGINEER	☐ CIVIL SERVICE
☐ Surveying and Mapping	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Marine Engineer	☐ Auto Repairing
☐ ARCHITECT	☐ PLUMBING AND HEATING
☐ Contractor and Builder	☐ Textile Overseer or Supt.
☐ Concrete Builder	☐ Navigation ☐ Spanish
☐ Structural Engineer	☐ AGRICULTURE ☐ Fr
☐ CHEMIST	☐ Poultry Raising ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

HB BATTERY CHARGING PAYS BIG PROFITS

You Can Make $100 to $200 Clear Extra Profit Each Month—This HB 500 watt outfit recharges 1 to 8 6-volt batteries at once for 10c to 15c each. Owner pays 75c to $1.50. Figure those profits! You can build a big, profitable business in battery charging. No mechanical knowledge required. Small investment—long, easy terms—BIG PROFITS.

Small Cash Payment Puts This HB Outfit in Your Shop

Balance on easy monthly terms. Profits easily carry payments. No burnouts, no expensive renewals—steady, dependable service, with BIG PROFITS. Absolute Money-Back Guarantee. Tear out this ad and mail TODAY for information.

HOBART BROTHERS COMPANY
Box EE31 Troy, Ohio
Successful Mfrs. Since 1893



Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF II SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

Send for This Book of Model Aeroplanes

Tells how you can build and fly accurate, reduced-scale Models of real Aeroplanes; DE HAVILLAND Battle Plane, NC-4 and others. You can build one easily. Send 10c in stamps NOW and get this 48-page book. Plans for Model Aeroplanes—NC-4, 50c; DE HAVILLAND Battle Plane, Curtiss Military Tractor, Bleriot Monoplane, Nieuport Monoplane, Taube Monoplane, 35c each; Cecil Peoli Champion Racer, 25c. Send for Plans or Book Today.



IDEAL AIRPLANE & SUPPLY COMPANY

Making Model Aeroplanes Since 1911

Cor. W. Houston & Wooster Sts. New York

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 7493 431 S. Dearborn St. CHICAGO

UmakeM Airplanes

Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

MODEL ENGINE CASTINGS

For engines described in previous numbers of "Everyday Engineering." Castings made in Bronze or "Duralite." Model water pumps also supplied.

J. E. CARRINGTON

49 So. Clinton St. East Orange, N. J.



Glide "O" Plane

Learn the principles of Aviation by flying our famous Glide "O" Plane, shipped complete ready to assemble and fly with illustrated flying instructions. PRICE 55 Cents POSTPAID IN U.S.A.

Illustrated instructions from which you may carve an accurate propeller complete with a sample propeller blank. 30 Cents POSTPAID IN U.S.A.

Both the above postpaid in U. S. A. 75 Cents. Send for our catalogue D4. It is free.

HEC Aeroplane Co.

345 East 49th St., New York City

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS

Official Organ: American Radio Relay League

Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work, all A.R.R.L. News, Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER

Regular price $1.50 per year, 15 cents per copy. Introductory rate: 9 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

Enclosed find $1; please enter my trial subscription to QST for 9 months.

Name_____

Address_____

COLLAPSIBLE FLOATS

A DESCRIPTION of collapsible floats has appeared in a recent issue of *L'Aerophile*, this detailing another interesting war development which the censor kept secret. Two or more floats of rubberized fabric are rolled up and stowed at any convenient place under the wings or fuselage, and these can be filled by means of a compressed air apparatus in thirty seconds. The number of compressed air containers required is reduced by the addition of an injector which draws in external air to assist in the inflation process.

The wheels of the chassis may be dropped off before alighting on the sea, but it would seem unnecessary to do this if the air bags were properly placed and proportioned. In addition a hydrovane is fitted to the chassis to prevent too great a shock to the inflated floats when they strike the water.

These air-bag floats may have considerable value for ship airplanes, allowing land machines to be used in lieu of seaplanes, which of course are much less speedy for the same power. They may also prove useful in commercial single-engine land machines flying over country with large stretches of water, as they will permit of emergency landings in case the motor fails without serious damage to either airplane or pilot.

VARIABLE PITCH PROPELLERS

LATE experiments with the variable pitch propeller indicate that it offers practical possibilities both in this country and Europe. Such mechanism will always be viewed with a justified prejudice by the aeronautical engineer as well as the flier, who dread the introduction of any additional mechanism to the airplane, no matter how simple it may appear to be.

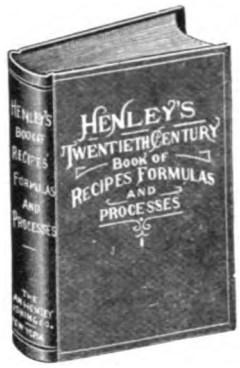
It is interesting to note that French engineers are considering another solution of the variable pitch propeller. A foreign designer proposes to have two two-bladed airscrews, one for taking off and climbing to 5,000 yards and the other for use at higher altitudes. The altitude screw will be free during the first part of the climb and be brought into service only as needed by a special clutch, thus converting the two-bladed screw into a four-bladed one at will. What will be done with the idle screw while climbing or at low altitudes so it will not increase the parasitic resistance or complicate matters must be guessed at until more details are available.

Photographers use spring clothespins to suspend their films and prints with when drying. An ingenious proposal is to make a sort of replica of such clothespins out of a couple of pieces of cork and a rubber band, avoiding the use of any metal. Prints or films can be held by this and put into a rather deep bath for washing. The cork will keep them floating near the surface in the best possible position for quick washing, and the operation is considerably expedited.

Digitized by Google

The Greatest Book Ever Offered to the Public

Henley's Twentieth Century Book of
RECIPES, FORMULAS AND PROCESSES



10,000 Trade Secrets, Practical Recipes, Chemical Processes, Scientific Formula

HOW TO MAKE EVERYTHING
FOR THE HOME, THE FACTORY AND THE WORKSHOP.

Antiseptics, Waterproofing, Lubricants, Rust Preventatives, Dyes, Filters, Cleaning Preparations, Enameling, Beverages, Inks, Adhesives, Polishes, Disinfectants, Flavorings, Cosmetics, Ceramics, etc., etc.; how to make fly paper; to color flowers artificially; to estimate weight of ice by measurement; to make materials fireproof; to work with metals — aluminum, brass, etc.; to make anything and everything, from A to Z.

THIS IS THE BOOK
every one who seeks PRACTICAL, ACCURATE KNOWLEDGE and guidance in his everyday work MUST HAVE at his command.

It is a money-maker and a money-saver; it appeals to the young as well as to the old. Great business enterprises owe their success to the manufacture or sale of simple inventions or compounds, usually the result of an experiment at home. One woman writes: "I am supporting myself and two small children from the sale of toilet articles I put up by following directions in your book." Profit by the knowledge that has made others successful. GET THIS BOOK TODAY.

Price $4.00

Delivered to any address

Send for our catalogue of practical books including a description of above book.

THE NORMAN W. HENLEY PUBLISHING COMPANY
2 West 45th St., New York, N. Y.

Book Review

AIRPLANE DESIGN AND CONSTRUCTION, by Ottorino Pomilio. Published by the McGraw-Hill Book Co., New York. 400 pages, 6 x 9 in.; 248 illustrations.

Pomilio is a name well known in the aircraft industry, as the Pomilio Bros. developed an aircraft plant in Italy, which later was taken over by the Ansaldo interests after which they came to this country and organized the Pomilio Bros. Corporation. Previous to the signing of the Armistice, this firm completed a number of different aircraft models which were submitted to the Government for tests.

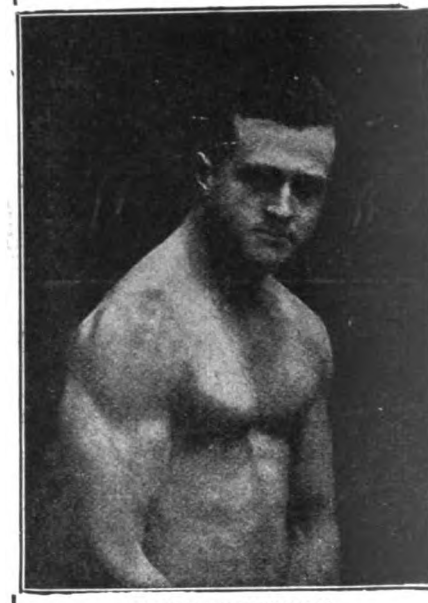
With a complete experience in the design and construction of airplanes, the author is well qualified to write on the subject. His book is a text of real engineering value dealing with the subject in an analytical way. The entire subject is treated in a complete and systematic manner. The author enumerates and defines the functions of each of the principal parts of an airplane, and considers the general laws of aerodynamics. In subsequent chapters, he gives a detailed treatment of the individual parts and a discussion of the laws of flying. The engine is dealt with only from the airplane designer's point of view, and its design is not discussed.

The text is divided into four parts, as follows: Part 1, Structure of the Airplane; Part 2, Elements of Aerodynamics; Part 3, Problems of Efficiency; and Part 4, Design of the Airplane. While considerable use is naturally made of mathematics, all of it is quite simple, and there seems to be no unnecessary mathematical treatment such as many engineering writers use for embellishment. There is much tabular material in the volume, relating to the properties of materials and other matters. The calculations are illustrated by examples of airplane design carefully worked out. English weights and measures are used instead of the usual metric system found in books of a foreign flavor. It is an authoritative and well written treatise that can be included in the library of anyone interested in the engineering side of aeronautics.

Radium gun sights for use in night work have been extensively made. They are so mounted on the gun that they can be pressed down out of the way in daytime. A glass tube one centimeter long and a little over a millimeter in diameter contains the luminous compound, a mixture of the radium salt with zinc sulphide. 0.4 milligram of radium bromide is used for a gram of the zinc salt. The latter, it is stated, must be impure, although the nature of the impurity is not known. For the tubes soda glass proved to be the best, as it turned only amethyst in time, while potash glass turned brownish.

What Would It Mean *to You* to Have Muscles Like These?

It would mean tremendous strength, putting you in a class above your fellows. It would mean that you could outdo them in feats of strength and be a leader of men. It would mean a strong personality because of your commanding appearance, thereby assuring you of success in both the business and social world. It would mean added lung power, unlimited vitality and perfect health; removing all fears of constipation, indigestion, etc., which undermine the average man and make him old long before his time.



EARLE LIEDERMAN
The Acme of Physical Perfection

All These Things Are Yours

I absolutely guarantee to do all this and more for you. I have found the short cut to physical perfection and applied it on my own body, proving its results. I have personally trained many of the world's strongest men by this same method. Why waste your time and money with old-time worthless methods? If you are desirous of being a real robust man, follow the path of those who have already made a success. Come now, get busy, for every day counts.

Send for MY NEW BOOK
"Muscular Development"

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN
Dept. 707, 203 Broadway, New York

EARLE E. LIEDERMAN,
Dept. 707, 203 Broadway, N. Y. City.

Dear Sir:—I enclose herewith 10c for which you are to send me without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write or print plainly.)

Name .....

Address .....

City .....State .....

Digitized by Google



NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4 H. P., 110 volts, induction, full load start - - $24.50
1/2 H. P., 110-220 volts, induction, full load start - $38.50
1/2 H. P., 110-220 volts, repulsion, for compressor $46.50
1 H. P., 110-220 volts, repulsion, with sliding base - - $67.50
2 H. P., 110-220 volts, repulsion, sliding base $108.50
3 H. P., 110-220 volts, repulsion, sliding base $124.50
5 H. P., 110-220 volts, repulsion, sliding base $164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

6 volts, 10 amp. $16.50
15 volts, 10 amp. $21.00
40 volts, 6 amp. $24.50
110 v, 2½ amp. $24.50
40 volts, 12 amp. $38.50
110 volts, 5 amp. $38.50
40 volts, 25 amp. $58.50
110 volts, 10 amp. $58.50
Moving Picture Arc Generator $85.00

Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 R.P.M., complete with base and pulley.

½ H. P. - $42.50
1 H. P. - $59.50
2 H. P. - $72.50
3 H. P. - $84.50
5 H. P. - $102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only - $36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt, 24 volts, without switchboard $40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard $68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard - $75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard - $85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard - $85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard $110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard $125.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL 1/4 H.P. 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $19.75 EACH Reg. Value $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

SHIP BY TRUCK

Motor Cartage.

One to Five-ton Trucks.

Hauls made to any point in United States and Canada.

Rates by hour, day or contract.

W. H. SQUIRES
1561 Woodward Avenue
Detroit, Mich.

NEW PLUGS FOR OLD

Your used Spark Plugs made new by our process.

We clean and repair any Spark Plug.

AGENTS wanted.

SPARK PLUG SERVICE CO.
6 Hendrie Ave.
Detroit, Mich.

A Necessity for Every Shop

"The Samson No. 3 Bench Punch," with a powerful leverage of 24 to 1, is intended for work beyond the capacity of the "Samson Hand Punches," and will punch holes from ⅛ to ⅜ in. in soft metal up to 12 Gauge. Extra sets punches and dies size ⅛, 3/16, ¼, 5/16, and ⅜ in. easily inserted and removed. (maximum punching capacity 3/16 in. through 12 gauge soft metal.)



Equipped with 3-16-inch Punch and Die unless Otherwise Specified. Price $12.50 F.O.B. Factory

Catalog of Complete Line Sent on Request.

The Machine Appliance Corporation
351 Jay Street, Dept. Eng. BROOKLYN, N.Y.

REWINDING A. C. MOTORS

And all methods for connecting and reconnecting are clearly shown in the ELECTRICAL WORKERS FRIEND. 66 diagrams with detailed explanations solving every rewinding and reconnecting problem. Electricians and Experimenters will find this book exactly what the name implies "The Electrical Workers Friend." Price $4.00 Cash with order or (C.O.D.—U.S.A. only).

HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Penna.

EVERYDAY ENGINEERING MAGAZINE
Is Now 20 Cents Per Copy
SUBSCRIBE AND SAVE MONEY

CHEMIST AMAZING DISCOVERY "MOTOROL"
ONE DOLLAR POSTPAID 25 to 40% more miles per gal. 25 to 35% more power.
Agents wanted. Starts your engine on a cold day instantly.
Eliminates Carbon Deposits, less wear and tear on motor.
AUTO PRODUCTS CO.
Dept. 66 468 West 145th St., N. Y.

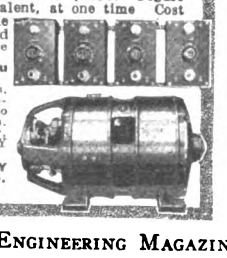
$210 PROFIT IN 4 HOURS
SELLING MIRACLE MOTOR-GAS

That's what O. V. Darling, South Bend, Ind., made. 3c worth equals gallon gasoline. Prevents carbon. Motorists amazed, eager to buy, become steady customers. More mileage, power, speed guaranteed. **Exclusive Territory. 300% Profit.** Agents everywhere coining money. Dave Isom, Boise, Idaho, wires: "Ship 500 packages. Made $60 yesterday". You should do as well Write or wire for territory today.
C. A. BUTLER CO. 523 BUTLER BLDG., TOLEDO, O.

Big Profits in Battery Charging with the HB 32-Battery Charger

Start Your Battery Business NOW—Make $150 to $350 Every Month

NOW is your opportunity. Make $150 to $350 Clear Profit every month with this HB Charger. Recharges 10c to 15c each. Owner pays 75c to $1.50. Figure 32 6-volt batteries, or equivalent, at one time Cost the profits. You can make BIG PROFITS and build a permanent business. Others are doing it—YOU can, too.
Small Cash Payment Brings You This Money-Maker
Balance on easy monthly terms. Profits easily pay for outfit. Absolute Money Back Guarantee. No expensive repairs or replacements. Runs 24 hours a day. Big, steady, profitable income. Write TODAY for full information.
HOBART BROTHERS COMPANY
Box EE33 Troy, Ohio.
Successful Mfrs. Since 1893



A PRACTICAL BLUE-PRINT PROTECTOR

BLUE-PRINTS are always getting dirty, wet, greasy or torn while being handled by workmen using them. An inventive genius has designed a very practical blue-print protector of simple construction and low cost. A sheet of transparent sheeting—the same material used for lights in auto curtains—is cut to desired size. A piece of lightweight leather substitute is then cut about a half inch larger all around than the piece of sheeting. This extra half inch allows for a lap-over on all but the top side of the protector. A sewing machine stitches the lap down to the sheeting, forming a large flat pocket, open at the top for the insertion of the blue-prints. Both the transparent front and the coated fabric back are waterproof and grease-proof. Dirt or grease may easily be wiped or washed off either without injury to the material. Both materials are flexible and the holder may be rolled up if desired in the same way an unprotected blue-print is usually handled by a workman.

MAGNETIC METHOD OF TESTING HARDNESS

An engineering firm in England has developed a system for testing the physical qualities of steel after heat treatment by means of the magnetic method. The principle is that the magnetic retentivity of a steel is a function of its hardness. First a specimen (usually a turned piece 3 in. long by ½ in. diameter) is heat treated as desired. It is then tried for magnetic hardness by being placed inside a standard magnetizng coil, and a direct current from the mains connected to the coil for an instant which magnetizes the steel to saturation. The specimen is then removed from the coil and is placed in a small search coil, which is coupled to a Grassot fluxmeter. The specimen is then sharply removed from the ballistic coil and a reading is obtained on the fluxmeter, which represents the hardness of the specimen. The scale of the fluxmeter is divided in terms of Maxwell-turns. With the search coil of correct design, the reading is also given in terms of C. G. S. units. Soft steel has less retentivity than hardened material and the magnetic flux will vary with the hardness of the specimen, so by comparison with known standards, a suitable calibration permits of determining the efficiency of the heat treatment with considerable precision.

In a recent investigation it was found that 3,717 American locomotives had mechanical stokers. The engines burned 10 per cent. to 40 per cent. more coal than when hand-fed, but hauled more and developed a better engine performance.

Digitized by Google

SUBSTITUTE FOR PLATINUM CRUCIBLES

A gold Palladium alloy, under the name of "Palau," has been put on the market by a firm in California and is offered as a substitute for the more expensive platinum-iridium alloy generally used by chemists. A crucible of this ware has been tested at the United States Bureau of Standards. The loss in weight on heating to 1,200 deg. C. is intermediate between that suffered by crucibles of platinum containing 0.6 and 2.4 per cent iridium, respectively. The melting point of the alloy is 1,370 deg. C. which corresponds to that of on alloy of 80 per cent gold and 20 per cent platinum. In resistance to most of the chemical reagents to the action of which such is ordinarily exposed, "Palau" compares very favorably with ordinary platinum ware. The one noteworthy exception is fused alkali pyrosulphate, which attacks it much more than it does platinum. The ware is very promising as a substitute for platinum for many laboratory purposes.

ALLOY FOR FINE CASTINGS

For making the finest quality of fine sand castings, such as used for models, tablets and ornamental work, the following mixture cannot be surpassed, and probably is unequaled:

Copper	90 parts
Tin	7 parts
Zinc	2 parts
Lead	1 part

It is unnecessary to say that for such work it is unwise to use scrap metals, and only the best new metals should be employed.

It is said that artificial graphite has particular advantages as a facing in making fine alloy castings. Its purity prevents it from slagging when the hot metal strikes it and a smooth skin results on the casting.

NICKEL PLATING ALUMINUM BY A NEW PROCESS

A METHOD of nickel plating aluminum is given in a French journal. Remarkable results as regards adherence of the plating is claimed. The aluminum is cleaned by treatment with caustic soda solution, then with milk of lime brushed on; it is next immersed for a few minutes in a 0.2% solution of potassium cyanide and washed. A bath of 1,000 parts of an equal mixture of water and hydrochloric acid with 1 part of iron dissolved in it is next employed. In this the aluminum is immersed until it shows colors due to the precipitation of iron either metallic or as some compound upon its surface. It is then washed and nickelled. The salt recommended is nickel chloride, instead of the sulphate generally employed. There is a deposit containing 0.25 to 0.50 gram of metallic iron to the square meter—a very minute quantity, and whose action is a mystery, although efforts have been made to determine the exact role played by the iron salt in the process. The plated metal can be bent and heated without injury up to the point, as regards the heating, when the aluminum melts.



Earning $9.50 in Two Hours
with an Auto-Wheel Coaster
and Some Old Boxes

A San Francisco boy turned the trick. Just before a big Frisco parade he loaded his Auto-Wheel Coaster with a lot of empty wooden boxes. Then he started through the crowds. The people almost fought each other to buy boxes at 25c. each—to sit on. He handled $5 worth of stock at a time, fitting the boxes one inside the other. The Auto-Wheel carries 1000 pounds with ease.

Do You Know the Story of Auto-Wheel Wagons?

The AUTO-WHEEL COASTER is an all-round wagon for hauling and coasting. The CONVERTIBLE ROADSTER is two wagons in one. One minute it's a box wagon. Swing the sides up and you have a racer.





Auto-Wheels are sturdy, easy to steer, fast, good-looking. Roller Bearings. Dependable Brake.

Auto-Wheel Magazine FREE. Get on mailing list. Send names of three coaster dealers, telling which handles Auto-Wheel. We'll send Magazine and descriptive Booklet FREE.

Organize Auto-Wheel Coaster Club. Write for plan of giving free caps to members, and special cap to Captain. Address

BUFFALO SLED COMPANY,
159 Schenck St., N. Tonawanda, N. Y.
In Canada: Preston, Ont.

REAL INDOOR FOOTBALL



A new game that gives you all the sport and thrill of a regular outdoor contest.

The players must make their own choice of moves and direct the operation of their teams just as if they had live men on the field.

Every point in the real game is covered and every move can be duplicated.

The most exciting game on the market to-day. You'll never grow tired of it. Attractively put up—with full directions.

Shipped Anywhere in United States **$1.00** **postpaid**

Order today while they last

UNIQUE GAME & TOY SERVICE
1328 Broadway, New York City

STUDY HUMAN NATURE

MAKE PEOPLE LIKE YOU
Get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "PERSONAL POWER," a little book that points the way. Address
PROGRESS LEAGUE, 5831 Union Sq., N. Y.

UmakeM Club You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 19 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.
W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 5th Ave., N.Y.

Earn $35 to $100 a Week
BECOME A PROFESSIONAL
PHOTOGRAPHER





Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:
MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free
Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.
N. Y. INSTITUTE of PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.



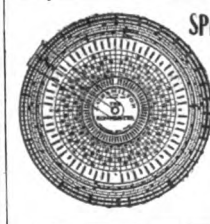
10 Cents a Day Pays for This Symphonola

Plays all records, Victor, Columbia, Edison, Pathe, Little Wonder, Emerson. Take a year to pay, after 30 days' trial. Compare its tone for clearness, volume, with more costly instruments. Return at our expense if it fails to make good. Ask today for the
Beautifully Illustrated Symphonola Book FREE
Shows this and other Symphonola styles sold on easy payments.
Symphonola Records Get our list of the latest song, dance, popular, clear sounding, full toned disc records. Playable on any Phonograph.
Larkin Co. Desk SEE 320, Buffalo, N. Y.

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46M, E. 12th St., N. Y., U.S.A.



SPECIAL KON-VER-TER SLIDE RULE

The original KON-VER-TER slide rule has over 8,000 graduations and over 1,800 letters and figures, will handle anything in Arithmetic, Algebra, Geometry or Trigonometry. Is 5.4 inches in diameter and in use all over the world, is much simpler to operate than others of similar construction. Eventually you will get the KON-VER-TER—get it now and save money. Plain Utility rules $1.00; Special De Luxe white Ivory celluloid $2.50. Leatherette case 50c extra.
J. C. HAMILTON & CO.
Dept. F-7 Water St., Boston, U.S.A.

MECHANICAL DRAWING

Successfully taught by mail. Learn to make and read drawings and become a Mechanical Draftsman. Fifty cents each lesson, pay as you go. No other expense. Complete drawing outfit valued at $20.00 free with the Course. One hundred blue-print lessons. Will assist you to secure good paying position when qualified. Send for particulars and sample lessons. **50¢ Per Lesson**
ALBANY INSTITUTE MECHANICAL DRAWING
Desk C, Lock Box 84, Albany, N. Y.

$110 A Month To Start As Railway Traffic Inspector



ONLY THREE MONTHS' spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad-minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today, and they're on the road to still further advancement, so write immediately for Booklet D 48 before you turn this page.
WE ARRANGE FOR A POSITION
Standard Business Training Institute, Buffalo N.Y.

Digitized by Google

PUMPING WATER WITH A SPIRAL SPRING BELT

WHAT the eminent British scientists are pleased to call a "mechanical impertinence" has recently made its appearance in England, in the form of a unique pump which works by means of a spiral spring belt. The pump consists simply of a spiral spring belt, a grooved weight which turns with the bottom loop of the belt and holds the latter in place, and a driving crank and pulley for turning the belt. Despite this simple construction the pump is capable of lifting a thousand gallons of water per hour from a depth of 300 feet, even when worked only by hand, according to reports. The coil-like cable is sunk to any depth by a rotating weight Obeying the law of capillary attraction, the water lodges between the turns of the spiral spring and only falls out when it reaches the top of the pump.—*Scientific American.*

Burnt earth or burnt brick clay, which has passed through a one-inch sieve and been held by a one-quarter-inch sieve, has been found available in England for making concrete where broken stone was not to be had. In South America experiments have been carried out, in British Guiana, with ligno-concrete, which is concrete reinforced with wood strips in place of steel bars. A wood called green heart was used. It was employed in strips, two inches square and two by three inches. A twelve by twelve inch pile, reinforced by two of each size, a total of four strips, carried some two hundred pounds more than a similar pile with five steel reinforcements, round in section and ¼ inch in diameter. Neither was tested to destruction in this test. In another trial a beam with two by three inch reinforcement collapsed under a load only 10 per cent. less than that required to break down a similar beam reinforced with ⅝ inch steel bars. There were two of the steel bars of this size and only one of the green heart, the wooden one three by two inches. It was found that the wood should be soaked in water for at least twenty-four hours.

Explosives, no longer needed for the destructive operations of war, are being made into fertilizers. All explosives contain the essential fertilizing element, nitrogen, and this is put into assimiltable form for the nourishment of plants. Ammonia products and nitric acid salts are mixed with powdered peat, and the final product analyzes well. The Italian government has been conducting the experiments, which promise to yield good results.

An interesting method of determining the percentage of sulphur dioxide, which in solution forms sulphurous acid, has been published. The solution is treated with an excess of hydrogen dioxide; this converts the sulphurous acid into sulphuric acid. Dilute sulphuric acid is then added and the excess of undecomposed hydrogen dioxide is determined by titration with manganese permanganate.

The Illinois Central R. R. has tried a concrete gondola car, capable of carrying 50 tons or more of coal. Its somewhat excessive weight of 53,600 lbs. it is thought can in future constructions be reduced to 46,000 to 48,000 lbs. The Portland cement used was mixed with burnt shale.

CAN YOU GET MORE FOR YOUR MONEY?

WHAT IS $2.00 WORTH ?

In twelve numbers of Everyday Engineering there is the equivalent of:

2 BOOKS ON MODEL MAKING, WORTH..... $ 6.00
1 BOOK ON AUTOMOBILES, WORTH..... 3.00
1 BOOK ON AIRPLANES, WORTH..... 2.00
2 BOOKS ON WIRELESS, WORTH..... 6.00
3 BOOKS ON GENERAL EXPERIMENTS, WORTH... 10.00

A $2.00 subscription to Everyday Engineering is equivalent to $27.00 worth of books

Telegraph Pictures
BY ELECTRICITY



A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.
L. J. LEISHMAN CO. Dept. L, Ogden, Utah

SEND $1. TODAY

For One Hundred Successful Circular Letters. No two copies alike. Letters that pulled business in 100 different lines of business. This is not a book that tells "How to Write Letters," but gives the complete copies of each letter. Worth their weight in gold. Special letters prepared on every subject, $5. each. Three follow-up letters, $15.00. These letters are endorsed by advertising agencies and the press.

Established Reputation (25th Year)
ROSENBLUM ADVERTISING EXPERT
1482 Broadway, New York City

Stop Forgetting — **Memory the Basis of All Knowledge**



The Key To Success
The secret of business and social success is the ability to remember. I can make your mind an infallible classified index from which you can instantly select thoughts, facts, figures, names, faces. Enables you to concentrate, develop self-control, overcome bashfulness, think on your feet, address an audience. Easy. Simple. The result of 20 years' experience developing memories of thousands.
Prof. Henry Dickson, Principal
Write Today for free booklet "How to Remember" and Copyrighted Memory Test, also how to obtain my FREE book, "How To Speak In Public."
Dickson School of Memory, 1740 Hearst Bldg., Chicago, Ill.

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

Don't Wear a Truss



Mr. C. E. BROOKS

Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.

Brooks' Rupture Appliance

Has automatic Air Cushions, Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.
Brooks Appliance Co., 264A State St., Marshall, Mich.



Small Investors Wanted

To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.
For full particulars address
Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit, and low price.
At Drug Stores or sent direct $1.00
Send for booklet of other styles and prices
J. C. SCHNOTER CO.
523 SIXTH AVE. Dept. E N. Y. CITY

Mathematics Made Easy



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.
Dept. U, L. J. LEISHMAN CO., Ogden, Utah

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing Lists St. Louis

DRAFTING
Inventions and Ideas Developed!
Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE
A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

KLEANE-Z-SUSPENSORY
FORM FITTING FOR ALL MEN
LINEN (MESH) $1.50



PRICES
Balbriggan $1.25
Linen (Mesh) $1.50
Fine Glove Silk $2.00
Heavy Silk (Mesh) $2.50
A CLEAN SACK EACH DAY
ALL SIZES
One Extra Sack
At your dealers or sent postpaid on receipt of price.
A. R. CHISHOLM CO., New York, N. Y.
Suite 597 1328 BROADWAY

Digitized by Google

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.

Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop then. PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs. Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School

YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

"Old Town Canoes"

OLD TOWN CANOE CO.
943 Fourth St.
Old Town, Maine, U. S. A.



Every Stroke Counts

Laze along in the alder shadows or shoot through swift water, an "Old Town Canoe" will obey every move of your paddle. Light as a bubble, graceful as a swan, but staunch as a scow. The "Sponson Model" is the safest canoe made—safer than most row boats. Write for catalog. 3000 canoes in stock. $67 up. At dealer's or factory.

PRINCE ALBERT

the national joy smoke

Our exclusive patented process cuts out bite and parch.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 906 Bogue Bldg., Indianapolis

UmakeM Lathe

You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $25. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

$1 Week



Nature's Lure

The freedom of riding anywhere is yours if you own a Black Beauty. The speediest, classiest bicycle you ever laid eyes on.

We want to send you this wonderful bicycle. Write for big, free catalog illustrating many styles. Pick out the one that appeals to you.

We ship at our risk. We pay freight. After examining it you pay a small deposit. Then, send a dollar a week. No waiting to save up.

18 Exclusive Features—Remember the Black Beauty is a **real** bike. Chock-full of "class." Graceful lines. Powerful steel construction. Fascinating color combinations.

Factory Wholesale Price
You save money by our "direct-to-you" plan.

Repair Kit, Tool Case and Stand Free! Don't wait. Write for Catalog **now!**

Sundries Get our factory prices first. Lowest anywhere. Tires, stands, horns, lamps, parts, etc. Sundries Catalog sent free.

Haverford Cycle Co.
Established 24 Years
Dept. 473 Philadelphia

pays for the **Black Beauty.** **FREE** Catalog in colors

SAFETY RAZOR BLADES

Safety Razor Blades, all makes sharpened with the "Minit Sharpner." Can be carried in the vest pocket. 50c postpaid.

Send 60c and get a Sharpener with a "Sail me" Airplane; fun and instruction for the kiddies. Airplanes singly, 15c postpaid.

OLDWELL MANUFACTURING COMPANY
240 Broadway, Room 11, New York, N. Y.

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into positions just as soon as they are ready. Good salaries are offered to start with splendid chances for rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6074-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Ship Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREM'N OR ENG'R
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Navigator
- ☐ CHEMICAL ENGINEER
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Window Trimmer
- ☐ Show Card Writer
- ☐ Outdoor Sign Painter
- ☐ RAILROADER
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Pub. Accountant
- ☐ Traffic Management
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ STATIONARY ENGINEER
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE
- ☐ Poultry Raising
- ☐ Automobiles
- ☐ Spanish
- ☐ French
- ☐ Italian

Name _____
Present Occupation _____ 7-26-19
Street and No. _____
City _____ State _____

Digitized by Google

Benzol-Alcohol Fuel Mixtures

(*Continued from page* 420)

stance, because wood alcohol tends to produce acetone and other compounds which are of corrosive nature and which might corrode the metal parts of the cylinder which were exposed to the effects of a by-product resulting from incomplete combustion of such a vapor.

Alcohol has the advantage in that the fire risk is less than with gasoline. The latter is a more volatile liquid than alcohol, and is more dangerous because it evaporates more readily. The flame of burning gasoline is one which radiates heat rapidly, whereas the alcohol flame does not radiate heat to such an extent. A mass of burning gasoline will generate sufficient heat to set objects at a considerable distance from it on fire. The heat from burning alcohol goes upward and exists mostly in the hot gases evolved by the flame. A gasoline fire is spread by water, whereas burning alcohol may be extinguished by it. Gasoline is much lighter than water and floats on its surface, but alcohol is so nearly the same density that it will mix with the water.

If one compares the chemical composition of alcohol and gasoline it will be found that it requires less air to burn a pint of alcohol than the same amount of gasoline. The oxygen contained in the alcohol tends to make combustion better, and there is practically no residue left in an engine burning alcohol gas. The exhaust from any of the petroleum distillates will smell strong and be smoky if an excess of fuel in proportion to air is in the mixture. The burned products of an alcohol mixture are not objectionable even if there is an excess of alcohol. These exhaust gases, besides being more agreeable to the senses, are cooler and cleaner, and as they contain a smaller proportion of free carbon less of this is deposited in the combustion chamber and muffler.

Among the conditions which are unfavorable to the use of alcohol and which militate against its use at the present time can be cited the present types of engines and carburetors, and the high price of denatured alcohol. While alcohol has not been extensively experimented with in this country, because the supply of gasoline at the present time seems adequate, it is expected that, should there be a shortage of this use of alcohol in connection with present-day forms of motors. Some authorities contend that alcohol will be the fuel of the future, while others believe that kerosene is more adaptable for use in the hydrocarbon motor.

Alcohol-Benzol Fuel.—According to reports, the Germany army automobiles were being run on a mixture of benzol and alcohol. As soon as Germany found herself cut off from outside supplies of gasoline a technical committee was appointed to find a substitute. Experiments were carried out with a 1914 Mercedes touring car equipped with an ordinary carburetor, when mixtures of alcohol and benzol were found to give satisfactory results. Summarized, the results obtained in these tests were as follows:

Benzol	Alcohol	Speed Obtained M. p. h.	Miles on 1 Liter of Fuel
1 part	1 part	42.2	4.66
1 part	2 parts	41	4.4
1 part	3 parts	39.1	4.3
1 part	4 parts	38.5	4.1
1 part	5 parts	36	3.7
Benzol only		41.6	3.79
Gasoline only		43.49	3.6

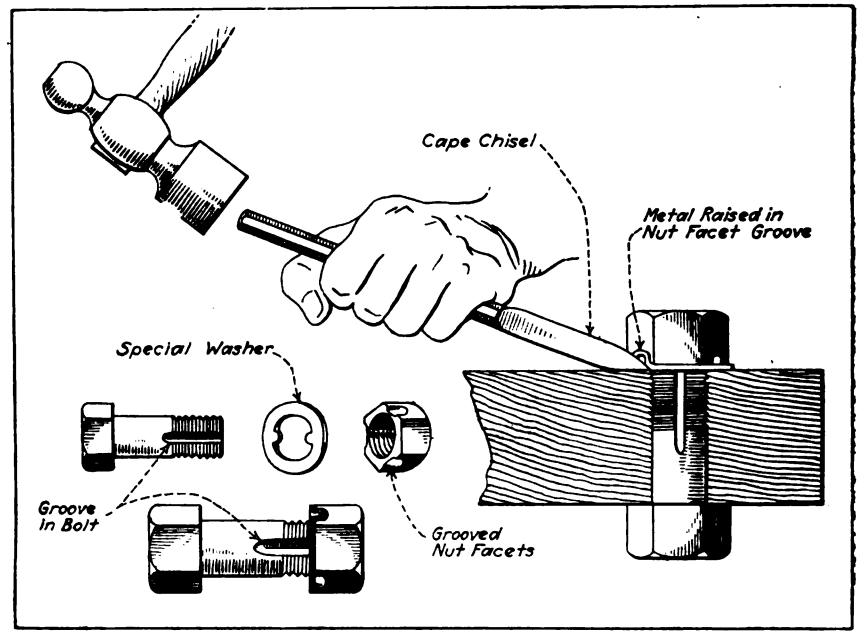
Calculating on the rates existing before the war, the benzol-alcohol mixture is the cheapest fuel obtainable. One liter of gasoline costs 9 cents, benzol 8.6 cents, and alcohol 8.2 cents. The cost per kilometer works out as follows:

	Cents
Gasoline	0.0157
Benzol	0.01362
Alcohol-benzol, 50%....	0.0125
Pure alcohol.....	0.0167

This shows that a 50 per cent. mixture of alcohol and benzol is the most economical, and it is this fuel which has been used throughout the German motor transport service. The only inconvenience experienced is the necessity of a preliminary heating of the carburetor. Starting the motor is a difficult task, and on several occasions when the army has been retreating automobiles have been abandoned on this account. This difficulty has been overcome by fitting a secondary tank containing a small quantity of gasoline or ether. A three-way cock allows the supplementary tank to be put into connection with the carburetor for starting purposes. As soon as the motor is warm the reserve fuel is shut off and the alcohol-benzol mixture supplied to the motor. In case of a breakdown near the enemy's lines, or the loss of the main fuel through a bullet or piece of shell entering the tank, the reserve supply is used. This is able to take the vehicle ten or twelve miles, which is generally sufficient to remove it from the danger zone.

NEW NUT LOCK

THE safety interlocking nut and bolt shown herewith is said to prevent stripping or wearing of threads, owing to the fact that the threads in the nut are always in perfect contact with the threads on the bolt and as no movement of the nut is possible, the threads cannot wear. A permanent contact, irrespective of the thickness of the bolted elements, is obtained through a combination bolt, washer and nut. The washer has two inner extending lugs that fit into grooves in the bolt. It is locked to the nut by upsetting a portion of the washer into one of the grooves on the nut. The bolt, washer and nut remain locked in contact with the bolted elements, and the nut will not loosen after the metal of the washer has been forced into the groove with a cape chisel. The nut is unlocked by driving the metal down out of the nut groove with the same tools.



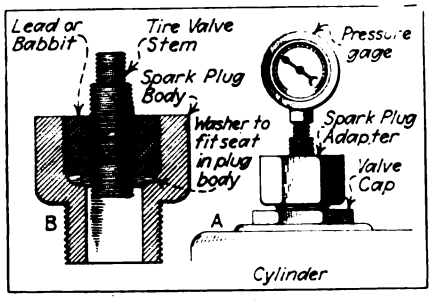
A positive method of locking nuts on mechanism subject to vibration

In Finland it is calculated that there is three million horsepower in its waterfalls, of which a little over one-third can be utilized. There are 79 waterfalls included in this calculation. At present only 150,000 horsepower are utilized.

Digitized by Google

SIMPLE GAUGE FOR MEASURING COMPRESSION

ONE of the most common causes of lost power in an automobile is that the force of the explosion pressure depends upon compression pressure before the gas is ignited. If the compression is 80 pounds, the explosive force acting against the piston top and imparting power to it will be about 400 pounds per square inch. If worn piston rings or leaky valves allow gas to escape when the piston is rising on its compression stroke, the resulting decrease to 50 or 60 pounds means a reduction of explosive pressure to about 300 pounds per square inch. Besides this diminution in pressure there is a



Simple compression gauge

loss due to further leakage through the faulty retaining members. A simple compression pressure indicating gauge may be made by taking an old spark plug body, from which the porcelain has been removed and fit in a valve from a discarded inner tube by pouring melted babbit or solder in to fill the space between the spark plug shell and the valve. When the metal has set, the valve is found to be firmly imbedded in the soft metal. The spark plug is removed from the cylinder to be tested and the combination plug body and valve stem put in its place. As the engine is turned over briskly by either the hand-crank or self-starter by an assistant, or the engine run slowly on the other cylinders, a tire pressure recording gauge held against the valve will record the compression pressure just as it does air pressure inside a tire. If the pressure is low on all cylinders it is a good indication that the entire engine needs attention.

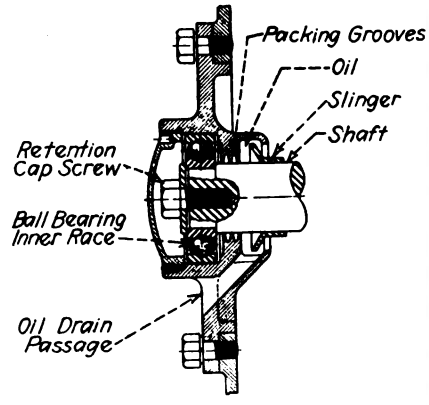
A new power development at Niagara is now in process of execution. A canal connects with the Welland River 4½ miles from its mouth. The flow of the river is to be reversed in direction so as to feed the water of the Niagara River into the upper end of the canal. This is located some distance above the falls. The canal, nine miles in length, runs to the lower end of the lower Niagara River, ending about a mile from Lake Ontario. Three hundred and five feet head are obtained, instead of from 136 to 165 feet as in the present installations. Each cubic foot of water per second gives 30 horsepower. The present rate is only 14 horsepower. The work is all on the Canadian side. At Niagara 605,000 horsepower are now used; it is claimed that 420,000 more can be taken without impairing the beauty of the falls.

NEW ALUMINUM ALLOY

A French engineer has patented an alloy of aluminum for which is claimed the possibilty of being cast as easily as the usual alloys and also worked, or tempered in the same way as steel. For the preparation of this metal, it is said a preliminary alloy is prepared containing cobalt, nickel, tungsten, silver, magnesium, and aluminum. About 10 per cent of this alloy is incorporated with 90 per cent of aluminum to make the new compound which is somewhat heavier than the simple metal and also stronger.

KEEPING OIL FROM MOTOR ARMATURE

THE use of ball bearings in electric motors and generators is a feature that has many advantages providing the installation is properly made. The accompanying illustration shows how the bearing housing may be made so the oil will not run out along the armature shaft and damage the windings or cause commutator trouble. The use of packing grooves will insure the retention of most of the lubricant in the bearing housing and any that does seep through will be thrown off centrifugally by the oil slinger and will run out of the housing through the drain passage cored in the end plate casting.



Oil slinger to keep oil from injuring windings

Concrete derrick cranes are reported from France. They weigh less than twice the weight of a corresponding steel crane. They are allowed 498 lbs. compression and owing to the reinforcement, 17,000 lbs. tensile strain. They are much cheaper than the steel structures. Another use of concrete is reported from Kingston, Jamaica. Mooring buoys have been successfully employed made of this material. They weigh five tons, are three inches thick, cylindrical in shape, with concave ends. A ton of ballast is needed to keep one upright. They cost £35 each, while steel buoys cost £75.

An alloy steel, termed "stainless steel", containing 12 per cent. of chromium, has been found of value for valves of aeroplane engines. At a red heat it does not scale.

Tycos

TEMPERATURE INSTRUMENTS

To standardize on TYCOS Indicating, Recording and Controlling Temperature and Pressure Instruments means to increase efficiency, reduce wastage, and gain in economy in any line of idustrial endeavor.

A few of the many instruments we make:

Industrial Thermometers
Capillary Recording Thermometers
Self-Contained Recording Thermometers
Capillary Index Thermometers
Thermo-electric Pyrometers
Fery Radiation Thermometers
Temperature Controlling Devices
Time Controls
Laboratory Engraved Stem Thermometers
Hygrometers (wet and dry bulb)
Indicating and Recording Thermographs
Coal Oil Testing Instruments
Hydrometers
Vacuum Gauges
Anerold Barometers

Complete information on any instrument or type of instruments on request

(BB-2)



Taylor Instrument Companies
ROCHESTER, N.Y.
There's a *Tycos* and *Taylor* thermometer for every purpose



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

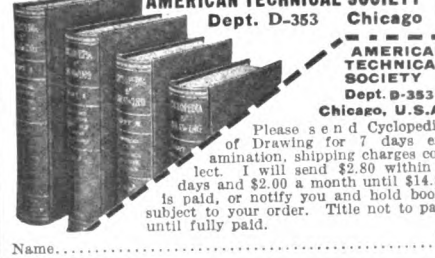
4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-353 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-353
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days examination, shipping charges collect. I will send $2.80 within 7 days and $2.00 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....
Address.....
Reference.....

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

AGENTS. Signs for store and offices. Entirely new. $50-week easily made. Chicago Sign System I-326-River St., Chicago.

SCIENCE CREATES NEW AUTO WONDER; solves puzzling problem; no more rain or snow blurred windshields; mystic cloth works like magic; deposits invisible chemical film; one rub keeps glass clear 24 hours; one agent sold 5,000. Security Mfg. Co., Dept. 255, Toledo, Ohio.

AGENTS—We want subscription agents in all high and manual training schools, colleges and technical institutions to take subscriptions to Everyday Engineering Magazine. All practical mechanical and scientific men and students are interested in a paper of this kind. Send for our money making proposition. Circulation Manager, Everyday Engineering Magazine, 2 West 45th Street, New York City.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E403, Muscatine, Iowa.

MORE Power, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

Aviation

WANT TO SELL small, uncompleted airplane, with motor, or will exchange for motorcycle. BRUBAKER, 522 East 78th St., New York.

Blueprints

SEND $1.50 FOR BLUEPRINT and instructions for building 20 x 5 foot Hydrofliver, 7 passenger. Something new. Very fast. Easy and cheap to build and operate. W. Olsen, 333 So. Dearborn St., Room 620, Chicago.

Books

NATURE LAWS married and engaged people should know. 50c prepaid. Central Company, 601 Ninth Ave., New York. Book Lists Free.

GAMBLING EXPOSED — Sensational book exposing secret systems, tricks, schemes and devices gamblers use with cards, dice, etc. You may need this book for your own protection. Particulars free. United Sales Co., Springfield, Ill.

BOOKS ON SEX—For men and women. Catalogue free. United Sales Co., Springfield, Ill.

BOOKS FOR MEN—Also "Classy" pictures. Catalogue free. United Sales Co., Springfield, Ill.

BUSINESS MAN'S LIBRARY

BOOKS DELIVERED FREE. Write today for Illustrated Guide to the Latest Books. Wesley Mills Co., Dept. A, 500 Fifth Avenue, New York, N. Y.

Business Opportunities

QUARTER FOR AGENTS' RATE BOOK, ETC., on magazine subscriptions. Supplies furnished. Wilson Agency, Middletown, Ohio.

USED CORRESPONDENCE COURSES BOUGHT AND SOLD. E. Moffett, Ruston, Louisiana.

BIG MAIL 5c—Clever Stories, Rockland, Wisconsin.

IN OZARKS—About 1000 kw. water, 192 acres with 50 rich bottom, railway near, truck road, $7,500; terms. Guthrie & Son, Ozark, Arkansas.

OPPORTUNITY FOR STUDENTS—Ambitious men who are working their way through school can make money by representing this magazine and securing subscriptions for the best publication of its class. We will gladly tell you how. Circulation Manager, Everyday Engineering Magazine, 2 West 45th Street, New York City.

Chemicals

MICROSCOPES. Balances, Experimental Laboratories. Buy through our easy Payment Plan. No red tape. Write for Booklet 24-E. Chemical and apparatus supplied for all Chemistry articles appearing in Everyday Engineering. Perform their experiments with our equipment. Lions Scientific Institute, Bausman Street, Mt. Oliver, Pittsburgh, Penna.

EXPERIMENTERS—This Ad pays for itself because Everyday Engineering Readers are our regular customers. Our chemicals, apparatus, and supplies outfit their laboratories. Why not yours? Ask for free price list and free service card. Lions Scientific Institute, Mt. Oliver, Pittsburgh, Pa.

EVERYTHING FOR THE AMATEUR CHEMIST—Price List free. George Ott, Reading, Pa.

WE MAKE A SPECIALTY OF SUPPLYING AMATEUR CHEMISTS. George Ott, Reading, Pa.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

MILLION TESTED FORMULAS, Trade Secrets, Processes. Everything! Thousand pages. Cost? Only $2.00 Postpaid. Can I find it? Yes; and 999,999 others. Write us. J. Goodnow, Highland Ave., South Sudbury, Mass.

For Sale

FOR SALE—One I. C. S. Qualitative and Quantitative laboratory outfit; never used; cost $70.00; must sell. How much will you offer? P. O. G., 429 Norway Ave., Trenton, New Jersey.

Help Wanted

MODEL MAKERS—Splendid opportunity in marine model shop for several young men who have decided taste and inclination in this line of work in both wood and metal. Write fully stating age, experience, where had, and wages expected. Address Model Maker, Everyday Engineering Magazine, 2 West 45th Street, New York.

YOUNG MEN, wanting to learn drafting, write to H. Hagene, 2225 Kemper Lane, Cincinnati, Ohio, for valuable information and data.

$100 TO $150 MONTH—Hundreds openings. U. S. Government positions. Men-women, 18 up. Experience unnecessary. List positions free. Write immediately. Franklin Institute, Dept. R-99, Rochester, N. Y.

Instructions

CRYSTAL GAZING—The craze. Send self-addressed stamped envelope right now for free instructions. Zancig's, Box 556, Asbury Park, N. J.

Inventors

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

INVENTORS. In all matters concerning Patents, The National Institute of Inventors, 118 Fulton St., New York City, a co-operative society of 2500 will help you protect, develop and market your inventions. Annual dues $10.00. Booklet on request.

INVENTORS—We do experimental Model, Tool, Die and Jig work. Light manufacturing. Miller & O'Brien Mfg. Co., North Saint Paul, Minn.

INVENTORS—Ideas large or small wanted. Let me know what you have. All drawings returned in five days with offer for same if wanted. Your Ideas are money; don't wait. Box 13, North Sanford, N. Y.

INVENTORS — I MAKE MODELS. Estimate free. Bennie Nortwed, Kellerton, Iowa.

INVENTOR'S MANUAL, HOW TO MAKE A PATENT PAY is a work of special interest to inventors in perfecting their inventions, taking out their patents, and disposing of them. It is not in any sense a Patent Solicitor's circular nor a Patent Broker's advertisement. No advertisements of any description appear in the work. It is a book containing a quarter of a century's experience of a successful inventor, together with notes based upon the experiences of many other inventors. 120 pages. Price $1.25 postpaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

TWO VOLUMES on MECHANICAL MOVEMENTS by G. D. Hiscox are works every inventor should have for reference. If the thing you want has been invented, it is illustrated in these volumes. If it hasn't been invented, then you'll find in it the nearest things to what you want, some movement or device that will apply to your case, perhaps; or which will give you a key from which to work. No books ever published are of more real value to the inventor, draftsman or practical mechanic than this set of books. Price per volume each $3.00 prepaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS; $110.00 a month to start and expenses; travel if desired; unlimited advancement. No age limit. Three months home study. Situation arranged. Prepare for permanent position. Write for Booklet CM-36. STANDARD BUSINESS TRAINING INSTITUTE, Buffalo, N. Y.

FIREMEN, Brakemen, Baggagemen, $140-$200; Colored Porters by Railroads everywhere. Experience unnecessary. 898 Ry. Bureau, East St. Louis, Ill.

Miscellaneous

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

DETECTIVES EARN BIG MONEY. Travel. Experience Unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

MECHANICAL DRAFTING, all kinds; Inventions, Models Developed. E. C. Timlick, 4238-A, W. Easton, St. Louis, Mo.

RADIO SET of Marvelous Efficiency. Blueprints, instructions, etc.; complete, $1.00. F. E. Webb, 327 West 55th Street, New York.

COMPLETE SET OF DRAWINGS of the Liberty 12 engine. A United States Standardized Aircraft Engine. Giving all views with number of parts, names of parts and weights of parts. Mail $1.00. Dept. A., Ocean Publishing Co., 25 W. 42nd St., New York City.

Miscellaneous--(Continued)

COLLECTORS'. HUNDRED-PAGE MAGAZINE — Two issues, 10 cents. West Collectors' World, Superior, Neb.

SHAWNEE, OKLAHOMA, a growing city, a good place to live. Write Board of Commerce, Shawnee, Okla.

MECHANICS—You can easily get your fellow craftsmen to subscribe to Everyday Engineering Magazine, the best mechanical and electrical paper published, and make some extra money. We want a reliable representative in every factory and have a good proposition. Circulation Manager, Everyday Engineering Magazine, 2 West 45th Street, New York City.

Motion Picture Plays & Supplies

$25-$300 paid anyone for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

Patents

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS — Herbert Jenner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York. 625 F Street, Washington, Tower Building, Chicago, Hobart Bldg., 582 Market Street, San Francisco, Calif.

DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION—Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster & Allwine, 237 Ouray Building, Washington, D. C., originators of the form "Evidence of Conception."

PATENTS—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years actual experience; full information upon request. B. P. Fishburne, 322 McGill Building, Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers, Washington, D. C.

PATENT WHAT YOU INVENT—It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" FREE. Franklin H. Hough, 510 Loan & Trust Bldg., Washington, D. C.

GET YOUR OWN PATENTS: Save attorney's fees; instructions and advice free. Carl Larsen Co., Park Row Bldg., New York.

Phonographs

BUILD YOUR OWN PHONOGRAPH—Big saving. We furnish parts and cabinets. Write today for free instructions. Associated Phonograph Supply Co., Dept. V, Cincinnati, Ohio.

Photography

DO YOU TAKE PICTURES? Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 466 Pope Building, Boston, Mass.

Pictures

HIGH ART PHOTOGRAPHS — Beautiful Models in artistic poses. Suitable for Den and Clubroom decorations or private collection. Send 10c for miniature samples, illustrated sheet and price list. United Sales Co., Springfield, Ill.

Real Estate

OZARK Water Power, Timber, free range and fruit. Guthrie & Son, Ozark, Arkansas.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

FREE PREMIUM with 4 Belgium German occupation, for 10c. Jos. Gallant, Hempstead, N. Y.

FINEST BRITISH COLONIAL APPROVALS—PRICES VERY MODERATE. RIEDELL, SCHENECTADY, N.Y.

STAMPS — 50 VARIETIES — Transvaal, Brazil, Peru, Cuba, Mexico, etc., and Album, 10c; 60 different U. S., 25c; 1,000 hinges, 10c; 1,000 mixed, 40c. List Free. I buy stamps. C. Stegmann, 5975 Cote Brilliante, St. Louis, Mo.

Used Office Equipment

ADDRESSOGRAPHS, Multigraphs, multicolors, folders, sealers and duplicators. Guaranteed. Office Device Company, 156 F North La Salle, Chicago.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¼" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotny Electric, Charlotte, N. C.

Digitized by Google

Interchangeable Type-Sets For Every Language

Every Business, Every Science and Every Profession



No Other Typewriter Can Do This:

Make Your Writing *T-a-l-k*



Only About 11 lbs.

Also—an Aluminum

PORTABLE Model

For Travelling—for Home. Full capacity

Ask for Special Folder



Just as oratory puts the power of emphasis into the *spoken word*, so the—

Multiplex Hammond

—puts the all-telling *power of emphasis* into the *written word.*

No other typewriter can turn cold type into living, breathing words—words pulsating with the writer's deepest convictions—words expressing to a nicety his most conventional mood—words showing always absolute correctness—*in business, professional or social usage.*

Note the several distinctly different type-styles reproduced below—*"Just turn the knob"* to change:

All Type Styles ~ All Languages ~ All Sciences

especially represented on one MULTIPLEX

CHANGE TYPE IN A SECOND

FOR BUSINESS EXECUTIVES: — Miniature Type and close spacing for condensing Loose-leaf Manuals and Index Card work

The Multiplex is *un*-like any other typewriter. Its work is as great an improvement over the typewriter as the earlier typewriter was over the fountain pen, or the fountain pen over the quill. There are *over 365 different type-sets, including all languages, to select from.*

Mail the Coupon for FREE BOOKLET

It will show you how, with the Multiplex, you can put the force of emphasis into your typed matter—how you can *drive home* with strength of accent the fulness of *your argument*—how you can write with the same convincing force that you use in speaking—an exclusive feature of the Multiplex.

We will also send our pamphlet, *"The President and His Typewriter."*

HAMMOND TYPEWRITER CO., 585A East 69th St., New York City

Mail this Coupon NOW

"Many Typewriters in One"

Because one machine will write many styles of type and many languages.

Gentlemen: Please send Free Booklets to

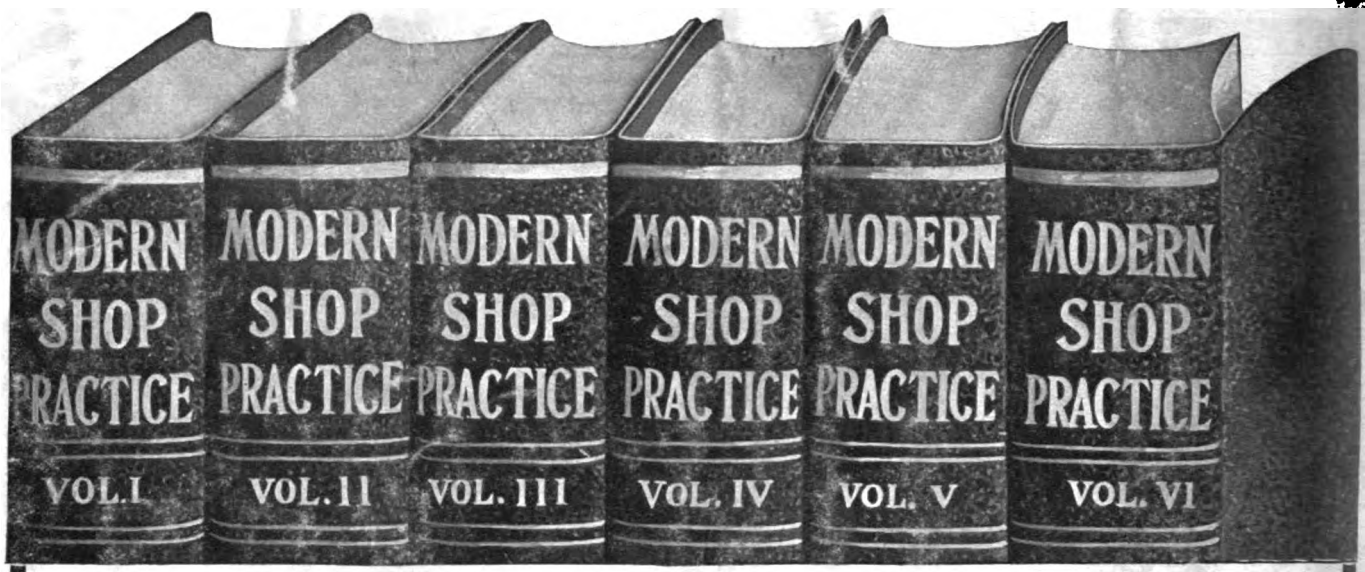
Name.....

Address.....

Occupation.....

Inquire about special terms to professionals

Digitized by Google



Can You Answer these Questions on Shop Work?

Test Yourself NOW

A surface of Cast iron is to be finished in one cut on a milling machine. The casting is 8 inches long and 5 inches wide. The milling cutter has a diameter of 3 inches and a width of 2 inches. How long will it take to do the work? Assume a feed of 2½ inches.

For what purpose is a magnetic chuck used?

How many processes for cutting gear teeth?

How do you determine the ratio of two gears, when the numbers of teeth are given?

The lead screw has a pitch of ¼ inch. What is the ratio of gears to be used to cut a screw with 18 threads per inch?

What determines the cutting speed in a milling machine?

Give a short description of the thermit-welding process.

What is essentially the first step in making any tool from a tool-maker's standpoint?

Why is it advisable to cut the threads of an adjustable tap somewhat smaller than the desired size for the tap to cut?

Under what circumstances would you consider it advisable to use a counter-bore, rather than a drill, when enlarging a hole? Why?

Why should undue accuracy never be indulged in when making drill jigs and similar tools?

What is the practical way to test the temper of molding sand?

How does the riser on a steel casting differ from one for iron?

What are some of the precautions necessary in pouring a mold in order to obtain the best results?

How are the sides of deep molds vented when a flask is used?

What point carbon steel should be used for machine tools, milling cutters, drills, and taps?

Why is it necessary to reheat large pieces after they have been hardened?

What must be the outside diameter of the original wooden pattern for the rim of a pulley with six arms, the diameter of the finished pulley to be 30 inches and the width of face 9 inches?

What are the allowances for shrinkage in the construction of a wooden pattern of a shaft hanger bearing cap?

A Few of the Subjects Treated

Machine Shop Practice	Tool Design
Machine Shop Management	Die Making
Production Manufacturing	Metal Stamping
Metallurgy	Foundry Work
Welding	Forging
Tool Making	Pattern Making
	Mechanical Drawing, etc.

THE skilled mechanic today is a specialist. He has no opportunity to build a complete machine or even a small part of one. His active work is carried along rather limited lines. But to make the best success in his work—to secure promotion to more responsible duties or to go into business for himself—it is absolutely necessary that he have a broad and comprehensive knowledge of machine work and shop practice. There is only one really feasible way for the mechanic to familiarize himself with other shop lines outside his own individual work—and that is to have specialists in all lines give him all they have learned in a form that will be readily accessible. There you have the reason for the famous standard reference work, called "Modern Shop Practice."

Thousands of Dollars' Worth of Shop Information

"Modern Shop Practice" is a wonderful reference work in Machine Shop Practice and Management, Production Manufacturing, Metallurgy, Welding, Tool Making, Tool Design, Die Making, and Metal Stamping, Foundry Work, Forging, Pattern Making, Mechanical Drawing, etc. It has been tested through six editions, bought by thousands of mechanics, consulting engineers, shop superintendents and owners, production managers, etc.

New Edition Only 7c a Day

Six magnificent volumes, flexibly bound in American Morocco, gold stamped. 2,300 pages. 2,500 illustrations—photographs, drawing, explanatory diagrams, tables, etc. Here you have at your finger tips up to date labor-saving methods that big manufacturers have spent thousands of dollars to develop. Facts that you can use in your everyday work. Information that fits you to earn bigger pay. All this is now yours in the new 6 volume set of "Modern Shop Practice," on payments so easy as to average only 50c a week or only 7c a day!

SHIPPED FREE

No money in advance. Not a cent. See the books in your own home or shop absolutely free at our risk. Read them, examine them, study them for 7 whole days before you need decide whether you want to keep them or not. Send no money to get the books for free examination. Make no deposit. Assume no obligation. Simply sign and mail the coupon herewith and the books will be promptly shipped to you for 7 days' free examination. If you are not more than delighted with the books and do not consider them a wonderful investment, just send them back to us, and you won't owe us a cent.

If you prize the books and consider them worth many times their price to you, send only $2 within 7 days and then $2 a month until the special introductory price of $19.80 has been paid.

Extra Feature Free

To those who order promptly, we will give free a consulting membership in the American Technical Society for one year. This gives you the right to ask our experts any question regarding shop practice for an entire year. You may ask as many questions as you please.

SEND NO MONEY

Merely sign and mail the coupon and the books will be shipped to you at our risk. Get the coupon in the mail at once, before this special offer is withdrawn. Send it today—NOW!

American Technical Society
Dept. M-357
Chicago, U. S. A.

Please send me set of Modern Shop Practice for seven days' free examination, shipping charges collect. If I decide to buy, I will send $2.00 within seven days and the balance at $2.00 a month until $19.80 has been paid. Then you send me a receipt showing that the set of books and $12.00 consulting membership are mine, and fully paid for. If I think that I can get along without the books after the seven days' trial, I will return them at your expense.

Name.....

Addr.....

Reference.....

AMERICAN TECHNICAL SOCIETY, Dept. M-357 Chicago, Ill.

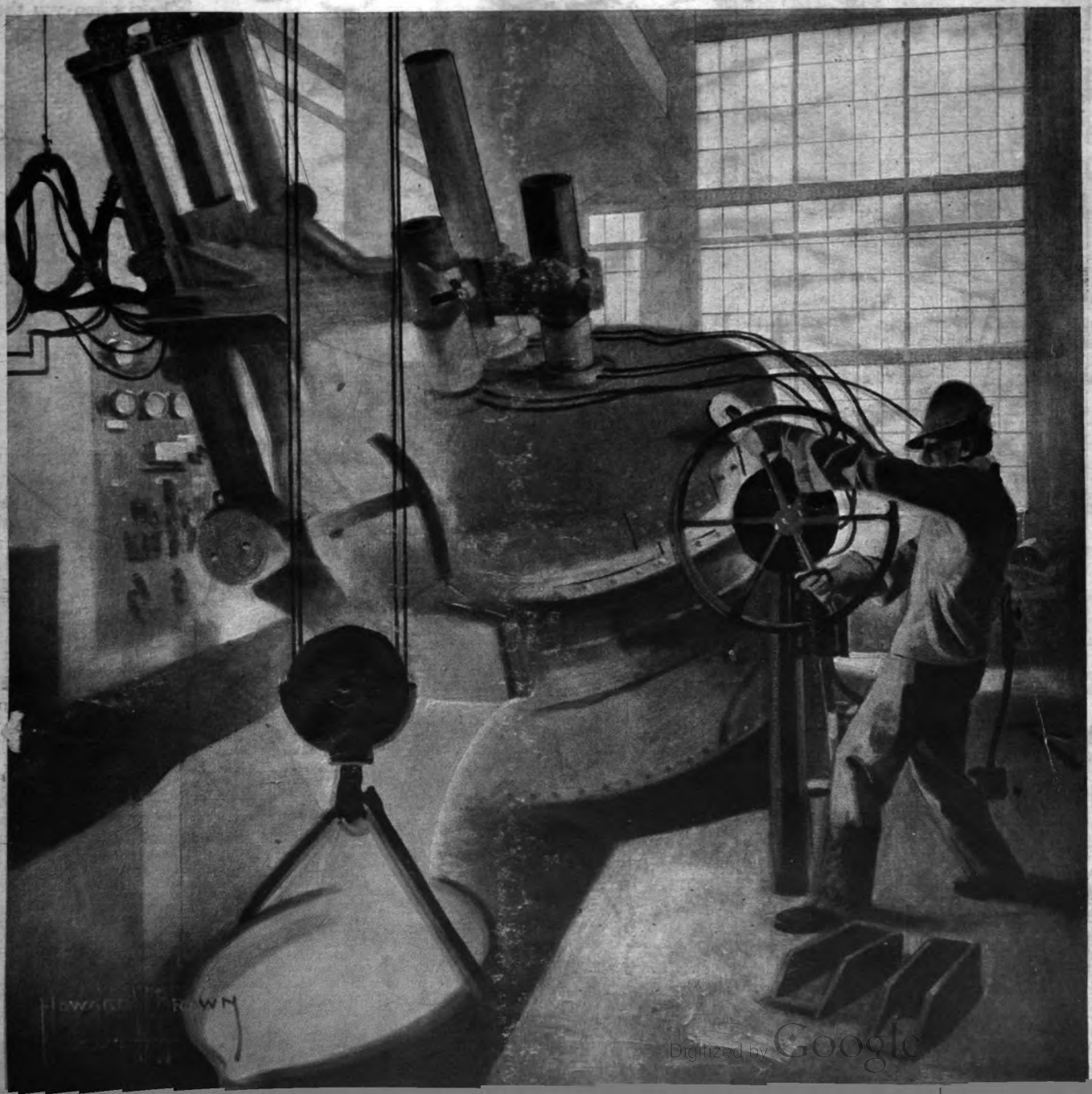
THE CAREY PRINTING CO. NEW YORK

Digitized by Google

EVERYDAY ENGINEERING MAGAZINE

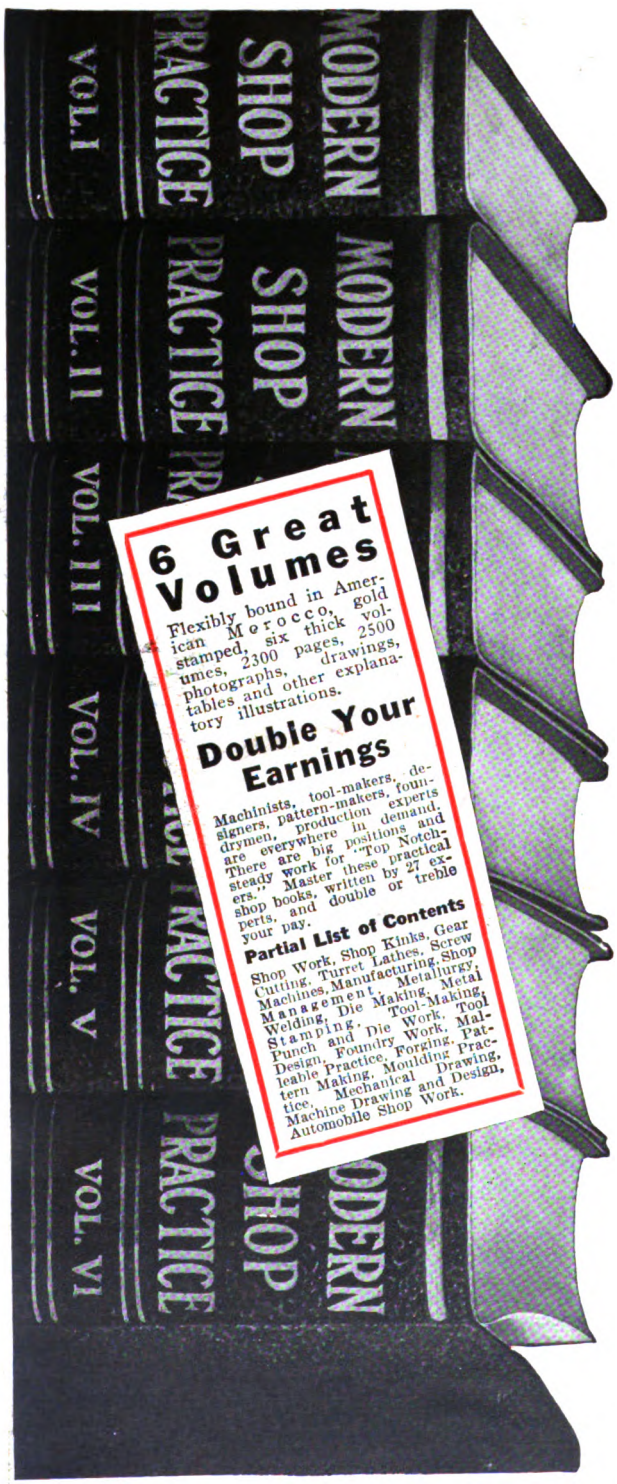
November—December
1919—Vol. 8—Nos. 2-3

Fifteen Cents
a Copy



Digitized by Google

Everything New About Shop Work!



Examine Them Free

The sixth edition of Modern Shop Practice is now off the press. Let us send you the six volumes for seven days' free examination—not a penny in advance. See how 27 mechanical engineers, designers, and specialists in shop methods have given you the benefit of their vast experience. Read what they say about production, metallurgy, welding, tool making, tool design, die making, metal stamping, foundry work, forging, pattern making, mechanical and machine drawing, speed lathes, planers, metal drillers, grinders, milling machines, stamping machines, die presses, etc. Then after free examination, send the books back unless you are convinced they will raise your pay.

Jump Ahead

The more you know about machine shop practice, the more money you will earn. Don't depend on your hands alone to earn your pay.

Make your head work for you. Equip yourself with knowledge that designs machinery, that does the *big* work. These six massive volumes tell everything you want to know about every phase of shop work. Written in clear, non-technical language.

Only 7c a Day

These six magnificent volumes are flexibly bound in American Morocco, gold stamped. Contain 2300 pages, 2500 illustrations, photographs, drawings, explanatory diagrams, tables, etc. Up-to-date labor saving methods that big manufacturers have spent thousands of dollars to learn. Facts that you can use in your everyday work at once. Examine the books free. Then if satisfied, pay for them at rate of 7c a day.

No Money in Advance

Not a cent in advance. See the books in your own home first. Read them for seven whole days before you decide. Make no deposit—assume no obligation. If you are not more than satisfied—send them back and you won't owe a cent. If you are sure they will raise your pay—send only $2 within seven days and then $2 a month until the special introductory price of $19.80 has been paid. (Regular price $30.) With each set we give you Free a year's Consulting Membership in the American Technical Society. (Worth $12.) Mail coupon for the books now. Send no money.

AMERICAN TECHNICAL SOCIETY
Dept. M-358 **CHICAGO, U. S. A.**

AMERICAN TECHNICAL SOCIETY
Dept. M-358 CHICAGO, U. S. A.

Please send me the six-volume set of "Modern Shop Practice" for seven days' examination, shipping charges collect. If I decide to buy, I will send $2 within seven days and balance at $2 a month until $19.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine, and fully paid for. If I think I can get along without the books, I will return them at your expense after seven days.

Name.....

Address.....

Reference:.....

Digitized by Google

Let me work for you

I WORK for Kings and Queens. I work for the President of the United States.

I work for the architects who build your sky scrapers.

I work for the surveyors and engineers who make your big bridges and subways possible.

I have a mathematical key board with the characters and signs used in higher and lower mathematics, and for engineering, mechanics, etc.

I am invaluable to the student of mathematics, engineering, chemistry and medicine as I carry the signs and symbols used in every profession—every science.

I "speak" every language, from Eskimo Indian to Kata Kana Japanese.

I use "speak" advisedly, because I *literally make your writing talk* — as the following samples of my work show.

I have over 365 different type sets, *including all languages*, from this note size to the following extended type for

HEADLINES

I put the same *Power of Emphasis* into the written word that oratory puts into the spoken word. "Just Turn the Knob" and *emphasize*.
Two type sets always on each machine.



Also an Aluminum PORTABLE Model

For traveling — for Home. Weighs about 11 lbs. Full capacity. Ask for *special* folder.

The Hammond Typewriter Co.
585A E. 69th Street New York City



The Heart of the Hammond

I am the

MULTIPLEX HAMMOND

Standard "Writing Machine"

Over 365 Different Type-Sets

Including All Languages to Select From

Any one of which may be substituted in a few seconds: "Just Turn the Knob"

I have shown you a few proofs of my versatility in the various types in the column opposite.

I think you will agree with me, when you see me, that no other typewriter *can* do what I do.

No other typewriter can *make your writing "TALK."*

No other typewriter can *INSTANTLY change from one style of type, or from one language to another.*

Multiplex Hammond Reasons

1. Variety of writing beyond the ordinary.
2. All sorts of type and languages on ONE Multiplex.
3. Automatically uniform type impressions without a cultivated touch.
4. Permanently perfect alignment.
5. Any width of paper, and writes cards flat without bending.
6. Large type, small type, medium type—all on ONE Multiplex.
7. Aluminum Portable, travellers' and home model.

There are more than sixteen (16) things I can do that cannot be done on any other writing machine; and it will pay you to

Mail the Coupon for FREE BOOKLET "How President Wilson Frightened the Lords at Midnight"

We will also send you our pamphlet, "People Who Count." Thousands of prominent men and women in all walks of life, and in all four corners of the globe, prefer and personally use the Multiplex. Note this partial list:

President Wilson
Queen Alexandra of England
King and Crown Prince of Sweden
Caliph of Morocco
King and Queen of Norway
Cardinal Merry del Val
Sir James Matthew Barrie
Walt Mason
Wallace Irwin
William Dean Howells
Bertha M. Clay
John Kendrick Bangs
Leigh Mitchell Hodges
Prof. L. A. Loiseaux
Etc., Etc.

MAIL FOR FREE BOOKLETS

HAMMOND TYPEWRITER COMPANY,
585A East 69th St., New York City.

Please send, entirely free and without obligation, the literature mentioned in your advertisement in Everyday Engineering.

Name .....

Address .....

Occupation .....

Digitized by Google

Our 21 Jewel SMASHES PRICES



Look!

21 Ruby and Sapphire Jewels—
Adjusted to the second—
Adjusted to temperature—
Adjusted to isochronism—
Adjusted to positions—
25-year gold strata case—
Genuine Montgomery Railroad Dial—
New Ideas in Thin Cases.

Only $3.50 A Month

And all of this for $3.50—only $3.50 per month—you pay only rock-bottom price—yes, "bed rock-bottom price"—the lowest price at which the Burlington is sold. Think of the high grade, guaranteed watch we offer here at such a remarkable price. And if you wish, you may pay this price at the rate of $3.50 a month. Indeed, the days of exorbitant watch prices have passed. Write now.

See It First

You don't pay a cent to anybody until you see the watch. You don't buy a Burlington Watch without seeing it. Look at the splendid beauty of the watch itself. Thin model, handsomely shaped—aristocratic in every line. Then look at the works. There you will see the masterpiece of the watch makers' skill, a perfect timepiece adjusted to positions, temperature and isochronism.

Practically every vessel in the U. S. Navy has many Burlington watches aboard. Some have over 100 Burlingtons. The victory of the Burlington among the men in the U. S. Navy is testimony of Burlington superiority.

Burlington Watch Co.
19th Street and Marshall Boulevard
Dept. 1399 Chicago, Ill.

Please send me (without obligations and prepaid) your free book on watches with full explanation of your cash or $3.50 a month offer on the Burlington Watch.

Name .....

Address .....

.....

Send Your Name on This Free Coupon

Get the Burlington Watch Book by sending this coupon now. You will know a lot more about watch buying when you read it. You will be able to "steer clear" of over-priced watches which are no better. Send the coupon today for the watch book and our offer.

Burlington Watch Company
19th Street and Marshall Blvd. Dept. 1399 **Chicago, Ill.**
Canadian Offices: 338 Portage Ave., Winnipeg, Man.

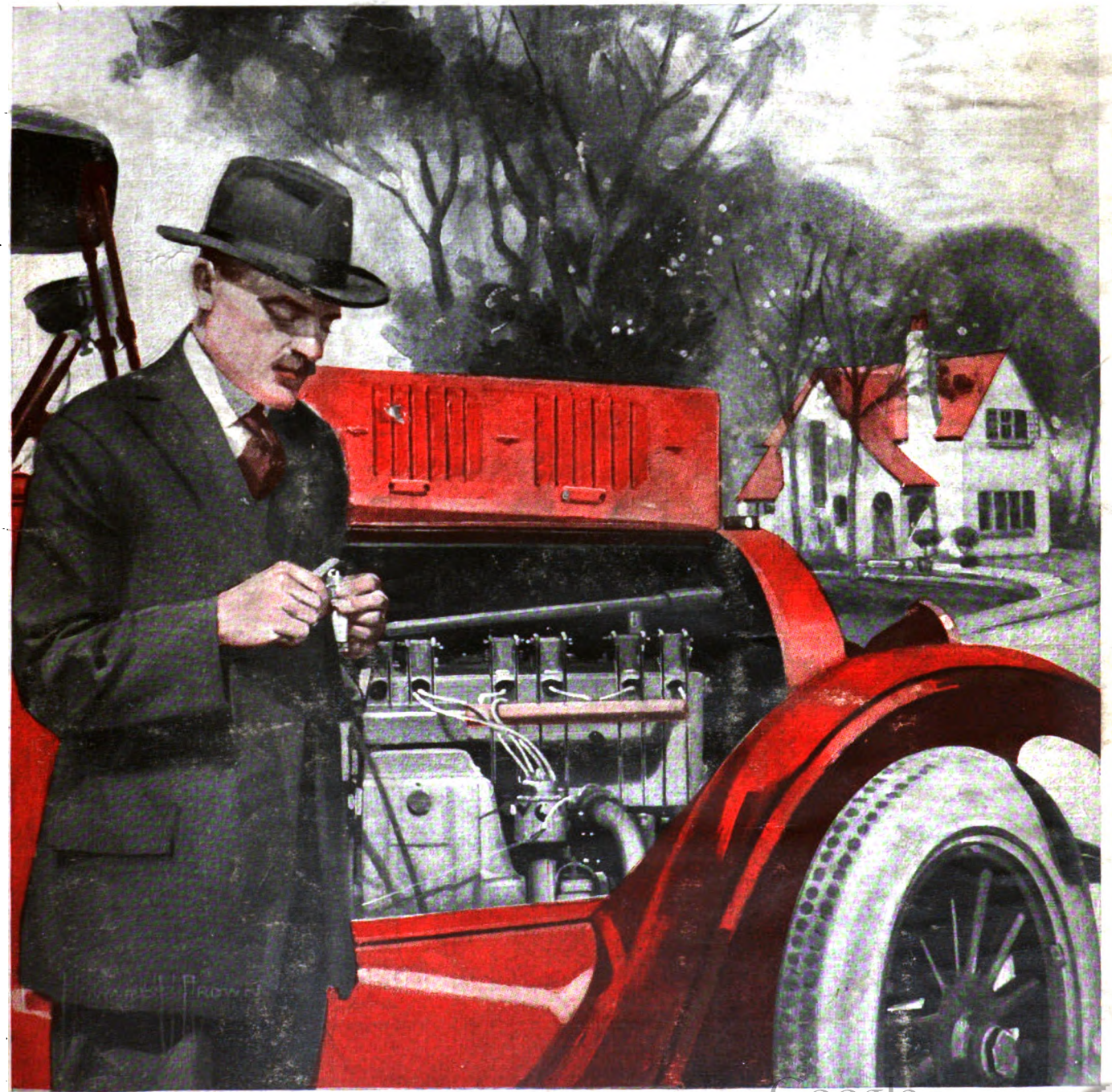
THE CAREY PRINTING CO. INC. NEW YORK

Digitized by Google

EVERYDAY ENGINEERING MAGAZINE

January, 1920
Vol. 8 No. 4

Fifteen Cents
a Copy



WHAT TO DO WHEN THE MOTOR STALLS (See Page 169)

Digitized by Google

Short Cuts to Bigger Pay

Your last chance to procure one of these famous McGraw-Hill Home Study Courses at the old prices.

Here are three of the McGraw-Hill Home Study Courses that make promotion sure. Each represents practically a life time of study and practice. They are not correspondence courses. They are self-teachers. All the information you need is laid before you in plain language and plain illustrations.



Croft's Library of Practical Electricity

The only electrical library in existence that actually teaches electrical practice as experts know it. 3,000 pages and 2,100 illustrations taken from electrical work itself. 8 flexibly bound volumes, pocket-size. Easy to read and easy to understand, and the principles easily applied to work as it is done. For both the beginner and trained man, for reference or study. Price before Feb. 28th, 1920, $16. Afterwards $20, payable $2 in ten days and $3 per month.



Power Plant Library

The most used engineers' library ever published. Over 30,000 power plant men are using them as a means of passing examinations and becoming chief engineers. 8 volumes, durably bound in dark blue cloth. About 2,700 pages, 1,800 illustrations. If you are interested in any branch of power plant work you must have these books. They will enable you to pass the examination in any state. Price before Feb. 28th, 1920, $12. Afterwards $16, payable $2 per month.

Not one cent in advance

Merely check the library in which you are interested, fill out the coupon and return to us. We will ship the set of your choice for ten days' absolutely free examination. Return at our expense if you are not thoroughly pleased. Pay only the small monthly payments called for if you are satisfied the books will increase your earning power. But act now. Tomorrow may be too late to get the books at the old price.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York



Machine Shop Library

The practical side of machine shop work, written by such well known authorities as Colvin, Stanley, Lake, Goodrich, Haas, &c.. 3,000 pages, 2,000 illustrations. 9 volumes, dark red cloth, morocco grained. Suitable to the needs of every man connected in any way with the machine shop. Records of actual practice that show the way to more pay. Price before Feb. 28th, 1920, $16. Afterwards $20, payable $2 in ten days and $3 per month.

Save $4 by ordering NOW

An advance of $4 in the price of each set must be put into effect after February 28, 1920. Orders received by us after that date will be charged at the increased rate. No exceptions can be made. Even at the new prices these books are the best buy in engineering literature of the time.

FREE EXAMINATION COUPON

Add $4 to the price of each set after February 28, 1920

McGraw-Hill Book Co., Inc., 239 W. 39th St., N. Y.
Gentlemen: Send for ten days' free inspection the Library I have checked below:

- ☐ Croft's Electricity, $16—payable $2 per month.
- ☐ Machine Shop Library, $16—payable $2 per month.
- ☐ Power Plant Library, $12—payable $1 per month.

If satisfactory I will send first payment in ten days and the same amount each month until paid. If not wanted I will return the books at your expense.

Signature .....
Residence address .....
City and State .....
Your employer .....
His address .....
Your occupation ED-2-20

Digitized by Google

Let me work for you

I WORK for Kings and Queens. I work for the President of the United States.

I work for the Architects who build your sky scrapers.

I work for the Surveyors and Engineers who make your big bridges and subways possible.

I have a Mathematical keyboard with the characters and symbols used in higher and lower Mathematics, and for Engineering, Mechanics, etc.

I AM INVALUABLE TO THE STUDENT OF MATHEMATICS, ENGINEERING, CHEMISTRY, AND MEDICINE, AS I CARRY THE CHARACTERS AND SYMBOLS IN EVERY PROFESSION--EVERY SCIENCE.

I "speak" every language, from Eskimo Indian to Kata Kana Japanese.

I use "speak" advisedly, because *I literally make your writing talk*--as these samples of my work show.

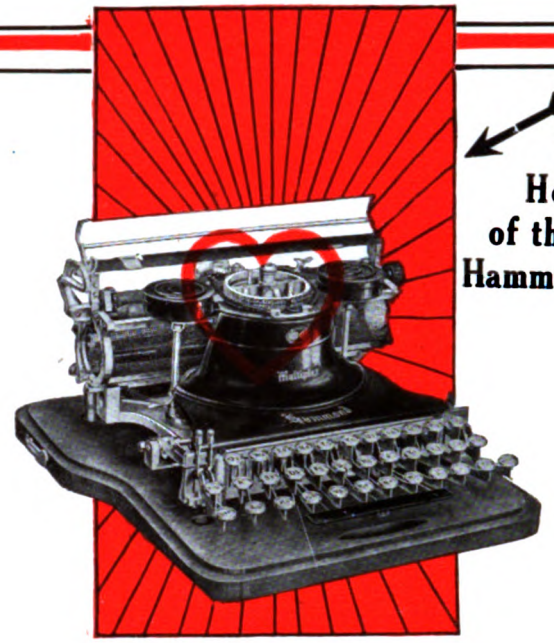
The above paragraphs were written on *one* Multiplex and give a very limited example of the work that can be done on this unique "writing machine"—the only "writing machine" in existence. Just examine the Multiplex and you'll find that it is as great an improvement over the ordinary typewriter as the fountain pen is over the old-fashioned quill.



Also an Aluminum PORTABLE Model

For traveling — for Home. Weighs about 11 lbs. Full capacity. Ask for *special* folder.

The Hammond Typewriter Co.
585A E. 69th Street New York City



The Heart of the Hammond

I am the

MULTIPLEX HAMMOND

Standard "Writing Machine"

Over 365 Different Type-Sets

Including All Languages to Select From

Any one of which may be substituted in a few seconds: "Just Turn the Knob"

I have shown you a few proofs of my versatility in the various types in the column opposite.

I think you will agree with me, when you see me, that no other typewriter *can* do what I do.

No other typewriter can *make your writing "TALK."*

No other typewriter can *INSTANTLY change from one style of type, or from one language to another.*

Multiplex Hammond Reasons

1. Variety of writing beyond the ordinary.
2. All sorts of type and languages on ONE Multiplex.
3. Automatically uniform type impressions without a cultivated touch.
4. Permanently perfect alignment.
5. Any width of paper, and writes cards flat without bending.
6. Large type, small type, medium type—all on ONE Multiplex.
7. Aluminum Portable, travellers' and home model.

There are more than sixteen (16) things I can do that cannot be done on any other writing machine; and it will pay you to

Mail the Coupon for FREE BOOKLET "How President Wilson Frightened the Lords at Midnight"

We will also send you our pamphlet, "People Who Count." Thousands of prominent men and women in all walks of life, and in all four corners of the globe, prefer and personally use the Multiplex. Note this partial list:

President Wilson
Queen Alexandra of England
King and Crown Prince of Sweden
Caliph of Morocco
King and Queen of Norway
Cardinal Merry del Val
Sir James Matthew Barrie
Walt Mason
Wallace Irwin
William Dean Howells
Bertha M. Clay
John Kendrick Bangs
Leigh Mitchell Hodges
Prof. L. A. Loiseaux
Etc., Etc.

MAIL FOR FREE BOOKLETS

HAMMOND TYPEWRITER COMPANY,
585A East 69th St., New York City.

Please send, entirely free and without obligation, the literature mentioned in your advertisement in Everyday Engineering.

Name .....

Address .....

Occupation .....

Digitized by Google



Automobile Engineer $125 A Week



Automobile Repairman $50 A Week



Expert Chauffeur $40 A Week



Garage Owner $150 A Week

Take Your Choice of These Big Paying Jobs

THOUSANDS of men like you are wanted to fill these big-paying jobs in the automobile engineering field. Thousands of places are open, too, for chauffeurs and garage managers. It's easy to get one of these good jobs and to prepare yourself to hold it. You don't have to go to school. You don't have to serve an apprenticeship. Spare time only is needed. These great automobile books will teach you everything you need to know. Fifteen of the greatest engineers and experts in the business wrote them in simple language that anybody can understand.



Auto Books

6 Volumes Shipped Free

Just off the press—the 1920 model—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Packed full of advance information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Anybody can understand them. Tastefully bound in American Morocco, flexible covers, gold stamped, 2650 pages and 2300 illustrations, tables, blueprints and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination. Over 50,000 sets of previous editions have been sold.

Partial Contents

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Fly-Wheels; Clutch; Transmission; Final Drive; Steering Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage; Design and Equipment; Electrics; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gas Tractors.

128 Blueprints of Electric Wiring Diagrams

Only 7c a Day!

Not a cent to pay in advance. First you see the books in you own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books, send only $2.80 in 7 days and $2 a month until the special introductory price of $21.80 has been paid. (Regular Price $30.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This part of our offer will be withdrawn when the membership is filled. Mail the coupon without delay.

Don't Send Money Now!

Don't take our word for it. **See the books without cost.** Here is a chance for you to get a real man's job with a man's size pay. Don't waste a minute in sending the coupon. **Put the coupon in the mails today. Send no money—just the coupon!**

American Technical Society, Dept. A-353 Chicago, Ill.

FREE Examination Coupon

American Technical Society, Dept. A-353 Chicago

Please send me the 6-volume set of Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $2 a month until the $21.80 has been paid. Then you send me a receipt showing that the $30 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after 7 days' trial, I will notify you to send for them at your expense. *[Please fill out all lines.]*

Name .....

Address .....

City ..... State .....

Reference .....

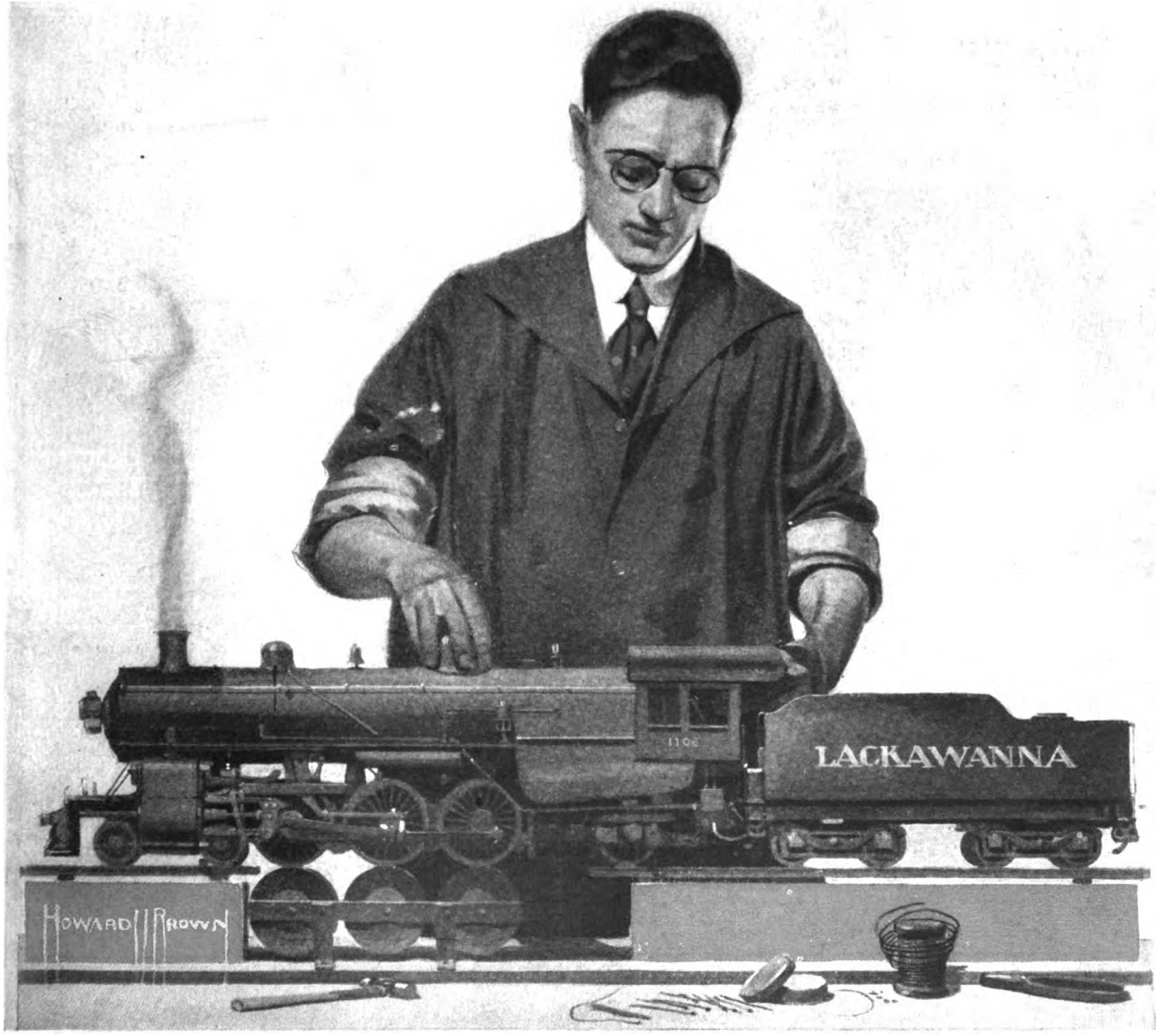
THE CAREY PRINTING CO. Inc.
NEW YORK

Digitized by Google

EVERYDAY ENGINEERING MAGAZINE

April, 1920
Vol. 9 No. 1

Twenty Cents
a Copy



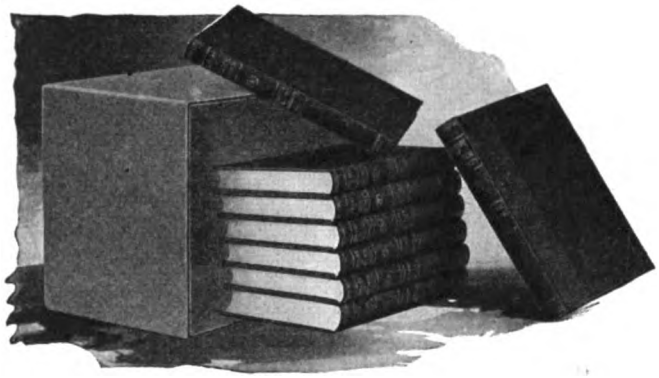
CONSTRUCTION OF MINIATURE LOCOMOTIVES (See Page 12)

Digitized by Google

Short Cuts to Bigger Pay

Your chance to procure one of these famous McGraw-Hill Home Study Courses for ten days' free trial.

Here are three of the McGraw-Hill Home Study Courses that make promotion sure. Each represents practically a life time of study and practice. They are not correspondence courses. They are self-teachers. All the information you need is laid before you in plain language and plain illustrations.



Croft's Library of Practical Electricity

The only electrical library in existence that actually teaches electrical practice as experts know it. 3,000 pages and 2,100 illustrations taken from electrical work itself. 8 flexibly bound volumes, pocket-size. Easy to read and easy to understand, and the principles easily applied to work as it is done. For both the beginner and trained man, for reference or study. Price $20, payable $2 in ten days and $3 per month.



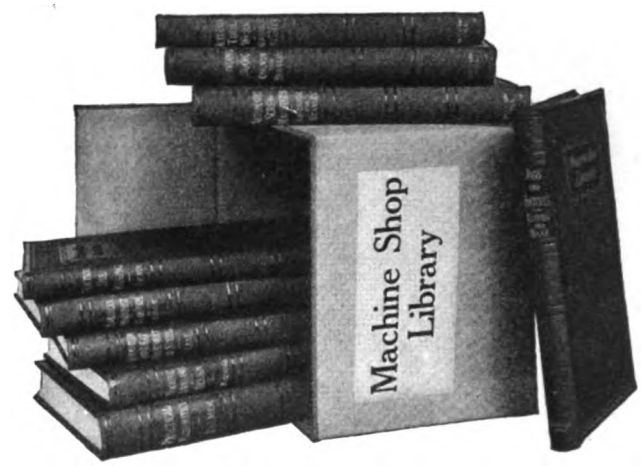
Power Plant Library

The most used engineers' library ever published. Over 30,000 power plant men are using them as a means of passing examinations and becoming chief engineers. 8 volumes, durably bound in dark blue cloth. About 2,700 pages, 1,800 illustrations. If you are interested in any branch of power plant work you must have these books. They will enable you to pass the examination in any state. Price $16, payable $2 per month.

Not one cent in advance

Merely check the library in which you are interested, fill out the coupon and return to us. We will ship the set of your choice for ten days' absolutely free examination. Return at our expense if you are not thoroughly pleased. Pay only the small monthly payments called for if you are satisfied the books will increase your earning power. But act now. Tomorrow may be too late.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York



Machine Shop Library

The practical side of machine shop work, written by such well known authorities as Colvin, Stanley, Lake, Goodrich, Haas, &c.. 3,000 pages, 2,000 illustrations. 9 volumes, dark red cloth, morocco grained. Suitable to the needs of every man connected in any way with the machine shop. Records of actual practice that show the way to more pay. Price $20, payable $2 in ten days and $3 per month.

Records of Work Itself

The fact that the material in these libraries was taken from the best in actual practice has made them the most used books of their kind in existence. They are for progressive men who insist upon the best in mechanical and engineering literature. Of equal value to the beginner and expert. Positively written in language that any man who can read and write can understand.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 239 W. 39th St., N. Y.
Gentlemen: Send for ten days' free inspection the Library I have checked below:

- ☐ Croft's Electricity, $20—payable $3 per month.
- ☐ Machine Shop Library, $20—payable $3 per month.
- ☐ Power Plant Library, $16—payable $2 per month.

If satisfactory I will send first payment in ten days and the same amount each month until paid. If not wanted I will return the books at your expense.

Signature .....

Residence address .....

City and State.....

Your employer .....

His address .....

Your occupation ..... E. D. 4-20.

Digitized by Google

CONTENTS

Vol. 9 APRIL, 1920 No. 1

How Steam Turbines Work 9
By Raymond Francis Yates

Model Car Trucks 12
By Henry Greenley

Systematic Lubrication and Maintenance of Automobiles 14
By Victor W. Page, M.S.A.E.

An Engine Drive for Bicycles 16

More Comfort for Aviators 17

Building a Two-Passenger Seaplane 19
By Charles Muller, M.A.E.

Adapting Engines to the Use of Available Fuel 22
By J. E. Vincent, M.S.A.E.

Rotary Pumps 25

Sopwith Triplane Model 26

Everyday Motorist 27

Shop Practice 30

Design for a Small Grinding Head 32
By Joseph Dante, Jr.

Readers' Workshop Page 33

Aeromarine Limousine Flying Boat 34

Experimental Chemistry 36

Measuring High Temperatures in the Laboratory 37
By E. P. Hurley

The American Society of Experimental Engineers 38

Electrical Progress Digest 39

Models Made by Our Readers 41

New Things for the Automobilist 42

The Construction of a Chanute Glider Part II 44
By Percy Pierce

The New Berliner Gyrocopter 47

Everyday Science Notes 48

New French Aviation Engines 50

The Junior Experimenter 52

How To Make a Small Propeller 54
By Paul F. Wilber

Some Ideas for a Crystal Receiver 58
By M. B. Sleeper

Comparative Efficiency of High and Low Spark Frequencies 61

A Long Wave Receiver 63

The Problem of Vacuum Tube Circuits 66
By L. M. Clement

Design Features of the S. C. R. 112 68

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

Editor Raymond F. Yates
Managing Editor Victor W. Page
Radio Editor M. B. Sleeper

Contributing Editor
Prof. T. O'Conor Sloane

Advertising Manager
Stephen Roberts

Branch Advertising Office
Sears & Irving, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, Inc.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechanics Co., Inc.

MATHEMATICS AND SCIENCE.

IT was once "proven" mathematically that it was impossible to fly. Langley battered this theory to death. James Clark Maxwell brought forth a mathematical treatment called the Electromagnetic Theory of Light. Twenty-two years later, the brilliant young Hertz of Karlsruhe proved experimentally that Maxwell was right. In the first case higher mathematics were wrong; in the second case they were right.

IT requires a great intellect to theorize in mathematics as Maxwell did, and few men are capable of doing it. The man or men whose mathematics told them that flying was impossible were probably incapable of handling such an involved problem.

THE value of mathematics to science depends largely upon the men who use mathematics in a scientific way. The mathematics of such men as Newton, Maxwell, Lodge, Kelvin, Euclid and Arrhenius have been of tremendous value to the world. A scientist wandering around in the upper regions of mathematics must be sure of his step else he makes a mistake and misinforms the world on some subject of vital importance. This would do more harm than good.

MATHEMATICS is the backbone of science. Without the higher expressions in mathematics there would be no science in a strict sense of the term. This means, then, that progress is dependent upon mathematics.

THE wrong use of figures may bring about great catastrophes. It may cause a liner to sink at sea, an elevator to drop, a building to collapse, a train to be wrecked or a city to be flooded.

MATHEMATICS stand guard over human knowledge. Mathematics prevent theory from running amuck. Mathematics analyze things. Few things are of greater importance to the world.

THE science of figures has made possible great things. The difference between rule-of-thumb procedure and real science is mathematics. It would be impossible to build a Brooklyn Bridge, a Woolworth Building or an Empire State Express without the science of figures.

MATHEMATICS lead into infinity. The science is as vast and endless as space itself. One can never hope to get to the end. The "bottom-bottom" of mathematics is as beclouded with mystery as any one of the great cosmological problems.

RAYMOND FRANCIS YATES, Editor.

Digitized by Google

Books For The PRACTICAL MAN

Henley's Twentieth Century Book of Recipes, Formulas and Processes.

Edited by GARDNER D. HISCOX. The most valuable techno-chemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of receipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work. New edition. Cloth.

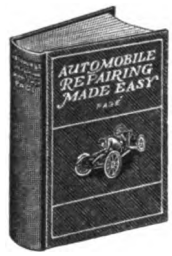
Price, $4.00

Model Making.

By RAYMOND FRANCIS YATES. A new book for the mechanic and model maker. This is the first book of its kind to be published in this country and all those interested in model engineering should have a copy. The first eight chapters are devoted to such subjects as Silver Soldering, Heat Treatment of Steel, Lathe Work, Pattern Making, Grinding, etc. The remaining twenty-four chapters describe the construction of various models such as rapid fire naval guns, speed boats, model steam engines, turbines, etc. This book must not be confused with those describing the construction of toys now on the market. It is a practical treatise on model engineering and construction. 400 pages. 301 illustrations.

Price, $3.00

Automobile Repairing Made Easy.



By VICTOR W. PAGÉ. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism. Written in a thorough but non-technical manner. This book also contains Special Instructions on Electric Starting, Lighting and Ignition Systems, Tire Repairing and Rebuilding. Autogenous Welding, Brazing and Soldering, Heat Treatment of Steel, Latest Timing Practice, Eight and Twelve Cylinder Motors, etc., etc. You will never "Get Stuck" on a Job if you own this book. 1,000 specially made engravings on 500 plates. 1,056 pages (5½x8). 11 folding plates.

Price, $4.00

How to Run an Automobile.

By VICTOR W. PAGÉ. This treatise gives concise instructions for starting and running all makes of gasoline automobiles, how to care for them, and give distinctive features of control. Describes every step for shifting gears, controlling engines. 178 pages. 72 illustrations.

Price, $1.50

Automobile Welding with the Oxy-Acetylene Flame.

By M. KEITH DUNHAM. Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone. 167 pages, fully illustrated.

Price, $1.50

Abrasives and Abrasive Wheels.

By FRED E. JACOBS. A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantages in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering. 340 pages, 200 illustrations. This is an indispensable book for every machinist.

Price $3.00

Machine Shop Arithmetic.

By COLVIN-CHENEY. Most popular book for shop men. Shows how all shop problems are worked out and "why." Includes change gears for cutting any threads; drills, taps, shrink and force fits; metric system of measurements and threads. Used by all classes of mechanics and for instruction in Y. M. C. A. and other schools. Seventh edition. 131 pages.

Price, 75c

Steel: Its Selection, Annealing, Hardening and Tempering.

By E. R. MARKHAM. This work was formerly known as "The American Steel Worker," but on the publication of the new, revised edition, the publishers deemed it advisable to change its title to a more suitable one. This is the standard work on hardening, tempering, and annealing steel of all kinds. This book tells how to select, and how to work, temper, harden, and anneal steel for everything on earth. It is the standard book on selecting, hardening, and tempering all grades of steel. 400 pages. Very fully illustrated. Fourth edition.

Price, $3.00

The Lathe—Its Design, Construction and Operation, With Practical Examples of Lathe Work.

By OSCAR E. PERRIGO. A new revised edition, and the only complete American work on the subject, written by a man who knows not only how work ought to be done, but who also knows how to do it, and how to convey this knowledge to others. It is strictly up-to-date in its descriptions and illustrations. A number of difficult machining operations are described at length and illustrated. The new edition has nearly 500 pages and 350 illustrations.

Price, $3.00

House Wiring.

By THOMAS W. POPPE. Describing and illustrating up-to-date methods of installing electric light wiring. Intended for the electrician, helper and apprentice. Contains just the information needed for successful wiring of a building. 125 pages, fully illustrated, flexible cloth.

Price, 75c

Electric Wiring, Diagrams and Switchboards.

By NEWTON HARRISON, with additions by THOMAS POPPE. This is the only complete work issued showing and telling you what you should know about direct and alternating current wiring. It is a ready reference. The work is free from advanced technicalities and mathematics, arithmetic being used throughout. It is in every respect a handy, well-written, instructive, comprehensive volume on wiring for the wire-man, foreman, contractor or electrician. Second revised edition. 303 pages, 130 illustrations. Cloth.

Price, $2.50

Starting, Lighting, and Ignition Systems.



By VICTOR W. PAGÉ. A practical treatise on modern starting and ignition system practice. This practical volume has been written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. It can be understood by anyone even without electrical knowledge. Nearly 500 pages. 297 specially made engravings. New edition.

Price, $3.00

Motor-Boats and Boat-Motors.

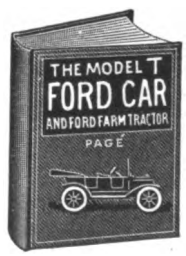
By VICTOR W. PAGÉ and A. C. LEITCH. All who are interested in motor boats, either as owners, builders or repairmen will find this latest work a most comprehensive treatise on the design, construction operation and repair of motor boats and their power-plants. It is really two complete books in one cover as it consists of two parts, each complete in itself. Part One deals with The Hull and Its Fittings. Part Two considers The Power Plant and Its Auxiliaries. A valuable feature of this book is the complete set of dimensioned working drawings detailing the construction of five different types of boats ranging from a 16-foot shallow draft, tunnel stern general utility craft to a 25-foot cabin cruiser. These plans are by A. C. Leitch, a practical boat builder and expert naval architect and are complete in every particular. Full instructions are given for the selection of a power plant and its installation in the hull. Valuable advice is included on boat and engine-operation and latest designs of motors are described and illustrated. The instructions for overhauling boat and engine are worth many times the small cost of the book. It is a comprehensive work of reference for all interested in motorboating in any of its phases. Octavo. Cloth. 350 illustrations. 500 pages.

Price, $3.00

The Modern Gasoline Automobile, Its Design, Construction, Operation.

By VICTOR W. PAGÉ, M.S.A.E. This is the most complete, practical and up-to-date treatise on gasoline automobiles and their component parts ever published. In the new revised and enlarged 1920 edition, all phases of automobile construction, operation and maintenance are fully and completely described and in language anyone can understand. 1,000 pages. 1,000 illustrations.

Price, $4.00



The Model T Ford Car, Its Construction, Operation and Repair, Including the Fordson Farm Tractor. The F. A. Starting and Lighting System and the Worm Drive 1-Ton Truck.

By VICTOR W. PAGÉ. This is the most complete and practical instruction book ever published on the Ford car and the Fordson Tractor. Illustrated by specially made drawings and photographs. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and operating principle made clear to everyone. 425 pages, 150 illustrations.

Price, $2.00

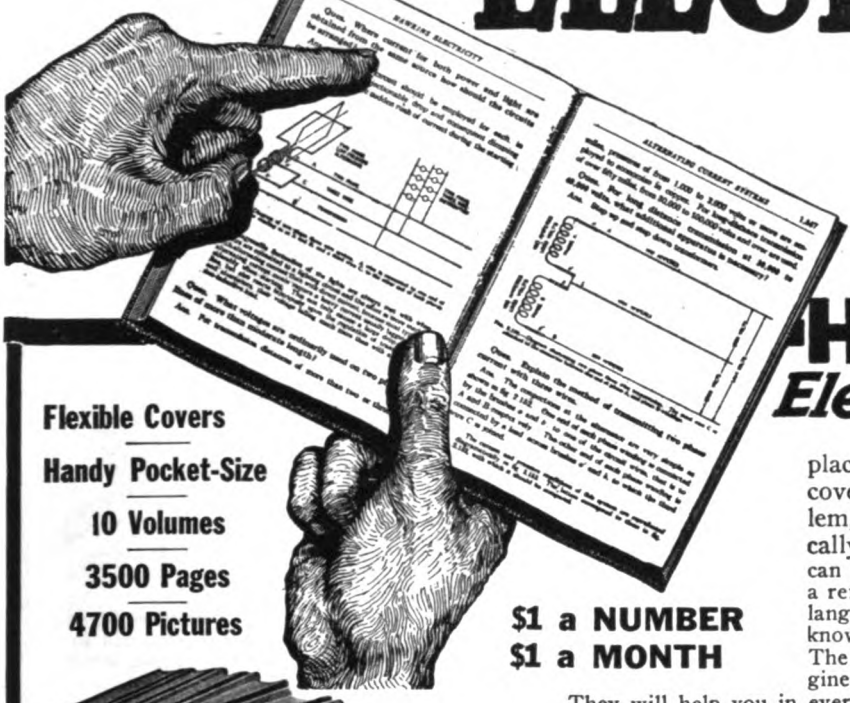
☞ Any of these books sent prepaid on receipt of price. FREE—Our new 1920 Catalog of Practical Books sent free on request

THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. **2 West 45th Street, New York**

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent
Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved
The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.
The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.
Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry
The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

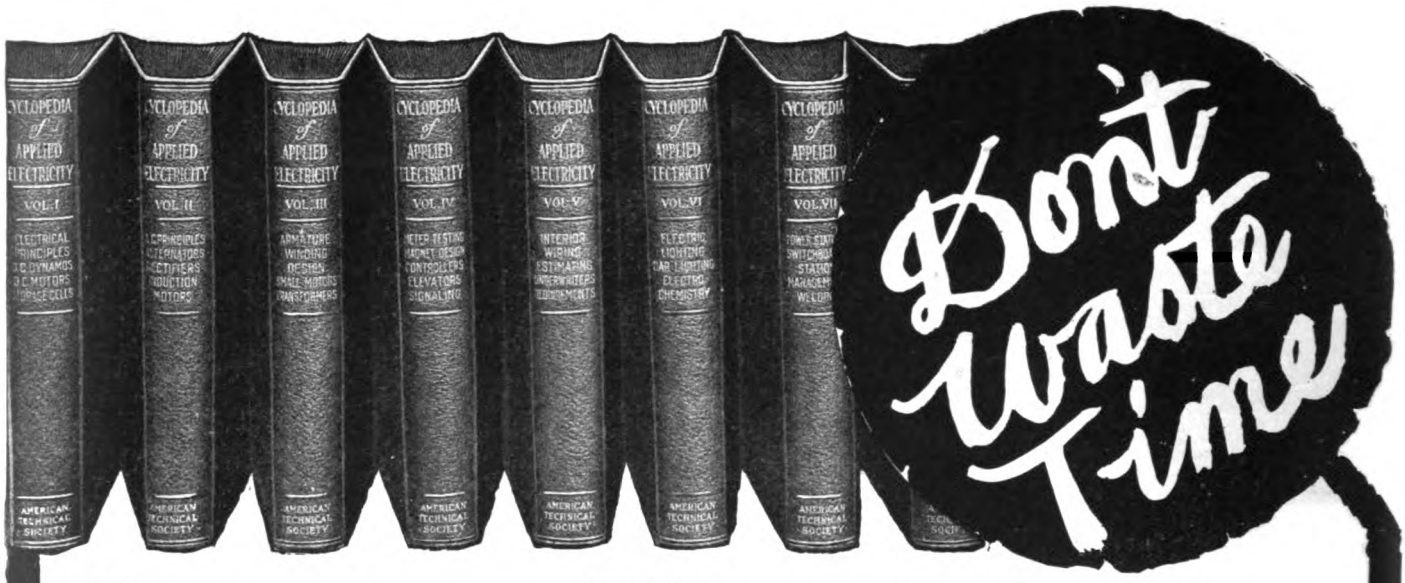
Employed by.....

Residence .....

Reference ..... April

SEND NO MONEY - USE THE COUPON

Digitized by Google



Don't Waste Time

Learn Electricity —the New Way

IT'S no longer necessary to go to school or serve an apprenticeship to learn electricity. With this new library of APPLIED PRACTICAL ELECTRICITY you learn right at home—in your spare time without interfering with your present work.

Any big job that you want in the electrical field is yours if you will train yourself to fill it. It only takes an hour or two a day with these books.

This is the 1920 edition—new from cover to cover—chuck full of the latest methods and most recent discoveries in this fascinating field. Everything is written in plain, good old U. S. language by 27 of the greatest experts in the business. The eight volumes with 3800 pages make up a complete course in electrical engineering. It's a home study course for the beginner and a handy reference guide for the expert combined.

Big Pay for Trained Men Jobs paying $1500.00 to $5000.00 a year are waiting for men who can qualify as Electrical Engineers—Substation Operators—Troublemen—Switchboard Operators—Dynamo Tenders—Electricians. Electricity is the greatest force in the world and it is growing bigger and bigger every day. More and more men are needed all the time. Why don't you get into this big paying field now?

Good Jobs Are Waiting If you are trained in some branch of electricity you will never have to look for a job. The job and the big pay will be looking for you. You can't dodge a good job if you have the "know how" under your hat. Let these 27 great engineers help you to the best kind of job with their books.

Send the coupon below and get them for FREE examination. See our free offer below.

What the Books Teach Elements of Electricity—Electrical Measurements—Electric Wiring—Underwriter's Electrical Requirements—Theory, Calculation, Design and Construction of Direct Current Generators and Motors—Types of Generators and Motors—Management of Electrical Machinery—Electric Lighting—Alternating Current Machinery—Power Transmission—Electric Railways—Self-Propelled Railway Cars—Trackless Trolley—Power Stations—Switchboards and Switching—Storage Batteries—Applied Electro-chemistry—Electric Elevators—Electric Welding and Heating—Wireless Telegraphy and Telephony—Land and Submarine Telegraphy.

Free Service With every set of these great electrical books we give a one year membership in this society. This entitles you to consult our engineers and experts on any electrical problem. Write as often as you like. Ask as many question as you like for one year.

The World's Greatest Electrical Books LOANED to YOU FREE

We will lend you this wonderful library to use in your own home or shop a whole week FREE. It won't cost you one cent. DON'T SEND ANY MONEY. Just fill out and mail the coupon today and the set of eight volumes will come to you by express collect. You be the judge and find out for yourself what the books will do for you. Use them as you please. Show them to your friends and get their opinion. Then if you have any doubt as to their value send them back at our expense and you won't owe us anything.

Only 7 Cents a Day

If you like the books after a week's examination you pay us only $2.00 and the same amount each month until $24.80 is paid. This is only 50 cents a week—7 cents a day. You can't afford to pass up a better job on these easy terms. MAIL THE COUPON NOW.

American Technical Society
Dept. E-354, CHICAGO

Coupon is All You Need— Send it Now

American Technical Society
Dept. E-354
Chicago, U. S. A.

Please send me the 8-volume set of Electrical Engineering for 7 days' examination, shipping charges collect. If I decide to buy I will send $2.00 within 7 days and balance at the rate of $2.00 a month until $24.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will return them, after 7 days, at your expense.

Name.....

Address.....

Reference.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

DETROIT

The Auto Center is the Logical Place To

LEARN AUTO AND TRACTOR BUSINESS



Training for Head and Hand

There were more than seven million cars and trucks licensed in the United States during 1919. Thousands more are being added to this astounding number every day and still the demand is far ahead of production. **And Detroit is the Heart of this Tremendous Industry**

Auto Factories Endorse School

The Auto Factories here in Detroit—THE HEART OF THE AUTO INDUSTRY—do not hesitate to endorse our school. We have letters from such factories as Packard, Maxwell, Hudson, Chalmers, Hupmobile, King, International Harvester Co. and others, endorsing the school. They employ our graduates and furnish us with their latest chassis for our students' use.

Earn $100.00 to $400.00 Monthly

Trained men are always needed and can get the big high-salaried jobs. Trained men are in big demand and we constantly have a greater demand than we can supply—both from Detroit and throughout the country. There are thousands of good locations for garages and the big factories help our graduates get these fine locations.

Service stations are after our graduates to fill positions as managers, foremen, etc., at big salaries. Auto owners prefer to put their cars in a competent mechanic's hands and our graduates have no trouble getting business and holding it. Our graduates who are in business make $5,000 to $10,000 and more yearly.

Read What the Factories say of the M. S. A. S.

HUDSON MOTOR CAR COMPANY
DETROIT, MICH., U.S.A.

The Michigan State Auto School in our opinion, is the finest institution of its kind in the country. In fact, we endorse its method of instruction.

We have recommended a great many students to them and the results were satisfactory.

The Michigan State Auto School ranks highest in the standard of schools. Its equipment and personnel is second to none. This school is considered one of the most efficient schools in the country.

If you intend to visit any school, then by all means choose the best one. The Michigan State Auto School, so far as we know, is the best. You will make no mistake by entering for a course.

Yours faithfully,
HUDSON MOTOR CAR COMPANY,
Service Department.

Packard Motor Car Company
MADE IN AMERICA
DETROIT, MICH., U.S.A.

The Michigan State Auto School enjoys a very enviable reputation, and is probably one of the best of its kind in the United States. Have no hesitation in recommending it in every particular.

Yours very truly
PACKARD MOTOR CAR COMPANY.

MANY TRAIN AT DETROIT AND RETURN TO THE FARM

This is your chance! Come to Detroit, the heart of this great industry. If you don't care to engage in the garage business, prepare to operate, adjust and repair your machines yourself—save thousands of dollars in repair bills as well as avoid costly delays at busy seasons. Think, too, of the money you can make in your spare time adjusting and repairing your neighbor's machines either in a small shop on your own farm or at some conveniently located place nearby.



MONEY-BACK GUARANTEE

We guarantee to qualify you for a position as chauffeur, repair man, demonstrator, auto electrician, garage man, automobile dealer or tractor mechanic and operator paying from $100 to $400 monthly or refund your money, provided you do your part and attend our classes.

Complete Training in Auto Electrics

Our course in Auto Electrics is complete. Standard electric equipment for autos, trucks and tractors is in actual operation for students to work on. Students are taught to quickly and easily locate electrical troubles. Hundreds of graduates are filling high salaried positions in electrical service stations. Every quarter of the globe recognizes our school as the world's training place for Auto, Truck and Tractor Mechanics.

Train in Detroit

Detroit, with its more than 180 Auto, Truck, Tractor and Accessory factories is the logical place to learn the Auto, Truck and Tractor business. 79% of all automobiles manufactured are made in Michigan—71% of them are made in Detroit alone. Can you think of a better place to learn this business.

Brazing, Welding and Tire Repairing Taught

These two subjects are taught in separate courses. Hundreds of students take them with the Complete Auto Course. Others take them separately. Competent men are in big demand in both fields. Brazers and Welders are needed in every field—Tire Repair men are always in big demand.

Graduates Pass State and City Examinations

Graduates of the M. S. A. S. have no difficulty in passing required examinations for automobile mechanics, chauffeurs, etc. No matter where you go, our training will enable you to handle the work easily and quickly.

Students From All Over the World

Men are coming to our School from every quarter of the globe recognizing it as the world's training place for auto, truck and tractor mechanics because of the close factory co-operation.

FREE BIG 176-Page Catalog

Send the coupon today for big 176 page catalog and copy of latest "Auto School News." They tell about courses—show more than a hundred pictures of equipment—give letters from big auto factories and graduates. Our Courses are reasonably priced—so reasonable in fact that many have jumped on train and come to Detroit without having stopped to write for catalog. Our Money-Back Guarantee protects you. If you can't come, get the catalog. Resolve to learn the business in Detroit—**the Heart of the Auto Industry.** Use the coupon NOW.

Open All Year—Start Any Time

Our school is open the year 'round. Enter the classes any day. You can get started the same day you arrive. Our welfare department will assist you in finding a good room and splendid meals.

Complete Tractor Course Included

You are given complete instruction on care and operation of Farm Tractors in our regular Auto Course. Constantly increasing use of tractors calls for trained tractor men. Manufacturers have placed machines with us to give our students the benefit of practical instruction. Hundreds of students are completing our course and returning to the farm, competent to care for their tractors and the tractors of their neighbors.

NOT A ONE-MAN SCHOOL

This school is founded on the best, newest and most practical principals in the Auto, Truck and Tractor business. Our course is built on the widest and closest co-operation of manufacturers, garages, service stations and owners. It is not one man's ideas, but the combined idea of the biggest and most successful men in each field.

A. G. ZELLER, Pres.



SEND THIS COUPON TODAY

MICHIGAN STATE AUTO SCHOOL
3964 Auto Bldg., 687-89-91 Woodward Ave.
Detroit, Mich., U. S. A.

Gentlemen: Please send me, absolutely FREE, New 176-page Illustrated Catalogue "Auto School News," and information as checked below.

[ ] Auto and Tractor Course. [ ] Tire Repairing. [ ] Brazing and Welding.

(Mark each course you are interested in.) Or, better still, you can expect me about

Name

Street

City State

MICHIGAN STATE AUTO SCHOOL

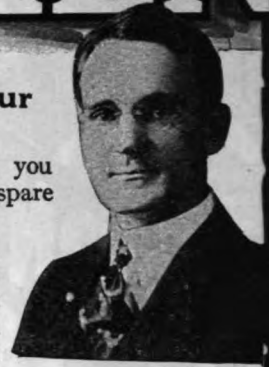
"Most Progressive Auto School in America"—"In the Heart of the Auto Industry"

3964 Auto Building
687-89-91 Woodward Ave. **Detroit, Mich., U.S.A.**

Digitized by Google

The World of Industry Needs DRAFTSMEN





ROY C. CLAFLIN, President
The Columbia School of Drafting

You Can Learn Quickly by Our Practical Method

If you are a person of even average ability, you can master this profitable profession in your spare time at your own home through our famous "Home Study Course." You can, in a short time, become a first class Draftsman because our training is most thorough and practical and because you will be personally instructed and coached by the President of the school, Roy C. Claflin, whose long experience as a draftsman and a teacher especially qualifies him to give you the kind of training you need. We teach you to make drawings just as you would in an actual drafting room, and when you finish our regular Mechanical Drafting Course you are given your choice of one of our **Special Post Graduate Courses, without extra cost.**

Draftsmen Get $35.00 to $100.00 a week

On account of the importance of his work, the Draftsman is paid an excellent salary and is always in line for advancement. Drafting is not only one of the best paying professions, but is the stepping stone to bigger opportunities. Many men, receiving up to $40,000 a year and over in technical positions, owe their success to their knowledge of Drafting. General construction companies, manufacturers of machinery, locomotives and automobiles, designers of tools and special equipment, makers of aeroplanes, large engineering companies, in fact all branches of industry need Draftsmen today in greater numbers and at better salaries than ever before.

"Columbia" Graduates Are the Kind of Draftsmen That Are Needed

The properly trained Draftsmen, such as those graduated from the COLUMBIA SCHOOL OF DRAFTING, are the ones who get the preferred positions and best salaries. The success of our graduates proves this to be true. Columbia Graduates are filling important positions as professional Draftsmen throughout the country and prominent concerns are continually offering positions to our graduates.

No Previous Training Required

As our students are given practical Drafting work from the beginning of our course, no previous training or drafting experience of any kind is required to take up this work with us. The training we give you is all that is needed to secure a position as Draftsman.

How Columbia Students Succeed

(More letters on request)

"I have accepted a position as draftsman, paying $2,640.00 a year to start. I had no previous drafting experience aside from my training with you, which has proven all that was needed for me to become a professional draftsman." Laurence P. Johnston. (Mr. Johnston is making as high as $200 a month extra in his spare time, which makes his total income from Drafting over $5,000 a year.)

"Several firms have offered me $40 and $45 a week to start. As I am doing nicely as draftsman up here and about to receive my second increase in salary have decided to stay. I find that there are hundreds of openings for draftsmen, and if I quit where I am I could secure another position in three hours' time. There will be a still greater demand for draftsmen." Geo. Murray, Jr.

"I wish to express my appreciation for your courteous treatment and sincere interest in the progress of my studies and for aiding me, upon completion of your course, to secure a very desirable position at $140 a month to start. I am getting on well and the chances for advancement are excellent." A. L. Gash.

"I have accepted a good position with a large manufacturing concern in Chicago and wish to thank you for the training your school has given me." Emil B. Johnson.

A few of our many other successful graduates are:

G. Tangorra	.	**$2,800 a year**
T. R. Brown	.	**2,860 a year**
R. Fowkes	. .	**3,700 a year**

Drawing Outfit Furnished Students

We furnish, without extra charge, an individual drawing outfit to all our students for use throughout the course. This becomes your own property as soon as the course has been paid for.

SEND THIS COUPON TODAY

or write to

COLUMBIA SCHOOL OF DRAFTING
ROY C. CLAFLIN
President
Dept. 1101 14th and T Sts., N. W., WASHINGTON, D. C.

COLUMBIA SCHOOL OF DRAFTING, Roy C. Claflin, Pres.
Dept. 1101, 14th and T Sts., N. W., Washington, D. C.

I am interested in your practical training in Drafting. Therefore, without obligation to me, please send me FREE your illustrated book of particulars, testimonials, terms, etc. I am particularly interested in the Course checked below.

....Mechanical Drafting	....Patent Drafting
....Architectural Drafting	....Sheet Metal Drafting
....Structural Drafting	....Topographic Drafting
....Electrical Drafting	....Ship Drafting
....Highway Drafting	....Statistical Drafting
....Aeroplane Drafting	....Automobile Drafting
....Special Machinery Drafting	....Builders' Course

NAME.....

ADDRESS.....

CITY.....STATE.....

Digitized by Google

He Earns $50 a Week Repairing Autos



THOUSANDS of men everywhere are doing the same. Many are getting more than this. Some are opening garages of their own. Why don't you get into the auto game too? Men in other lines with a little mechanical ability have doubled their earnings after getting into the fascinating field of auto construction and repairing. Ten times the number of men now engaged in the business are needed. Fine, big paying jobs are waiting for men who "know" to fill them. Read below and find out how you can fit yourself to hold one of these big, man's size jobs in your spare time, without going away from home at a cost of only 7c a day.

Learn at Home

No need to pay for an expensive course that will take you away from home. You can learn the auto game at a cost of one-tenth the expense of going away to school. You don't have to serve an apprenticeship either. Use spare time only and keep right on with your present work. This Library of Automobile Engineering and Tractor Information will make an expert out of you and fit you for the biggest kind of job. It is in six thick volumes, with 2600 pages and 2300 pictures, plans, diagrams and blueprints, etc. Every part of every well known car is explained. They teach you everything the best auto schools teach.

Fifteen great auto engineers prepared these money-making books for men like you. You don't have to know a thing about cars to understand them. Every page is written in plain, everyday language and they begin right at the beginning. With every set we give FREE a consulting membership in our society. You can write our engineers any time and get their help on any proposition on which you get stuck.

Everything About Autos

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Fly-Wheels; Clutch; Transmission; Final Drive; Steering; Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage Design and Equipment; Electrics; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gasoline Tractors.

128 Blueprints of Electric Wiring Diagrams

FREE Examination!

Mail the coupon for free examination. Don't send any money. We will ship the books (all 6 volumes) by express collect and you can have a whole week to use them as if they were your own. Give them every test you can think of. Take them to your shop. Show them to your friends and ship them back at our expense if you don't want to keep them. If you do keep the books to help you earn more, send us only $2.80. You can send the balance of the $21.80 price the same way—$2.00 each month. Only 7 cents a day. This is your chance to double your earnings—earn two dollars in the same time it takes to get one now. The coupon is your start. MAIL IT TODAY.



Don't Send Money— Just Mail This Coupon

American Technical Society :: Chicago

AMERICAN TECHNICAL SOCIETY
Dept. A-354, CHICAGO, U. S. A.

Please send me the 6-volume set of Automobile Engineering for 7 days examination, shipping charges collect. If I decide to buy I will send $2.80 within 7 days and balance at the rate of $2.00 a month until $21.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will notify you after 7 days to send for them at your expense.

Name.....

Address.....

City..... State.....

Reference.....

Please Fill Out All Lines

Digitized by Google



Free Proof that I Can Raise Your Pay

No matter how much you are earning now, I can show you how to increase it. I have even taken failures and shown them how to make $100—$200, and in one case as high as $2,000 weekly. I am willing to prove this entirely at my risk and expense.

LET'S have a little chat about getting ahead—you and I. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches.

I'm no genius—far from it. I'm just a plain, everyday, unassuming sort of man. I know what poverty is. I've looked black despair in the eye—had failure stalk me around and hoodoo everything I did. I've known the bitterest kind of want.

But today all is different. I have money and all of the things that money will buy. I am rich also in the things that money won't buy—health, happiness and friendship. Few people have more of the blessings of the world than I.

IT was a simple thing that jumped me up from poverty to riches. As I've said, I'm no genius. But I had the good fortune to know a genius. One day this man told me a "secret." It had to do with getting ahead and growing rich. He had used it himself with remarkable results. He said that every wealthy man knew this "secret,"—that is why he was rich.

I used the "secret." It surely had a good test. At that time I was flat broke. Worse than that, for I was several thousand dollars in the hole. I had about given up hope when I put the "secret" to work.

At first I couldn't believe my sudden change in fortune. Money actually flowed in on me. I was thrilled with a new sense of power. Things I couldn't do before became as easy for me to do as opening a door. My business boomed and continued to leap ahead at a rate that startled me. Prosperity became my partner. Since that day I've never known what it is to want for money, friendship, happiness, health or any of the good things of life.

That "secret" surely made me rich in every sense of the word.

MY sudden rise to riches naturally surprised others. One by one people came to me and asked me how I did it. I told them. And it worked for them as well as it did for me.

Some of the things this "secret has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. In one case I took a rank failure and in a few weeks had him earning as high as $2,000.00 a week. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered around" with it, barely eking out a living. Today this young man is worth $200,000. He is building a $25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling whenever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were $20,000. During 1917 the profits ran close to $40,000. And this genial 64-year-young man is enjoying pleasures and comforts he little dreamed would ever be his.

I COULD tell you thousands of similar instances. But there's no need to do this as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you.

A Few Examples

Personal Experiences

Among over 400,000 users of "Power of Will" are such men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, Ex. U. S. Chinese Ambassador; Assistant Postmaster General Britt; Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, former Vice-Pres. Art Metal Construction Co.; Gov. Ferris of Michigan; E. T. Meredith, Sec'y of Agriculturist; and many others of equal prominence.

$300 Profit from One Day's Reading

"The result from one day's study netted me $300 in cash. I think it a great book and would not be without it for ten times the cost."—Col. S. W. Wilke, Roscoe, So. Dakota.

Worth $15,000 and More

"The book has been worth more than $15,000 to me."—Oscar B. Sheppard.

Would Be Worth $100,000

"If I had only had it when I was 20 years old, I would be worth $100,000 today. It is worth a hundred times the price."—S. W. Taylor, The Santa Fe Ry., Milans, Tex.

Salary Jumped from $150 to $800

"Since I read 'Power of Will' my salary has jumped from $150 to $800 a month."—J. F. Gibson, San Diego, Cal.

From $100 to $3,000 a Month

"One of our boys who read 'Power of Will' before he came over here jumped from $100 a month to $3,000 the first month, and won a $250 prize for the best salesmanship in the state."—Private Leslie A. Still, A. E. F., France.

I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help 99 out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained, inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years it would become powerless to lift a feather, from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstance—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

How You Can Prove This at My Expense

I know you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive not a pamphlet, but the whole "secret" told in this wonderful book, "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you do feel that "POWER OF WILL" will do for you what it has done for over four-hundred thousand others—if you feel as they do that it's the next greatest book to the Bible—send me only $3.50 and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a $3.50 sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

Pelton Publishing Company

156-H Wilcox Block Meriden, Conn.

Pelton Publishing Company,
156-H Wilcox Block, Meriden, Conn.

You may send me "Power of Will" at your risk. I agree to remit $3.50 or remail the book to you in five days.

Name.....

Address.....

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 9 APRIL, 1920 NUMBER 1

Steam Turbines and How They Work

By Raymond Francis Yates

While the average man generally understands the operating principles of the reciprocating steam engine, few thoroughly understand the operation of the steam turbine, which is really a far more interesting machine. This is probably due to the small amount of literature which treats of the steam turnbine in a popular strain. Realising this the author has attempted to set forth the principles of the turbine in an "everyday" way. The subject of the steam turbine is full of interest for the man who "likes to understand things".

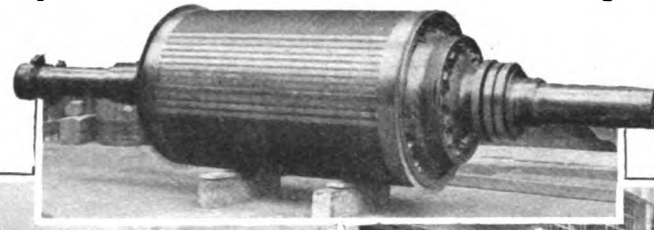
ABOUT eighteen hundred years have rolled by since the first steam turbine was made. History credits Heron as being the inventor of the first "steam-motor" which was really a reaction turbine. Although the steam turbine had its inception long before the reciprocating engine, and as a prime mover is far more efficient than the latter, it did not reach a point in its development where it could be applied in the work-a-day world until the early 80's. Today the whirling, hissing steam turbine is proving its worth in the power stations of the world; it has come into its own.

The ordinary reciprocating steam engine is inefficient for several reasons. When matter is set in motion, force is required to overcome this motion, before the body can be brought to rest. When steam delivers an impulse to a piston in an engine cylinder, the piston is forced to the opposite end of the cylinder and when it reaches this point it must stop and its motion is reversed by the crankshaft. When the piston stops a certain amount of the force represented by the steam is used in overcoming its motion. The general efficiency of the steam engine is further added to by its great number of sliding surfaces. These cause part of the useful energy to be used in overcoming friction.

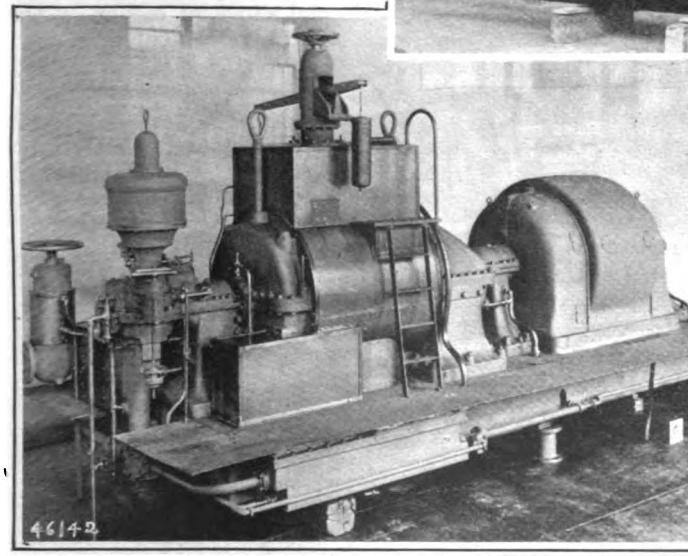
The steam turbine is far more efficient as a prime mover than the steam engine as it possesses no reciprocating parts. It has one moving member which is the rotor and this revolves in one direction only. The absence of a number of sliding surfaces also contributes to the general efficiency of the steam turbine. In most machines only two bearings are used.

The De Laval steam turbine first made its appearance in 1883. This machine is the A-B-C type of the turbine family. It consists simply of a single disc with lunette buckets arranged about its periphery. The steam is directed against these buckets by a number of nozzles which are mounted at an angle of from 15 to 20 degrees. The steam exhausts from the opposite side of the wheels into the atmosphere or condenser. The power produced by a turbine of the De Laval type is obtained entirely through the impact of the live steam delivered to the nozzles against the buckets.

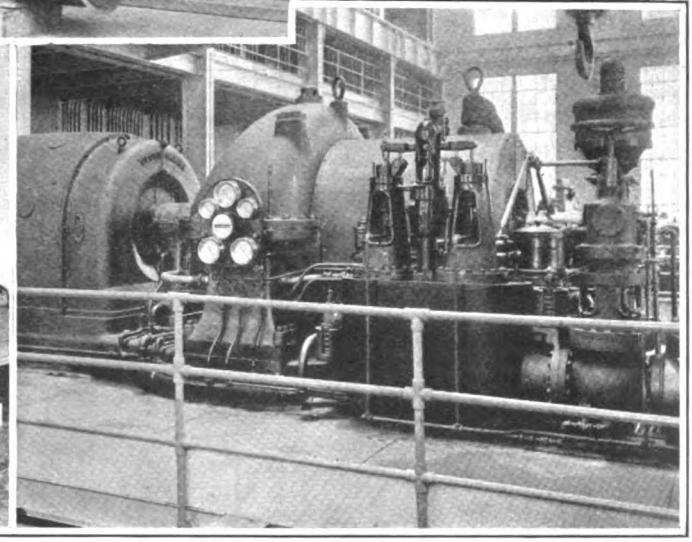
The steam ejected from the nozzles of the De Laval turbine reaches the almost unbe-



Rotor for a 7500 kva. turbo-generator



A Westinghouse automatic bleeder turbine, single flow, type 1200 R.P.M.

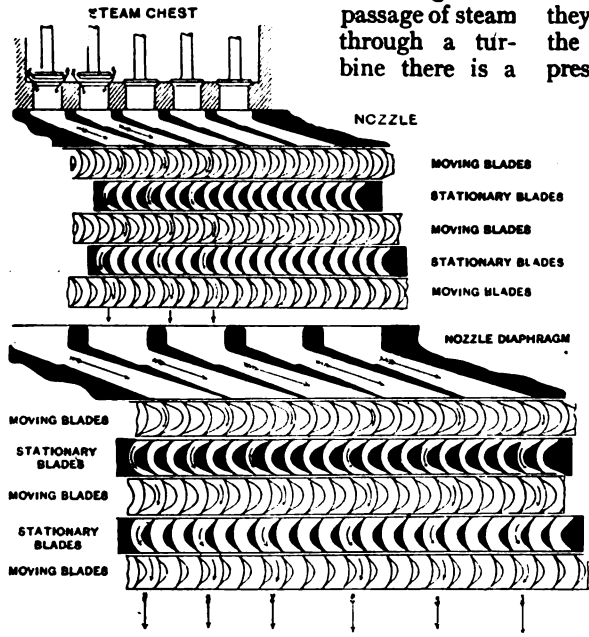


A 2500 kw. turbo-generator unit in operation

Digitized by Google

lievable velocity of from 2,000 to 4,000 feet per second. The latter figure is equivalent to a speed of over three-quarters of a mile per second. This steam velocity would theoretically produce a rotor surface velocity of from 90,000 to 120,000 feet per minute, which would involve a rotational speed as high as 80,000 R.P.M. with a wheel 6 in. in diameter. This tremendous speed is too excessive for practical application and the ordinary speeds of turbines of this type range from 30,000 for the smaller sizes to 9,000 for the larger types. Even these speeds are far too high for direct connection and the power is transmitted through a train of spiral gears which reduce the speed to the proper value. The speed is reduced to 1/10th of its original value by means of the gears.

The Parsons steam turbine was first introduced in the year 1884. This machine originally consisted of a number of discs mounted upon a single shaft revolving as a unit between stationary blades. Each disc has blades or buckets mounted upon its periphery. The method of sandwiching the stationary blades with the revolving blades is shown in the illustrations. It will be understood that the stationary blades are mounted on the inside of the turbine casing. The steam enters the turbine casing at high speed and pressure and sort of "elbows" its way through the spaces between the movable and stationary blades. By refering to the sketch it will be seen that the direction of the steam is altered as it passes from the stationary to the movable blades. A turbine with the blades arranged as described is said to be of the reaction type. In this type of machine the pressure of the steam is less on the exit side of the blades than on the entrance side. A reaction Parsons turbine has about three thousand blades compared to 300 for a De Laval turbine of the same size. The Parsons turbine, however, is by far the most efficient of the two.



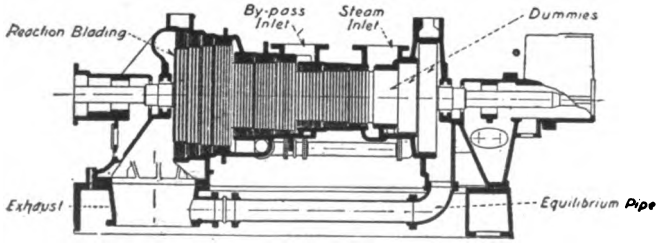
The arrangement of the blades and valves on a Curtis turbine

During the passage of steam through a turbine there is a considerable thrust. This thrust is overcome in the multistage machine by three balancing pistons on the opposite end of the rotor shaft. This arrangement will be noticed by refering to the sketches of the turbines. These balancing pistons are connected by passages to the different stages of the turbine so that as the steam is passing through each stage it will exert an equal and opposite pressure against the balancing piston. In this manner serious end thrust is eliminated. The balancing pistons never come into contact with the cylinder in which they revolve and there is little added friction to the motion of the rotor.

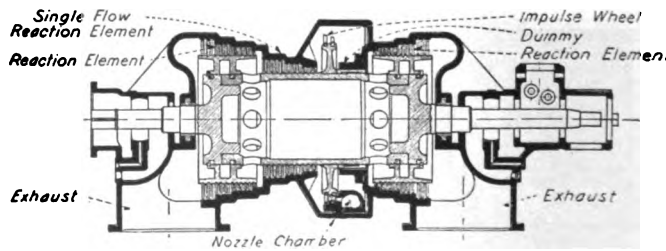
Steam turbines are made to operate on different pressures; high pressure, low pressure and mixed pressure. High pressure turbines operate at about the same initial pressure as triple expansion steam engines. Low pressure turbines generally operate on the exhaust steam of a reciprocating engine and they are generally interposed between the engine and the condenser. Mixed pressure turbines operate on the exhaust steam of engines which is supplemented with live steam for heavy loads.

Steam does not flow through high pressure turbines in one continuous stream, but rather in blasts or puffs at regular intervals. These puffs of steam are admitted by means of a cam on the governor, a spring-operated piston and a steam relay which causes about three impulses per second. The steam admissions are not throttled in proportion to the load and at full load the steam puffs merge into an almost continuous flow. On the larger machines an automatic cutoff is placed on the steam line which will cut off the supply if the speed of the turbine gets beyond a certain predetermined limit.

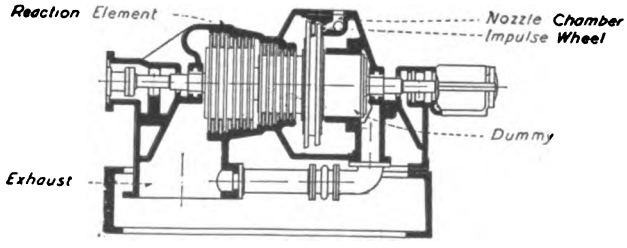
The Curtis type of steam turbine is assumed to be a combination of the principles of action of the De Laval and Parsons types, in that the first impact of the steam is from a series of several expanding nozzles in groups of two or three, at equal distances around the revolving wheel directly upon the revolving blades and from a reaction by a fixed blade disc, and in that a further impact occurs upon the second revolving wheel blades, the steam thus expanding through two or three stages and terminating in the condenser. The vertical arrangement of the shaft with the horizontal range of motion is one



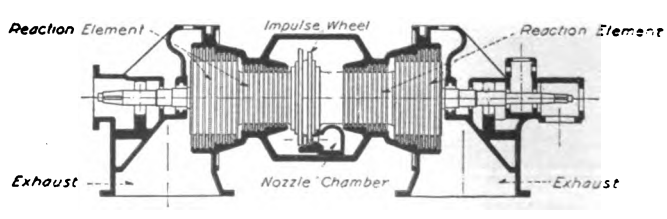
Section of a Parsons Type Single-Flow Turbine.



Section of a Combination Impulse and Reaction Single-Flow Turbine.



Section of a Double-Flow Turbine.

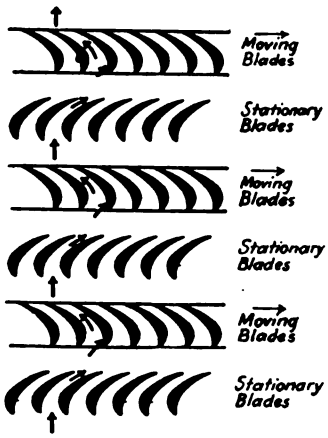


Section of a Double-Flow Turbine.

Digitized by Google

of the distinctive features of the Curtis type of steam turbine.

One of the drawings shows the arrangement of the steam chest valves and nozzles, and moving and stationary blades for a Curtis turbine. The most vital point in a steam turbine are the buckets since they, and the spaces between them, must be shaped exactly right to give the correct direction of flow and highest mechanical efficiency and also provide for the progressive ex-



The arrangement of the blades in a turbine

pansion of the steam. The buckets or blades for the Curtis turbine are cut out of the solid metal by a special bucket cutting machine.

In the following lines will be found a more detailed outline of the various turbines and their principles of action.

In the reaction turbine approximately one-half of the expansion in any one stage takes place in the stationary blades, imparting to the steam a velocity substantially equal to that of the moving blades so that it enters them without impact. The remainder of the expansion takes place in the moving blades, the spaces between which gradually grow smaller from the inlet to the exit side of the turbine forming a ring of moving nozzles. The velocity imparted to the steam by reason of the expansion occurring in the moving blades produces a reactive effort on these blades which turns the rotor of the turbine. This effect is very similar to that produced by water issuing from an ordinary hose nozzle.

In the turbines of the impulse type the complete expansion for any one stage takes place in the stationary blades or nozzles and the steam is delivered to the moving blades with a velocity somewhat more than double that of the blades. The passages between the moving blades are of uniform or even slightly increasing cross-section from inlet to outlet. The moving blades check and reverse the velocity of the steam current and the reluctance of the steam current to having its directions and velocity altered gives rise to a force against the blades which sets the rotor in motion.

Each of these two general classes of turbines has its partisans and doubtless always will have. The modern practice in turbine construction seems to be in the direction of a combination of the two types.

The use of a single impulse for the first stage of the expansion is desirable inasmuch as it replaces without any appreciable sacrifice of economy a considerable number of rows of reaction blading in the least efficient part of the reaction turbine, and makes possible a shorter and consequently stiffer rotor. For the intermediate and low-pressure sections, in which the volume of the steam is sufficient to require reasonably long blades moving at considerable velocities and extended experience confirms the belief that reaction blading has a decided economic advantage.

The all-impulse type necessitates a rotor built up of discs mounted on a shaft of smaller diameter in order that the circumferential clearance between the shaft and the diaphragms separating the pressure chambers may be as small as possible so that the considerable pressure drops between adjacent stages will not cause too much leakage

In the reaction type the pressure drops between adjacent stages are very much smaller and the body of the rotor may be built up in the form of a hollow drum. The drum construction is much stiffer than the shaft and disc design and it is believed much safer. When a disc is heated it develops internal strains that are impossible of calculation and which are liable to start cracks in the metal, resulting in many instances in complete rupture. On the other hand, in a rotor made up of a comparatively thin drum of considerable diameter and rings of large bore no such strains are encountered. Again the drum construction of rotor makes the turbine very much more accessible for examination and repairs. In most of the later designs of Westinghouse turbines the upper half of the cylinder can be lifted without interfering with the governor steam chest or pipe connections.

Bleeder turbines are for use in plants which are required to furnish not only power, but also considerable and varying quantities of low pressure steam for heating purposes. In these turbines a part of the steam after it has done work in the high pressure stages may be diverted to the heating system and the remainder expanded through the low pressure blading and exhausted into the condenser. In this way none of the energy of the heating system, due to the difference in pressure between the boiler and the heating system is wasted. On the other hand, if no steam is required for heating purposes, the turbine operates just as efficiently as though the bleeder feature was absent.

Steam turbines have been brought into use for the propulsion of ships. The real high speed of the turbine prevented its being adopted for this use for a long time. Finally a very efficient reducing gear was developed which made it possible to apply the turbine in this field. These reducing gears have been perfected to a point where they transmit 98½% of the power delivered to them. Turbines have been designed to operate on low pressure steam and these run on the exhaust steam from the engines. On the great steamship *Olympic* steam turbines are fed from the exhaust of the compound engines and a saving in fuel of from 12-15% is realized. The impossibility of reversing the turbine makes it necessary to install a separate unit when running astern.

TIN AMALGAM

TIN and mercury combine readily at ordinary temperatures. If 3 parts of mercury are brought into contact with 1 of tin, 6-sided crystals of tin amalgam are formed. Tin amalgam is used for silvering looking-glasses. When pulverized and rubbed on the polishing-stone it forms a kind of mosaic silver. Electric amalgam may be made by melting tin and zinc together in various portions in a porcelain crucible. The mixture is well stirred up, and when on the point of solidifying the mercury is added and worked into the mass. The whole is next transferred to the mortar warm enough to keep the amalgam soft, while it is well worked together, after which a piece of tallow or lard, not quite the equal in bulk to the mass, is kneaded in until the amalgam attains the proper consistency.

SILVER AMALGAM

THIS is best prepared by the use of pulverulent silver obtained by the reduction of silver solution. It may be prepared by bringing a solution of nitrate of silver in 10 to 15 parts of water into a bottle, adding a few small pieces of sheet zinc and vigorously shaking for a few minutes. The silver separating in the form of a very fine black-gray powder need only be washed and dried to be suitable for the preparation of amalgam. This finely divided powder may be directly dissolved in the mercury, though it requires some time. The object is more quickly attained by heating the mercury nearly to boiling in a crucible, then throwing in the pulverulent silver and quickly combining the mass by vigorous stirring with an iron rod.

WATCH

Watch for the announcement of a new contest which will appear in one of the early numbers of EVERYDAY ENGINEERING. This announcement will greatly interest all men who use tools. Several very substantial and worthwhile prizes are to be offered.

Digitized by Google

Model Car Trucks

Two-and-a-half Inch Gauge

By Henry Greenley

Associate Member Institute of Locomotive Engineers, England

QUITE recently the writer has been required to design and make patterns for some really satisfactory bogies for certain well finished "working" models of British Pullman cars. These trucks naturally embrace most of the characteristics common to American railroad practice and the accompanying drawings have been therefore rearranged in line with U. S. A. conditions and also slightly modified to suit amateur construction.

The trucks are of the over spring equalized type and as detailed in the drawings herewith require three patterns only viz: the side frames, stretcher or bolster, and the combined equalizer and axleboxes. It is advisable for the amateur to build the trucks from castings and make his own patterns even if a small number of trucks are required and all parts can be cast in gunmetal (bronze) thorughout if fine soft cast iron is not obtainable for the frames and bolster. With regard to the wheels, these may be in cast iron or turned from mild steel discs cut from the bar.

The chief feature of the trucks lies in the arrangement of the equalizer and axleboxes and in the attachment of the bolster to the car body. Although the wheels and equalizer can take up the position shown in an exaggerated degree in the sketch, Fig. 3. The bolster is provided with a half round transverse rib on its upper surface. This rib bears on a metal plate attached to the underside of the car transom beam and gives lateral stability to the truck, any direct side roll being taken up entirely by the equalizer springs. The truck is, however, quite free to rise and fall at the ends to accommodate itself to longitudinal waves in the track—i. e., such as are encountered at changes in gradient. The position taken up in Fig. 3 would therefore not be possible except in a slight degree, depending on the restraining action of the rubber washer fitted in the recess in the underside of the bolster casting under the head of the pivot screw or bolt.

The combination of the equalizer side springing with the "scale-beam" type of support for the bolster should provide for the roughest track and at the same time prevent the coach body from oscillating in a lateral direction. Nothing looks so bad as to see a model coach—and many do this—"dithering" and wobbling from side to side as it proceeds along the railroad.

To provide for the action indicated in the rough sketch, Fig. 3, rectangular holes in the side frames of the truck should be sufficiently free to allow the combined equalizer and axlebox to take up the position shown and to this end the sharp corners of the square boxes may be chamfered off to a substantial amount where they pass through the opening in the side plates of the truck.

Of course, separate boxes could be used but if the prospective maker of these bogie trucks is anxious to get say a train of four or five cars ready—this means 40 axleboxes—he will welcome anything in the nature of labor saving. With a view to the future use of the patterns one is always requiring bogie trucks in the equipment of a model railway—and to obtaining clean castings metal patterns are recommended. For the side frames a piece of sheet brass ⅛ in. thick should be cut out to the shape required by detail drawing Fig. 5 allowing for sand "draw" and providing for shrinkage (3/16 in. to the foot, approximately). On this the three inside blocks may be silver soldered or soft soldered *and riveted.* The raised horn plates may then be cut out of 1/16 in. sheet and soft soldered on, the plates being further secured by countersunk screws driven from the back with their points which should be nicely rounded projecting through the front to indicate rivet or bolt heads in the final castings. The openings for the axleboxes should be arranged for in the pattern but enough metal should be provided for filing to size and "draw" on the sides of the hole should also be ample.

This is the third installment of Mr. Henry Greenley's series on model railway engineering. During the past two years the Editor has received a multitude of inquiries relative to the construction of model car trucks and he hopes that this article sets forth all of the necessary information on the subject.—EDITOR.

In soft soldering several parts to one base successive heats are necessary, and care should be taken not to oxidize or "burn" the surfaces and the solder by overheating. The temperature to which the metal is raised should be sufficient to just melt the solder. Parts fixed in the previous heats should be screwed or riveted to secure them in the succeeding ones. To hold several parts together during the soft soldering operation, strip steel clamps, as sketched in Fig. 4, will be found extremely useful. Cleanliness is necessary to successful soldering, and a certain amount of practice is required to produce a satisfactory pattern. When completed it should have nicely rounded corners and such fillets—which are essential to sound clean castings — may be obtained by floating soft solder wherever it is required to form a fillet. Another point to observe is that soft solder cannot follow silver soldering until the whole of the work is recleansed. To remove the burnt borax the object should be warmed (a black heat is sufficient) and immersed in a pickle of sulphuric acid and water, strength 1 to 20. The pattern for the equalizer may be made out of ¼ in. x ⅜ in. brass strip, the ends being silver soldered to plates made of 3/16 in. stuff. When shaped to dimensions (plus allowances for casting shrinkage) the axleboxes may be sweated on, also the small pieces forming the spring bearings. These additions are similar in shape to the pieces soldered to the side frames (see sketch Fig. 4) and may be sawed out of 7/16 in. sound bar brass. To retain the spiral springs in position the pattern should provide for the small spring pin shown in cross section drawing Fig. 6 and in Fig. 7.

If the latter course is adopted the casting may be of L section in the center to lighten it, although lightness in a model truck need not be studied. A little weight in wheels and trucks is to be desired. The side frames are attached to the bolster by three screws (3/32 in. diameter) on each side, but before the truck can be assembled the work to the wheels and axles must be completed, as the fixing of the side plates secures the whole of the parts of the bogie truck. It has been arranged in designing the truck to make the combined equalizer and axlebox (Fig. 7) quite flat at the back. These castings can then be quite easily finished by filing, machining or "band-grinding" the back and drilling 11/64 in. blind holes for the 5/32 in. axle journals. The rest of the casting, except for the sides of the axleboxes and the all-important rounding of the corners where the box passes through the side plate, only requires fettling up to provide a reasonably clean surface for the final painting.

The hole for the truck pivot bolt or screw in the bolster casting should be at least 1/32 in., if not 1/16 in. larger than the pivot itself. The rubber washer or disc will restrain the truck from any display of sloppiness due to the clearance between the hole and the screw or bolt, and at the same time the rubber will allow of the equalizer action of the

(*Continued on page* 88)

Digitized by Google

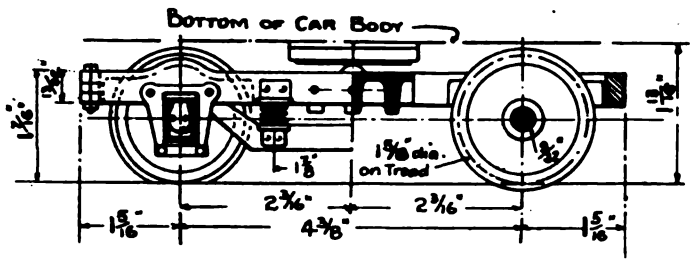


FIG. 1

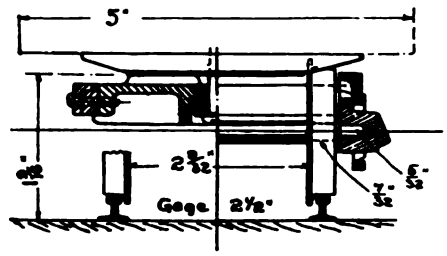


FIG. 2

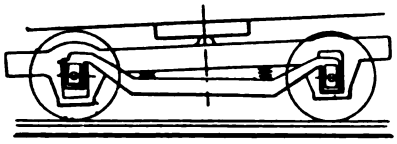


FIG. 3

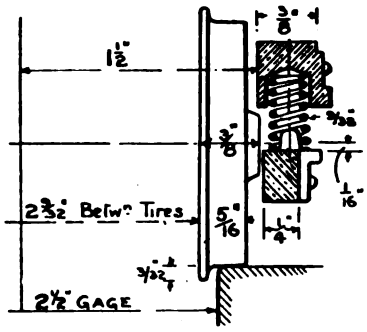


FIG. 6

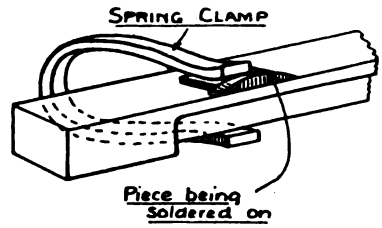


FIG. 4

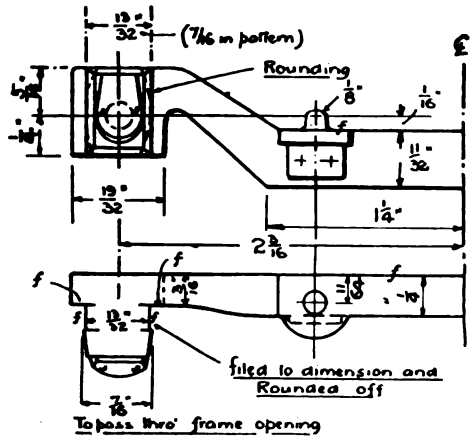


FIG. 7

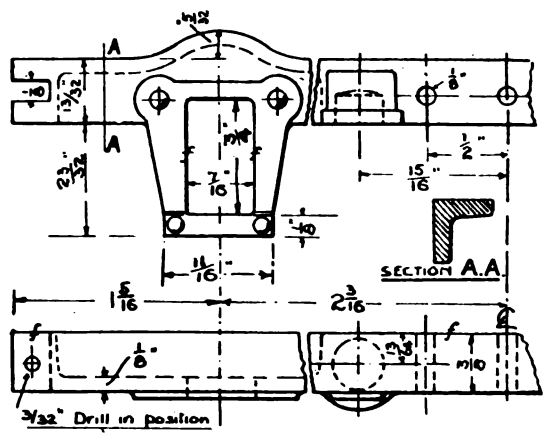


FIG. 5

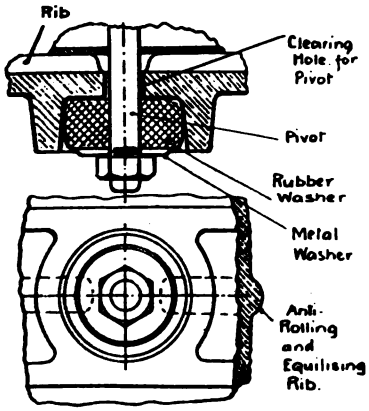


FIG. 8

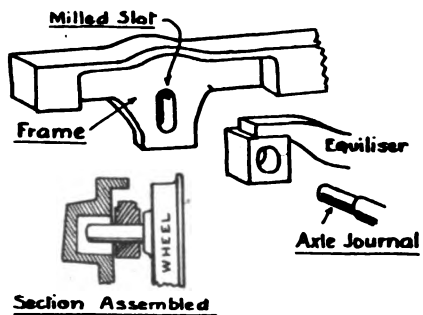


FIG. 10

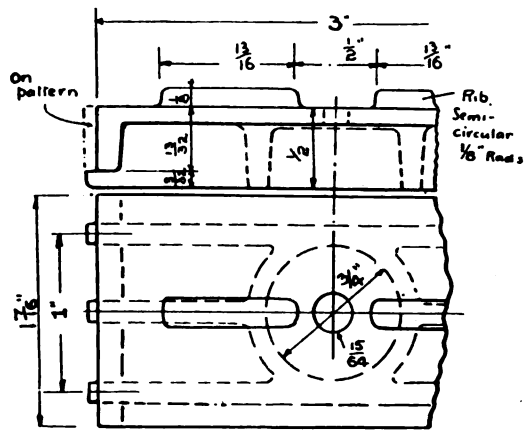


FIG. 9

Digitized by Google

Systematic Lubrication and Maintenance of Automobiles

An Exposition Dealing With the Importance of Giving an Automobile Regular Care, and How to Inspect the Mechanism in a Thorough Manner. The Necessity for Periodical Lubrication to Reduce Operating Expenses and Rapid Depreciation is also Made Clear

By Victor W. Pagé, M. S. A. E.

MORE automobiles come to an untimely end by abuse than are worn out by useful service and more parts of the mechanism become worn or broken by neglect than depreciate from normal use. The average motorist who looks after his own car is apt to be neglectful and keeps the car in operation as long as it will run. Even the cheapest of automobiles represents an investment of nearly a thousand dollars, yet their owners do not always take the care required to conserve the investment and lessen depreciation, which is apt to be abnormally high because no effort is made to give the mechanism the care it deserves.

This is not always the fault of the automobile owners, because in many cases they have no idea of what parts to inspect and what to look for even if they do carry on a more or less haphazard inspection of the power plant or chassis mechanism. The care that an automobile demands should not tax even the busy man, as several hours per week spent systematically will insure that the car will be properly oiled and that no serious defects will materialize without giving notice in advance. The instructions which follow are intended to help the automobilist in caring for the car in his charge and apply to most standard cars. The subject of lubrication is considered first, then that of logical and periodical inspection.

Car Lubrication Important

Without question the subject of lubrication is of more importance to an owner than any other subject, because proper lubrication contributes in no small degree to keeping a not inconsiderable investment from depreciating too rapidly. It does not suffice that the best of workmanship and highest grade materials are employed in manufacture. They cannot give the owner that service he has the right to expect if this feature is neglected. The best of material will not lubricate a bearing, and the finest workmanship will not keep a piece of machinery out of the scrap heap if wearing surfaces are not lubricated regularly. Even slight neglect, not in itself enough to destroy immediately, will have damaging effect upon wearing parts, and will cause not only increased depreciation but lost time, increased maintenance and operating cost, and a performance not at all in keeping with that which the automobile was designed and constructed to give.

The instructions which follow can be followed to advantage by drivers and owners of practically all standard makes of cars, though they will be subject to slight modifications as the arrangement of the mechanism dictates.

Motor Lubrication

The oil reservoir, when empty, will take two or three gallons of oil, depending on the size of the motor. The best oil to use depends on the type of motor and the recommendations of the manufacturer should be followed and only lubricant of the best quality used.

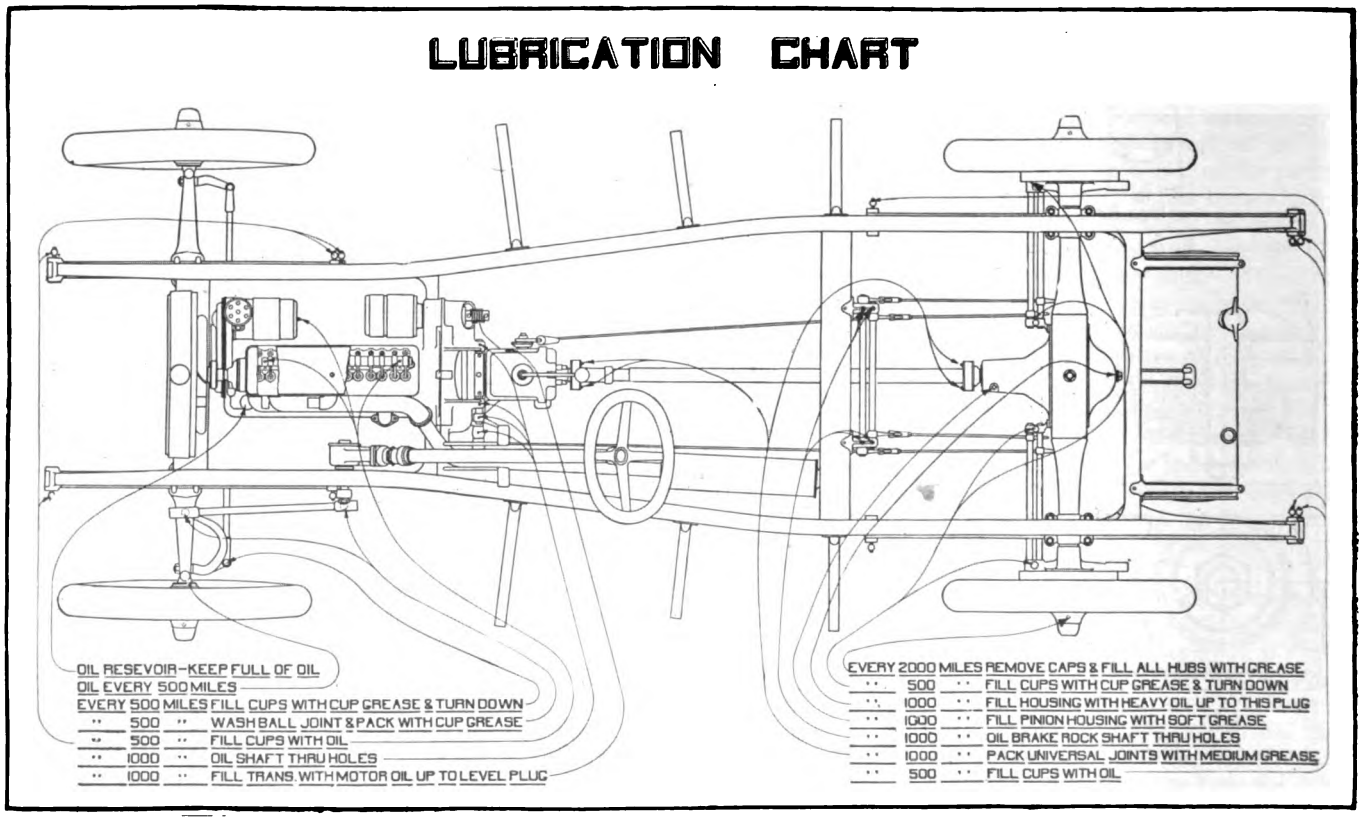


Chart showing location of oil and grease cups on a popular light car, the Oldsmobile Six, also giving the periods when attention is needed

Digitized by Google

The oil filler will be found located at forward end of the motor on the left side in most cars, though the location will vary. Care should be exercised at all times to see that the oil is kept between high and low marks on the gage usually found at rear end of motor. Watch oil circulation indicator on dash carefully, and should it not register when motor is running, investigate immediately, ascertaining if the oil line is stopped up, or if the reservoir is empty. The oil reservoir should be drained every five hundred miles through the plugs located at rear of reservoir in the starting and lighting system. One or two drops of three-in-one oil injected into the oil wells every thousand miles will be sufficient. One of these wells is located on the top of the distributor housing, oiling the armature ball bearing, the distributor plain bearing and the oil wick in the timing lever body. The other oil well will be found on the extension of the end plate at the driving coupling, and lubricates the ball bearing on that end of the magneto. Oil cups will also be found on the bearings of generator and motor of the starting and lighting system.

lubrication of the clutch is necessary if a dry plate or cone clutch is used except that the clutch throw-out bearing should receive regular lubrication. This is generally provided for by a large grease cup located on the floor board, which should be given one turn every morning or noon.

Oil cups are provided on the steering gear, and they should be kept filled with a good grade of light oil. At each end of the drag link is a socket in which the ball of the steering arm operates, as well as the arm on the knuckle arm. These should be thoroughly greased at least

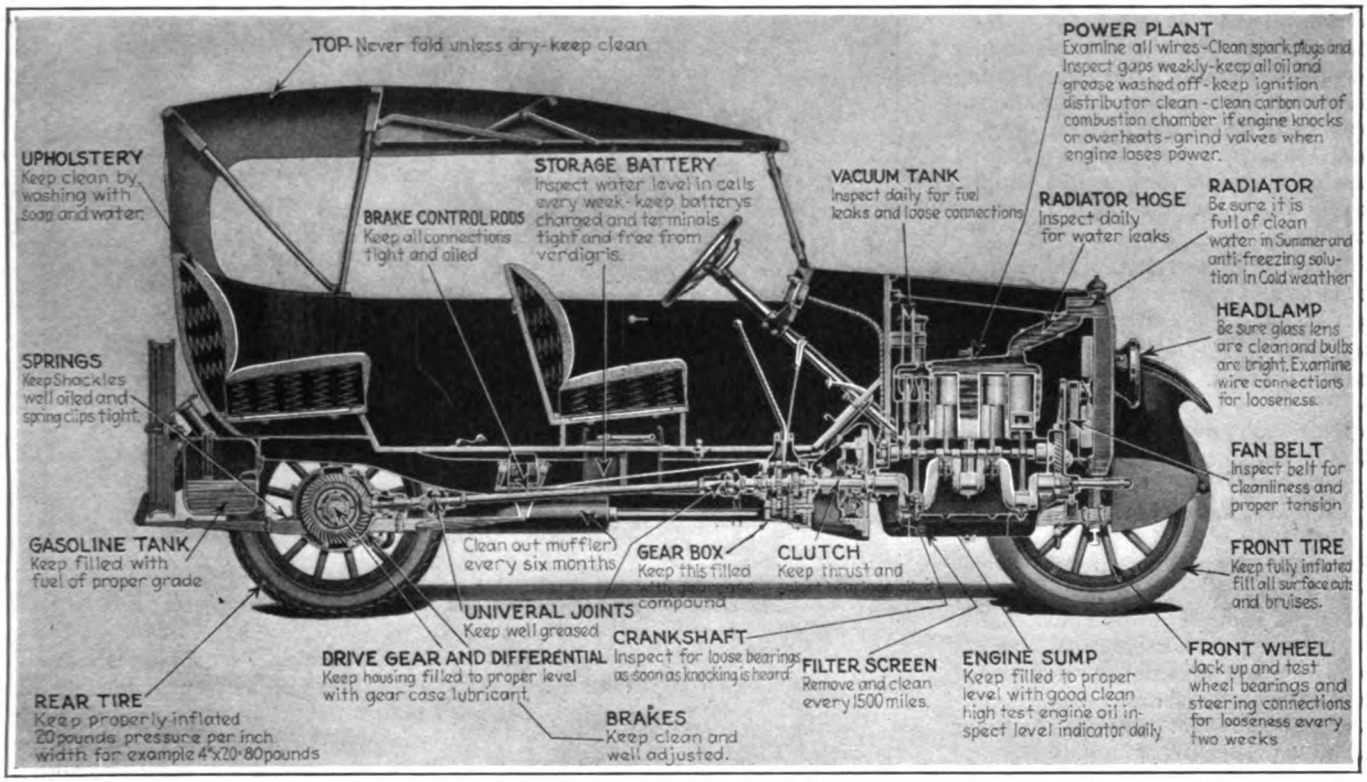


Chart showing cross section of modern four-cylinder automobile depicts parts of mechanism that need regular inspection

bottom of crank case, and refilled with fresh oil. The reason for this is obvious; the grade of gasoline that is being sold at the present time is such that perfect carburetion is impossible until the motor warms up, resulting in considerable raw gasoline finding its way into the oil reservoir, which gradually thins the oil until it ceases to be a perfect lubricant. For this reason, heavy-bodied cylinder oils are often recommended.

The oil system of modern automobiles is nearly always the force-feed type and pressure is maintained by a positive gear-driven pump located in the bottom of oil reservoir, generally to one side. There is an oil strainer surrounding the pump intake which should be cleaned occasionally. This can be easily removed for cleaning by simply taking out cap screws or unscrewing a plug. A grease cup is provided on the fan. Fill this with grease weekly and turn every day. Do not overoil the magneto or the dynamo and motor of the electric

Chassis Parts

Grease cups are usually provided at all points on the front axle where friction comes. Make sure that the grease cups are filled with a high-grade light grease free from acid and grit. Keep reserve supply of grease in a tightly covered can so that no grit or dust can get into it. If oil cups are used be sure to keep these filled with fluid oil.

The bearings on the front wheels of most cars are tapered roller forms and may be lubricated with any light grease or heavy oil if it is positively free from acid. Plugs are sometimes provided in the wheel for lubricating the bearings, and in addition the wheels should be removed periodically, the bearings thoroughly cleaned with kerosene and relubricated with light grease, using a clean wooden paddle for spreading.

The transmission should be filled in about 1½ inches above center line of the main shaft with a good grade of heavy transmission grease or oil. No twice a month. Grease universal joints weekly with a good grade of cup grease, using grease gun, and once every three months joints should be completely taken down, thoroughly cleaned and repacked.

Oil cups on brake flanges and grease cups should be given attention once a week. These lubricate the internal brake cams of the rear axle. All external brake joints should be given a few drops of oil once a week. Fill differential gear-case one-third full of heavy oil or very light grease. Do not fill over one-third full.

Every six months take out drain cup in the bottom of case and thoroughly rinse out old lubricant with kerosene by pouring it in at top cap. After rinsing out with kerosene, then fill with lubricant as above instructed. Rear hub bearings on full floating axles can be given sufficient grease by simply removing hub cap and filling this with grease, then screwing back in position.

Digitized by Google

This should be done about every three months. Every six months the springs should be taken apart and lubricated with a good grade of grease mixed with graphite. Spring-bolt bearings are provided with oil cups and should be oiled daily. There are numerous other points of friction such as control rods, cross rods, rocker shafts, etc., not mentioned, where a drop of oil occasionally will materially benefit.

Daily Maintenance Routine

Engine: Examine all wiring terminals for tightness. Clean magneto or ignition distributor externally. Note tension of fan belt. Inspect oil supply in engine crank case. Inspect oil pump for performing its proper function. Inspect radiator water supply. Inspect hose connection for leaks. Inspect gasoline tanks for proper fuel supply. Inspect fuel pipe line and all connections for leaks.

Brakes: Inspect for undue wear or looseness and tighten if necessary. Inspect for proper operation.

General: Inspect and thoroughly clean all lamps. Inspect tires for air pressure, cuts or damage. Make sure spare tires are properly inflated. Tighten all loose bolts and nuts.

Weekly Maintenance Routine

Engine: Inspect all wires for proper support and freedom from damage. Thoroughly clean engine externally. Inspect all pump connections for oil leaks. Inspect all water connections for leaks. Inspect carbureter control connections. Do not attempt to alter carburetor adjustment unless this is shown to be necessary when the truck is in service.

Remove magneto or battery system distributor cover and clean with gasoline and a clean cloth. Operate engine at low speed and, with one wire at a time separated from the spark plug inspect the spark given for length and apparent hotness. Keep engine free from carbon; inject tablespoonful of kerosene into each cylinder, through pet cock or spark plug holes. This should be injected when the motor is hot and allowed to stand over night. Remove, clean and adjust all spark plugs.

Brakes: Inspect and thoroughly clean and oil all brake connections. Adjust if necessary.

Springs: Inspect center bolt of spring and spring clips for apparent tightness.

Wheels: Inspect front wheels for alignment with rear wheels. Inspect tires for undue damage and wear. Jack up wheels and inspect bearing adjustment. Inspect spindles and spindle bolts. Inspect the steering rod adjustment and all rod ends of the steering linkage.

Clutch: Inspect entire clutch mechanism.

Transmission: Clean and inspect all control connections.

Universal Joint: Inspect universal joint for undue looseness and wear. Clean and refill universal joint with grease.

Differential: Inspect differential and propeller shaft bearing adjustment.

Body and Equipment: Inspect body bolts, hood fasteners and all similar bolts for apparent tightness. Inspect tool equipment for completeness.

Monthly Maintenance Routine

Engine: Determine if carbon is present in quantity in the engine. Examine and inspect engine for loose parts, leaks, noises. Clean oil pump screen. Grind valves if necessary.

Ignition: Clean magneto or distributor head, polish and adjust breaker points. Inspect magneto or timer cam for correct advance.

Clutch: Inspect clutch hub grease tube. Inspect clutch operation. Inspect clutch alignment.

Transmission: Clean externally and inspect for leaks, particularly the drain plug and the rear bearing.

Springs: Thoroughly inspect and clean spring shackle connections. Inspect springs to ascertain damage, if any.

Differential: Clean and inspect differential housing for oil leaks. Inspect brake arms and equalizers on differential housing.

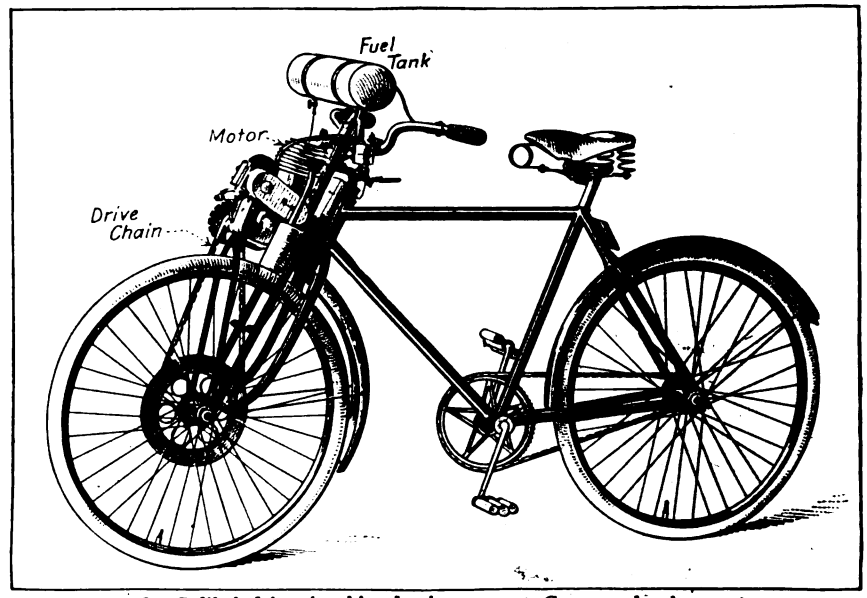
Wheels: Remove hub caps and inspect for proper lubrication. Inspect condition of bearings.

Universal Joint: Inspect universal joint ring and yokes. Inspect housing bolts inside joint housing.

General: Inspect transmission arm bolts. Inspect front motor support bolts. Inspect oil pan and transmission bolts. Inspect steering gear for lost motion and lubrication. Inspect speedometer drive.

ENGINE DRIVE FOR BICYCLES

AN easily installed gasoline engine drive for bicycles is not a novelty in the United States, but those of domestic design follow other principles than those of a new German design which is shown herewith. The power plant is mounted on the front fork and pulls the bicycle by driving the front wheel. The Colibri front drive is said to reduce dangerous skidding, also the weight will be less. It consists of an air-cooled, four-cycle, single cylinder engine of 1½ H.P., mounted on a fork frame of steel tubes. This is intended to be attached beside the front fork of the bicycle and is connected to the bicycle frame by spring joints. The vibrations of the engine are insulated from the bicycle frame, which could not stand such detrimental strains for a long period owing to its light construction.



The Colibri drive for bicycles is a recent German development

The engine drives a secondary shaft through a short chain, this crankshaft contains the clutching device and, from this shaft, the chain wheel at the front hub of the bicycle is driven with a longer chain.

By releasing the clutch the bicycle can be driven with pedals. The motor has a high-tension magneto and jet carburetor. The fuel tank is mounted at the steering bar and from the handles of this bar the throttle and clutch are controlled by Bowden wire. To prevent splashing of oil on the rider, the back and top side of the fly wheel is covered with a sheet metal guard. The weight of the complete Colibri motor

Digitized by Google

drive is 36.2 lbs. (16.5 kg.), the speed ranging from 18 to 25 m.p.h. with small fuel consumption that could be expected from a low powered engine. This is an interesting revival of the Clement motor, a French design of over fifteen years ago.

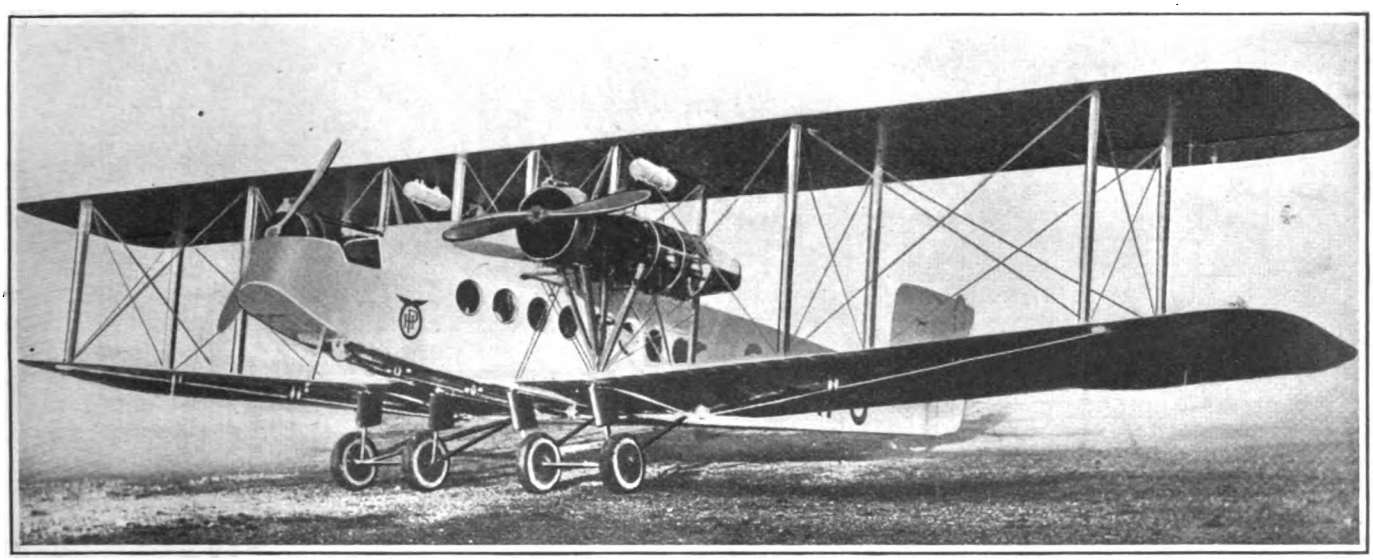
MORE COMFORT FOR THE AVIATOR

THE pilot's and navigator's cockpit in a recently devised machine intended for long flights is fitted with Triplex glass side windows and a floor window in front of the pilot. Normally the seat placing allows the crew to sit with their heads just clear of the cockpit, but the design is such that the cockpit may be converted into an enclosed cabin. The seats are fitted with clips which permit them both to drop about a foot, and sliding doors are pulled across the openings to close in the cockpit. Some of the side windows are made to open, and a pipe running from the front of the radiator supplies fresh air to the cockpit interior. Dual control is provided, and the pilot has two rudder bars one above the other, for the two seat positions. There is a system of pull-out tables for charts and slots for instruments. The circular opening for the pilot's head is fitted with an aluminum beading which is graduated off into degrees for use with a sextant. In the rear of the navigator are cupboards for food.

It would seem quite possible even in small single-engined machines to design a cockpit providing every facility for piloting and navigation, which will be thoroughly comfortable and livable for the pilot as well as the passengers. The accompanying illustration shows the thorough enclosure of the passengers' cabin in the Handley Page London-Paris flyer, and shows how well protected the passengers can be and how luxurious the furnishings of air liners can be made. The complete machine is also shown and the size of the fuselage necessary to accommodate the twelve passengers is clearly shown. Illustrations of an earlier design have been published previously in this magazine, but the latest type is particularly interesting in view of the improvements that have been made and the luxurious appointments of the "Pullman" body provided for the accommodations of the passengers who use the London-Paris air route.



Luxuriously appointed cabin of Handley-Page passenger-carrying airplane



The Handley-Page twin-motored airplane is a converted bomber with a well-appointed cabin for passengers

The effect of temperature on the duration of incandescent lamps has been the subject of recent experiment. At 392° F. lamps were used up in 40 hours, while at 36° F. the duration was normal or better. This explains the short life of lamps in luminous signs, where being crowded together they are kept at a high temperature.

A mixture of sodium silicate (water-glass) baked in a kiln, forms a solid bonding material, with a tensile strength of over 2,000 pounds to the square inch. It is said to be used for abrasive wheels.

LEAD BURNING

LEAD burning consists in melting the metals and causing the parts to flow together and become joined without the aid of solder. It requires considerably more skill than any other form of brazing or soldering. A long step toward success may be taken by the proper arrangement of the work. It is usual to provide something which may serve as a mold or guide for the melted metal. For example, if two lead sheets are to be united by soldering, they are laid on a sheet of some non-heat-conducting substance, such as brick or asbestos. The work in the immediate neighborhood of the joint is carefully scraped so as to remove all oxide or scale which would tend to bind the melted lead and prevent it from flowing freely. The metal at the seam is heated by a very hot bit or the flame from a blowpipe so that there is a uniform flow of lead across the seam. It is sometimes necessary to add more lead to the seam by melting a strip held in the hand. A flame of some sort is the most satisfactory source of heat for the average lead burning job, because not only is the heat more uniform, but also more intense, and the lead melts at the desired point before the surrounding metal becomes sufficiently hot to soften. There are several types of blowpipe for this purpose on the market. Some employ an alcohol flame, while others make use of mixed hydrogen and air. The flame is usually small, sharp-pointed, and very intense. Lead burning is absolutely necessary, and is insisted upon in certain classes of work, for instance, in lining tanks with lead for chemical solutions, or for joining the grids and lugs of storage batteries.

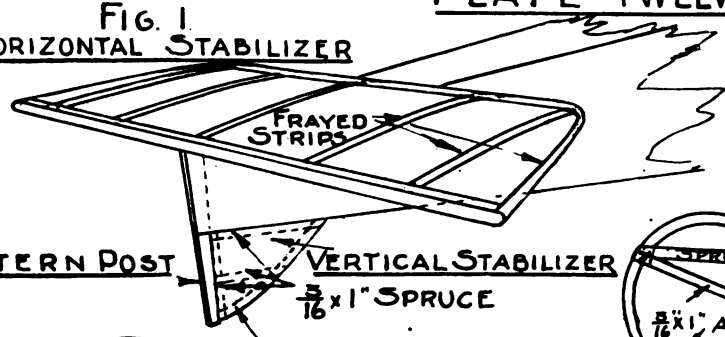
Digitized by Google

DETAILS OF TWO SEATER SEA-PLANE

Designed By C.E. MULLER M.A.E.

PLATE TWELVE

FIG. 1
HORIZONTAL STABILIZER



SECTION OF STABILIZER TRAILING EDGE
$\frac{5}{16}$ x 1¼ SPRUCE FALSE RIBS

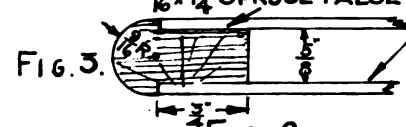


FIG. 3.

FIG. 2.

STERN POST

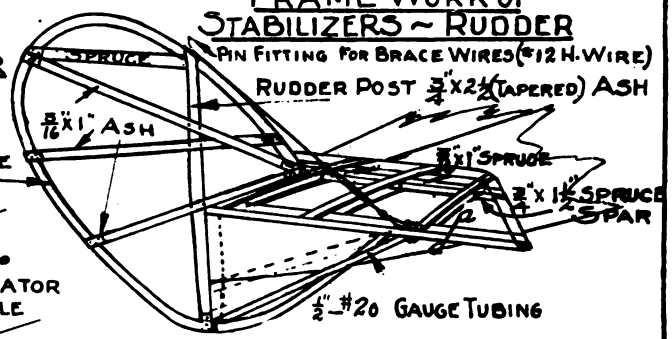
VERTICAL STABILIZER
$\frac{5}{16}$ x 1" SPRUCE

EDGEING OF ¼" X 1½" LAMINATED SPRUCE

FRAME WORK OF STABILIZERS ~ RUDDER

PIN FITTING FOR BRACE WIRES (#12 H. WIRE)

RUDDER POST ¾" X 2½" (TAPERED) ASH



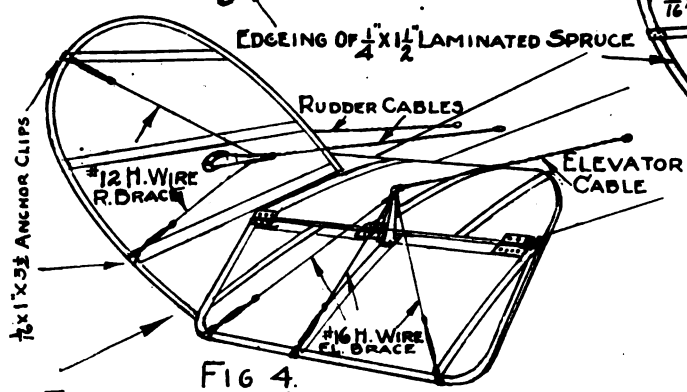


FIG 4.
EMPENNAGE ASSEMBLY

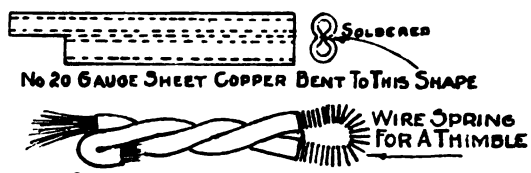
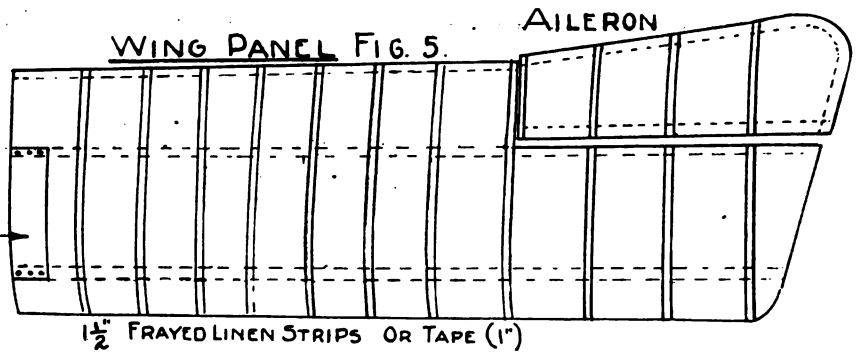
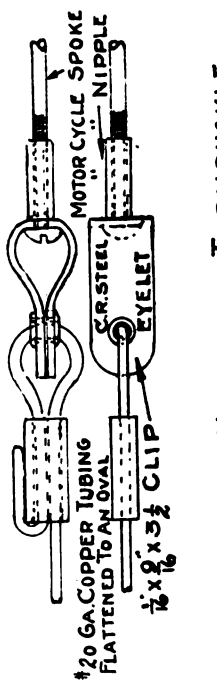


FIG. 6 CABLE TERMINAL

WING PANEL FIG. 5.





HARDWIRE TURNBUCKLE
FIG. 7.

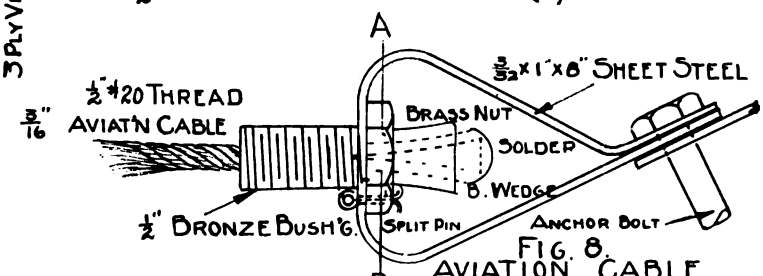
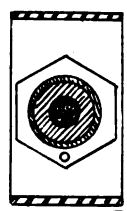
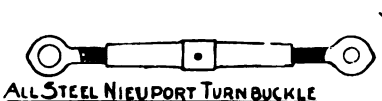


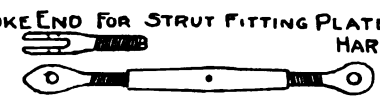
FIG. 8.
AVIATION CABLE ANCHORAGE TURNBUCKLE



SECT A-B



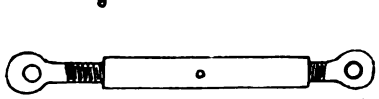
ALL STEEL NIEUPORT TURNBUCKLE
BARREL 4 $\frac{5}{8}$ LONG TENSILE STRENGTH 11,000 lbs



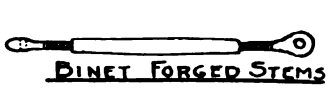
ENGLISH TYPE BRONZE BARREL



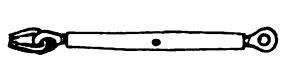
METHOD OF SAFETY WIRING



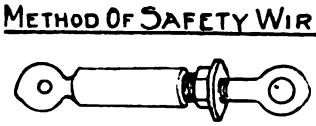
BINET TURNBUCKLE
LARGEST BARREL 5 $\frac{1}{8}$" LONG T.S. 22,000 lbs
SMALLEST " 1 $\frac{3}{8}$" " T.S. 4001 bs



BINET FORGED STEMS



LEFT HAND EYE WITH CABLE THIMBLE
RIGHT " " TO TAKE A PIN



NAIN-GEANT FRENCH TURNBUCKLE
RIGHT AND LEFT HAND THREADED TUBING

Digitized by Google

Building A Two-Passenger Seaplane

By Charles E. Muller, M.A.E.

Consulting Aeronautical Engineer

PART EIGHT

Fabric Covering and Assembling of Machine

THE covering of airplane surfaces has undergone decided changes, principally in the improvement of the material itself and the methods of applying and doping the fabric. This is far from being standardized. Each manufacturer has his own method. Up to about 1912 cotton and silk, oiled or varnished, and some of the various rubberized fabrics then used for balloons were experimented with. The principal objections with these were the difficulty in getting them sufficiently taut, and the rapid deterioration by the oil and gasoline from the motors. Also they were weakened by the coating processes then used. Cotton fabrics weigh from 1½ to 4 ozs. per sq. yd. with a tensile strength of 25 to 80 lbs. per inch, depending on the weight.

Linen Widely Used

Closely woven linen, weighing from 3 to 4¾ ounces per sq. yd. with an approximate tensile strength of 75 lbs. per inch in the warp lengthwise of the material to about 100 lbs. per inch in the weft (crosswise of the material), is now almost universally used. This is carefully fitted, and smoothly but not too tightly stretched over the frame work. From 3 to 5 coats of cellulose dope is then applied and finished with a coat of spar varnish. On the large airplanes the fabric is applied so that the warp and the weft run diagonally and tacked or sewed on to the cap strips top and bottom of each rib. This tends to assist in stopping and ripping or tearing of the fabric. On the small machines, the fabric is lengthwise of the wings with the seams, if any, near the trailing edge. It may be tacked along the rear wing bar by placing filling-in-strips between the rib cap strips. The edge of the overlapping seam to face the rear so that the air in the slip stream cannot get under it. A brief explanation of some of the characteristics of fabrics that have been used may help the amateur to select a substitute, a cheaper covering.

Substitute Covering Materials

Cotton muslins and percales are comparatively strong and inexpensive. Careful selection of the very best quality of closely woven unsized and unbleached grades, should test from 40 to 60 lbs. per inch. Sea Island and Egyptian goods are the best cottons in strength and durability. I believe these are used exclusively in pneumatic tires in which the stresses are literally terrific. Cottons are susceptible to rapid deterioration by the elements especially moisture, therefore must be waterproofed by a "dope" explained later and spar varnished.

Rubberized cotton balloon fabric 36" to 50" wide, weighing 2¾ to 4 ozs. per sq. yds, formerly sold for 90 cents to $1.50 per yd. It is now seldom used.

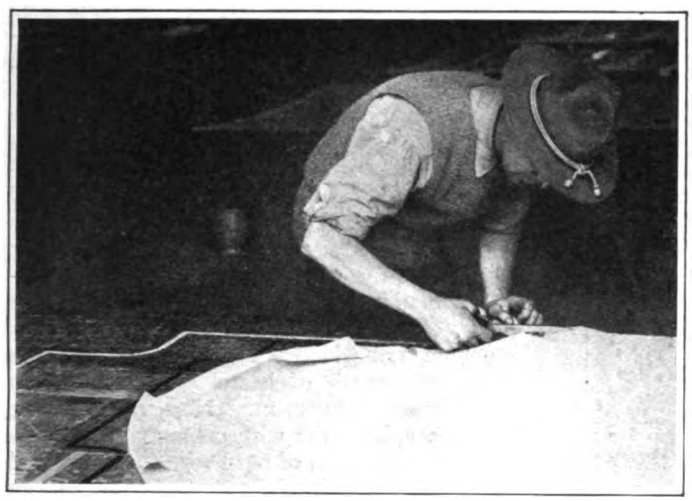
The fabric on an airplane sustains an average load at the C. P. (center of pressure) of approximately 20 lbs. per sq. ft. at seventy miles per hour. About 75% of this is exerted on the upper surface of the wings so it is therefore essential that this surface be properly fastened to the frame structure by copper tacks closely spaced or sewed to the cap strips by copper wire or flax cord after the 2nd or 3rd coat of dope is applied. Tape or frayed strips are then cemented with dope or varnish over the rows of tacks or stitches.

Dopes Used for Treating Cloth

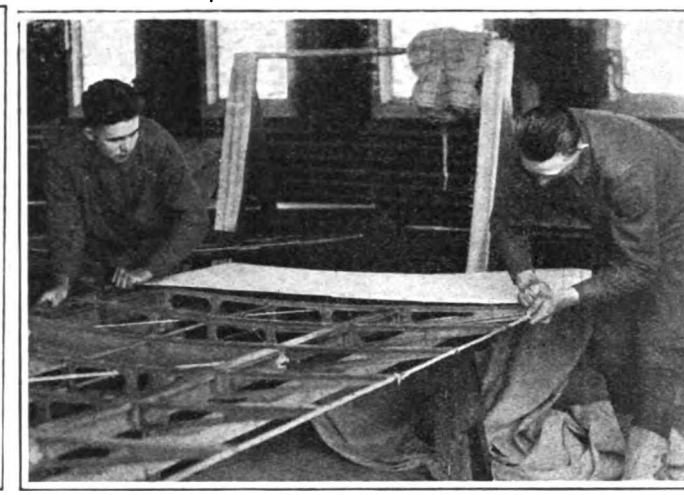
The history of the development of dopes is an interesting one, but a few pertinent facts will suffice for the needs of the amateur. Those in use today may be divided into two classes, namely; those made from a base of cellulose nitrate or pyroxylin and those manufactured with a cellulose acetate base. Both are dissolved in a suitable solvent more or less a trade secret, probably either alcohol or acetone. Sometimes, other substances are added to preserve its flexibility or to modify the shrinkage.

The chief advantage of the acetate dopes over the nitrates or pyroxylin is the reduced inflammability of the former. This will probably be appreciated to a greater extent for commercial machines, although the initial cost of cellulose acetate dope is greater. Some manufacturers apply three coats of the pyroxylin followed by two or three coats of the acetate. This gives a fire-resisting surface even though the doping is not non-inflammable all the way through.

The writer built a Farman type machine in 1911 that was covered with a single surfaced six-ounce cotton duck. It was stretched tightly over the framework with a pocket for each rib and wing bar. One coat of hot paraffine was applied with a stiff brush as rapidly as possible, then ironed with hot irons top and bottom. This machine was considered fairly efficient in the pioneer days. This method is purely experimental but may be worthy of further exploiting.



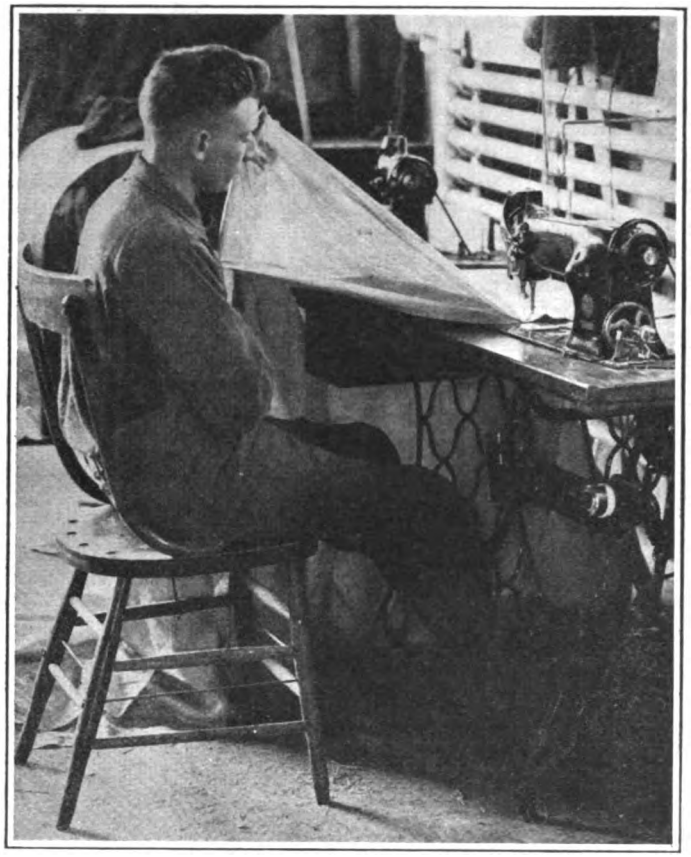
How cloth is cut on the pattern table to fit wing frames



Slipping cloth covering made in the form of a bag over wing frame

Digitized by Google

Some engineers recommend stretching the fabric on the frame as tightly as possible, then use a dope of slight shrinkage power, others stretch the fabric less taut and depend on the dope to shrink the fabric taut. Personally I favor an intermediate course especially for this seaplane. The frame construction of this plane was consistently designed so far as practical to eliminate the sewing of the fabrics and the easy attachment thereof.



Stitching pieces of cloth together to form a bag to be used as airplane wing covering

Securing Fabric to Frame

On the main wings the fabric may be tacked to the entering and trailing edges, and along the rear wing bar, where cut out for the ailerons. The aileron stabilizers and elevators are covered and tacked on the trailing edges. The rudder covering is made in the form of a bag and slipped over the frame and tacked to the rudder post and under the part that extends over the stabilizer.

The fuselage and the turtle back cover may be covered with an inferior grade of material and tacked where convenient, then doped, similar to the other surfaces.

Smooth Surfaces Important

The importance of a smooth aerofoil surface is of far greater aero-dynamical importance than most practical men realize. This has been empirically demonstrated by wind tunnel tests made by Zahm, Libbous, and others. The desirable properties of a good wing surface may be summed up as follows: It should be taut, smooth, water- and fireproof with dope adhering well to the fabric.

The fabric should then be well doped, the first coat should be well brushed in especially along the edges and the cap strips. It should be carefully rubbed down with No. 0 sand paper and well dusted. The last coat may be heavier than the others or may be a spar varnish of a grade that is recommended for seaplanes.

The tape or frayed strips should be applied after the third coat. If any patching is necessary the spar varnish must be removed with mineral wool and the doped surface well washed with the proper solvent. The patch is then well doped, two coats or more then applied. The dope will then act as a cement. After the dope has set, varnish may be applied to the patched area to protect it.

ASSEMBLING

When assembling we may divide the airplane in three units, firstly, the fuselage, with or without the motor, usually with the landing gear in position, the tail placed on a wooden horse so that the upper longerons are horizontal (level); secondly, the wings or cellulose in two sections (right and left); thirdly, the empennage or tail surfaces including the elevators and the horizontal stabilizer vertical fin, and the rudder. The rudder and vertical fin are usually left attached to the fuselage when transporting or storing the airplane but they are considered a part of the empennage. The next installment will explain the common method of truing up the fuselage, empennage and cellule.

The horizontal stabilizer is fastened on the longerons by 2 3/16 inch U bolts at the leading edge and braced by two light ½ inch No. 20 gauge steel tubing members from the trailing edge to the stern post and from the entering edge to the longeron.

The vertical fin is then attached to the stern post and to the horizontal strut by 20 gauge steel plates. The rudder and elevators are then hinged. Ordinary 10 penny nails make excellent hinge pins if kept well greased. A 1/16 inch hole must be drilled in one end to lock wire, or cotter pin it securely in position.

In the larger planes the cellule or wings are usually assembled by standing the entering edge of the panels, on pads, fitting the struts in their respective sockets and attaching the wires. In this type it is advisable to sling up the upper wing panel to the ceiling. Then have the lower wing panels on horses or blocks in their relative flying position, that is its proper dihedral and angle of incidence, then fit the struts in their sockets. It will be necessary to note the margin of take-up of the particular size turnbuckle that is used for each size wire as they vary according to size of wire from 1⅜ to 5⅛ inches in the length of barrel and therefore in their adjustment. Now measure the length of the wire cables (the cable is used instead of hard wire for flying and landing wire because it shows broken strands before failure and is therefore more reliable). Allowance must be made for loops and take-up. The stems must be turned in the barrel at least twice their diameter.

Novel Wire Terminals

Figure 6 shows an easily made cable terminal of 20 gauge sheet copper that is bent over a form of drill stock, then soldered. The cable is slipped through the short side, then a piece of wire spring, then returned through the long side and bent over, then placed in a vise and twisted as shown.

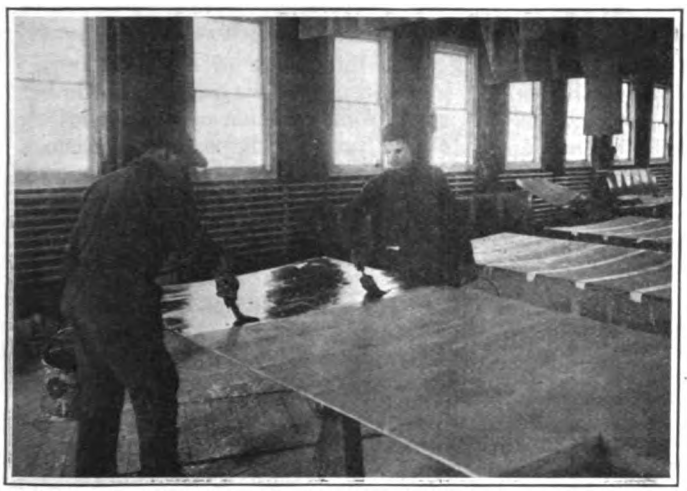
Figure 7 shows the adaption of the bicycle and motorcycle spoke and nipple for a take-up for hard wires. It may do very well for the fuselage tail wires or if cleverly done, the fitting eye bolts may suffice for a take-up.

Figure 8 suggests a possibility for an adjustment for cables. The nut is to take up the slack and also is used for

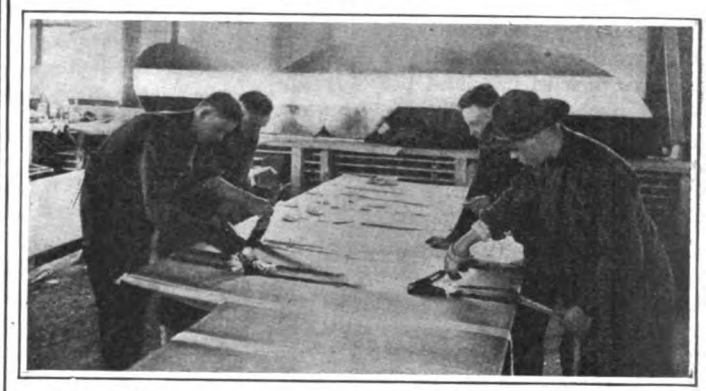
Digitized by Google

wedging the soldered cable end firmly. The bronze or brass bushing may be a piece of tubing about 2 inches long threaded for 1½ inches, with sufficiently thick walls to take an 18 to 20 thread. The opposite end may be reamed tapering or expanded to fit a wedge (brass is best for soldering) this is driven into the core of the wire cable, then soldered over the bushing and cable. A hole must be drilled through the nut and clip to lock it in position.

Of course these substitutes are not recommended if the regular turnbuckles are procurable but are suggestions to the ingenious. The stagger wires (sometimes called incidence wires) are made of cable and sometimes of hard wire. These are the wires that brace the wings in a fore and aft direction. The alignment of the airplane showing several methods of checking up the dihedral and incidence together with some practical flying instructions as taught in the U. S. Army during the war will conclude the series in the next issue.



Doping covered airplane wing frame at left. Large brushes are used to save time



Method of applying doped frayed strips to cover tacks or cord stitching shown above

CONCRETE HOUSES

QUITE a number of methods are employed in the construction of concrete houses. At Brighton, England, an experiment has been carried out with concrete slabs. Briefly, the system known as the "Doric" is as follows: A skeleton framework of lath is put up first, and then, both outside and inside, slabs or panels of a patented composition of weather-proofed cement and asbestos are attached. These slabs form the surfaces of both sides of the wall and between them is poured the concrete, making, when it sets, an unbroken, unjointed wall faced inside and out with asbestos covering. The outside is finished with rough cast. The building will be completed on traditional lines, but the time required for the erection of the shell is only about one-third that required for brickwork, and the cost approximately two-thirds. Concrete, as such, can be made more quickly and cheaply than brick, but it is found in practice that the process of rendering it waterproof makes its ultimate cost greater than that of brickwork. It is claimed for the new method that that extra cost is avoided.

A NATIONAL FUEL FOR FRANCE

ARRANGEMENTS are being made in France for putting on the market what will be known as the national fuel. This will be composed of a mixture of benzole and alcohol. At the present time experiments are being carried out, although it is difficult to understand what new data can be desired, for the Paris General Omnibus Co. used a benzole-alcohol mixture for several years with complete satisfaction, and only abolished it on account of the fluctuations in the price of alcohol. Actually all of the taxicabs and motorbuses in Paris are running on benzole exclusively. This is being imported from England and America. This fuel is adopted because of its lower price and also because the drivers refuse to run on anything else. As is generally known, there is a local tax on all motor fuel brought into the city of Paris; this tax is 20 centimes per litre of petrol and 15 centimes on benzole. As drivers buy their own fuel, they naturally refuse to accept the one bearing the higher tax.

DELIVERING A BUILDING BY TRUCK

THE development of motor truck transportation is shown in the recent delivery at Milwaukee of an all-steel building, 90 x 80 feet. This was made by a Youngstown, Ohio, plant on order of a large automobile manufacturer, and as it was urgently needed motor trucks were used to expedite delivery. The building, in parts, was transported on two large trucks in three days, much faster than would have been possible by freight; besides, two handlings of the material were saved, as it was possible to load the material on the trucks at the plant and unload it at the building site.

FUEL EFFICIENCY OF ENGINES

THE question of fuel economy is of vital interest to the users of cars both because of its affecting, as it does, the pocketbook, and the ability of the car to cover great distances on a moderate load of fuel. A survey of the field by this authority shows that the brake thermal-efficiencies of the various types of engines places the automobile motor in a "fairly satisfactory position". In the class of steam engines, the locomotive stands at the bottom with an average efficiency of 6 per cent, followed by the compound non-condensing engine, 10 per cent, the compound condensing engine, including boiler, 13 per cent and the Parsons turbine, including the boiler, 17 per cent. When we come to the internal combustion engine, there is a decided jump. The automobile motor is credited with 23 per cent, the airplane motor with 27 per cent, the coal gas stationary engine with 30 per cent, and the average Diesel engine with 34 per cent. On reaching that modern development in which the internal combustion and the steam engine are combined, we get for the Still engine an efficiency (actually obtained) of 41 per cent, and Dr. Dawson sets down the probable future efficiency of the Still-Diesel combination at 44.5 per cent.—*Scientific American.*

WHEN GARAGE PLANNING

IN planning the home garage, remember that for a single car the minimum floor space will be 12 ft. by 20 ft., if you purpose doing any work on the vehicle in its shelter. Also these dimensions do not allow room for either a work bench or for storage space; they are simply irreducible minimum for the man who intends to take care of his car.

The cement mills of the United States in 1918 saved from their waste 1,429 tons of potassium oxide. Of course, it was not recovered in this form, but the savings are calculated on the basis of the oxide. The amount recovered in 1917 represented 5 per cent. of the total production of this country.

Digitized by Google

Adapting Engines to the use of Available Fuels

By J. G. Vincent, M.S.A.E.

PROBABLY the most absorbing topic today in the automotive engineering world is the fuel question. This is as it should be, for it is essential that we design engines which will utilize not only the fuel that is being sold today but also the fuel which will be on the market two or more years hence. It is time that we devise some system which will insure the realization of the entire useful life of the cars we are designing today, rather than have them discarded or run under adverse conditions when the quality of the fuel deteriorates. The petroleum resources of the country are already taxed to the limit to supply sufficient gasoline for the cars now in use, and the only apparent way in which this fuel supply can be materially increased is by utilizing some of the heavier fractions which at the present time are not considered fit for automotive use.

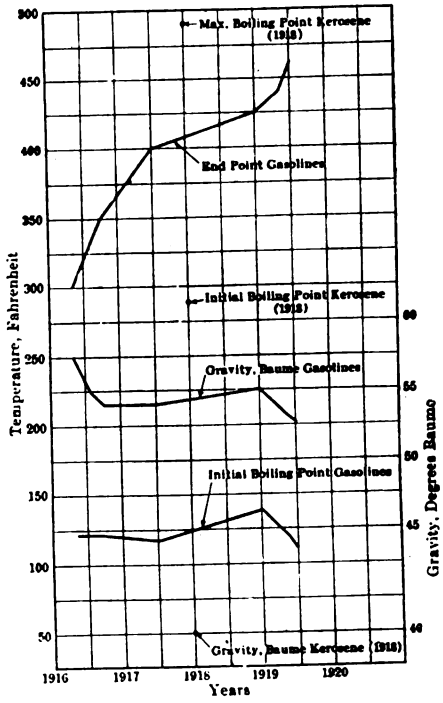
The accompanying curves are intended to bring out some of the salient facts in regard to the character of the fuel marketed in the past few years. Only three characteristics which are of special interest have therefore been plotted, although many additional considerations are to be borne in mind. It will be noted that the end-point of the average gasoline has been rapidly ascending in the last four years and is now but little less than the end-point of the kerosene of today. The gravity, Baumé, readings are slowly descending but the initial boiling point has not undergone much change. As long as this latter condition holds we shall not have much trouble in starting engines in cold weather.

Meeting the Fuel Problem

Let us now examine various methods of meeting the fuel problem. There was a time when we pointed with pride to the frost on a bare aluminum intake header, considering this a very desirable symptom indicating perfect vaporization. This applied when we were dealing with fuels of about 80°, Baumé, which vaporized under the conditions obtaining in the manifold at ordinary temperatures. The low temperatures produced by this vaporization increased the volumetric efficiency of engines very materially and cold headers were therefore looked on with favor. Thus we have repeatedly demonstrated on Liberty engines that 500 h.p. or more can be developed by one of these engines, which normally will give about 420 h.p., by using high-test gasoline and getting the mixture into the cylinders cold enough. But nowadays we are dealing with fuels which refuse to vaporize at ordinary temperatures in the

The paper from which the accompanying article is condensed was presented at the annual meeting of the Society of Automotive Engineers. Col. Vincent is one of the designers of the Liberty motor and Vice-President in charge of engineering of the Packard Motor Car Co. of Detroit, Mich., so his description of a new vaporizing device should be of interest to our readers following internal combustion or automotive engineering progress.

header. In the course of some experiments with glass manifolds I found that when using 56° Baumé gasoline it is necessary to put the mixture into the cylinders at about 180° Fahr. to secure a perfectly dry mixture. Of course, this is going to the extreme, and for all practical purposes the mixture



can be somewhat wet and yet the engine will function properly. We will therefore assume that a mixture temperature of 120° Fahr. is the minimum to be used.

I would like to state some of the reasons why the mixture should be introduced in as dry a condition as possible. From the standpoint of the driver the item first in importance is that of spark-plug fouling.

Second in importance to the driver is the question of performance with a cold engine. During the past few years we have used thermostats, water-jacketed headers, hot-spots and heated air intakes. All these, of course, help the situation somewhat, but I believe that with the fuel getting worse more rapidly than the engine is improving the winter operation of cars is becoming less satisfactory each year.

The third item in order of importance, insofar as the owner is concerned, is the contamination of the lubricating oil by fuel which passes the pistons. This is a serious problem, for few owners will go to the trouble of draining off the oil at comparatively short intervals in winter. In consequence the lubricating system soon becomes filled with a mixture of fuel and oil of little or no lubricating value.

There are many minor questions involved when we try to distribute and burn a wet mixture. Many have tried numerous types of intake headers to find which insures the nearest approach to equally proportioning the air and gasoline to each of the various cylinders. We are often using gas velocities in the intake header exceeding 100 m.p.h. and it is therefore to be expected that the liquid gasoline will separate from the air stream, due to its greater inertia. Of course, when the gasoline is turned into a dry gas it behaves just like air and takes the turns nicely along with the air. The failure to obtain prompt response when opening the throttle quickly when using a wet mixture is also undoubtedly due to the fact that the air will accelerate more quickly than the liquid gasoline particles, with the result that the engine either "lies down" or spits back. When a dry mixture is used we can step on the throttle and get instant response. The more finely divided the gasoline, the better the engine responds.

Securing a Dry Fuel Mixture

I take it that we are now all agreed that a dry mixture is desired. There remain to be examined the various methods of obtaining this result. The commonest one now employed is to utilize some of the heat contained in the exhaust gases, and since there is expelled in the exhaust from 20 to 40 per cent. of the heat units contained in

Digitized by Google

the original gasoline, depending upon the engine speed and other considerations, it would appear that this is the most practical and economical way to obtain the result. Theoretically it undoubtedly is, but practically, in some cases, the method presents serious objections. If we assume that the intake and exhaust manifolds are in some manner constructed integrally, it is obvious that the temperature of the intake walls will vary in proportion to that of the exhaust walls. This, of course, means that at high speed and under heavy load the walls will be very much hotter than at low speeds and light loads. It is therefore obvious that if the intake header is sufficiently hot to do the job at low speeds and light loads, it will be altogether too hot at high speeds and heavy loads to obtain the maximum volumetric efficiency of the engine. Of course, there are many cases where a high volumetric efficiency under heavy loads or at high speeds is not essential, so that this solution gives pretty fair results. We are all, however, striving to get the most power possible out of the least engine, and it certainly hurts to cut 10 or 20 per cent off the maximum output of the engine to insure a dry mixture at low throttle and light loads.

Then again there are various compromise schemes most of which are based on the theory that it is possible to locate a very hot spot at such a point that the heavy particles of the fuel will be thrown against this surface and vaporized, whereas the air and the lighter particles will be diverted from the hot-spot by the particular design of the header. This would be fine if it were possible to get the hot-spot hot enough under low throttle conditions. It is undoubtedly a good compromise scheme and does not detract from the volumetric efficiency of the engine to the extent that the regular exhaust-jacketed job does.

Another Solution of the Problem

It was these various considerations that led me to look elsewhere for a solution of the problem. It appeared desirable to evolve some simple inherently automatic method of supplying the heat, not possessing any of the disadvantages cited above. It was shown that about 4,574 B.t.u. per hr. would represent an average requirement. Assuming that there are 19,000 B.t.u. in 1 lb. of gasoline, it will be seen that we could secure the necessary heat from the complete combustion of 0.24 lb. of gasoline per hr., providing we could attain a 100 per cent heat transfer. We do not, of course, obtain 100 per cent efficiency with the scheme I am going to describe, but I believe that from a thermal standpoint you will agree that it is a very efficient arrangement or one representing but very small heat losses. The principle of this device is to take advantage of the difference in pressure existing on either side of the carbureter butterfly-valve and cause a small amount of the combustible mixture to pass through a passage which is in parallel with the main carbureter passage, burn this mixture in a suitable burner and then allow the burnt gases to mix with the incoming main supply to the engine above the throttle. It was evident immediately that this general scheme would be at its maximum efficiency under low throttle and light load conditions; an intense heat is generated very promptly under these conditions, which are obtained when starting up and idling. On the other hand, under wide-open throttle conditions, when we wish to maintain the volumetric efficiency of the engine as high as possible, but very little mixture passes through this "shunt" passage and a negligible amount of heat is produced in the burner. Of course, the reason that the mixture needs to be heated for wide-open throttle conditions is that combustion is largely assisted by the increased turbulence, increased compression pressures and naturally higher jacket-water temperature.

There are four main units which combine to give the desired result. They are briefly as follows:

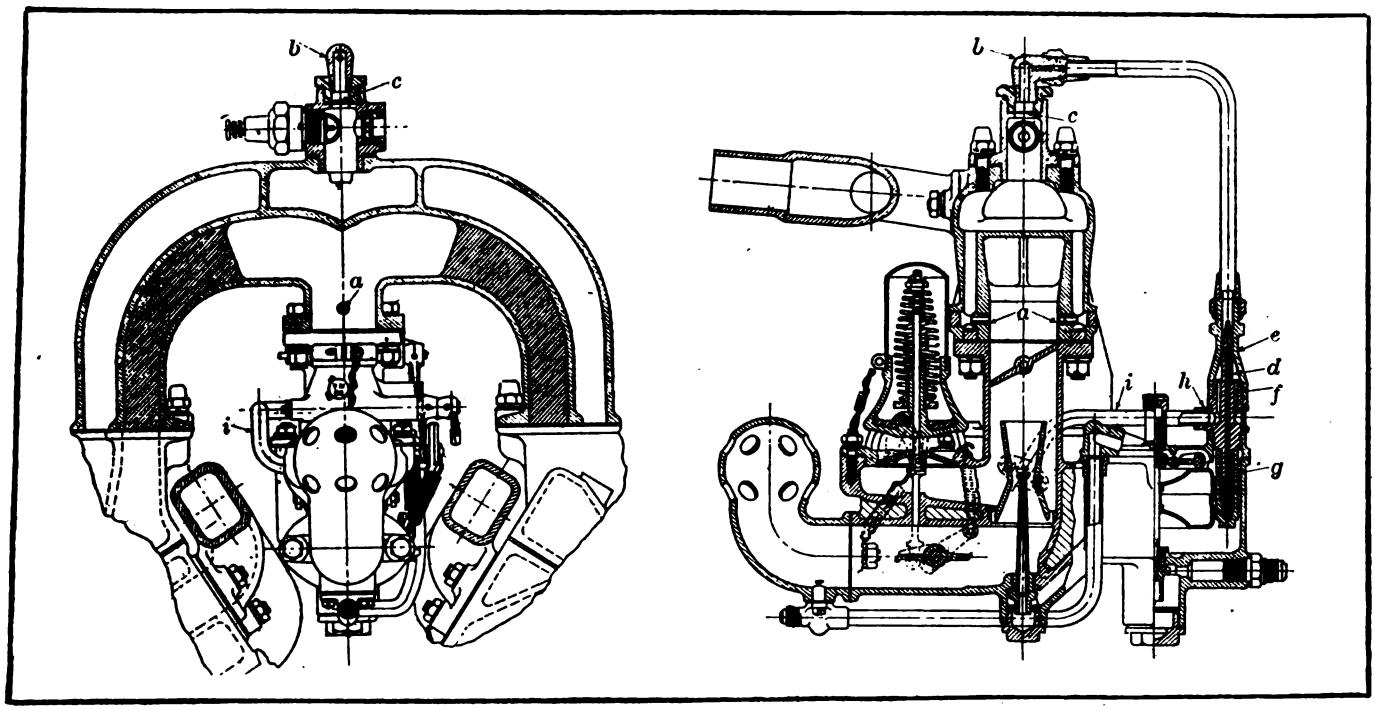
(1) A special inlet manifold which has a water-jacket as well as a combustion jacket.

(2) A burner which is attached to the combustion jacket.

(3) A vaporizer or miniature carbureter which is used to furnish the mixture for the burner.

(4) An auxiliary ignition breaker and coil which is used to furnish the spark for the burner spark-plug.

The manifold as shown on the accompanying drawing is of the conventional construction except for the additional jacket used for the hot gas which communicates with the main intake passage through the two hollow "suction" plugs shown at *a*. The burnt gas joins the main mixture after coming through these holes and the proportions are such that at no time does the burnt gas come into contact with the new mixture at a sufficiently high temperature to preignite the mixture.



Sectional views showing construction of new vaporizing device to handle low volatility fuel in cold weather

Digitized by Google

The burner body is fastened to the manifold by the two-bolt flange shown, and in the burner body there is formed a combustion chamber into which a spark-plug fitted with a wide gap is inserted, as well as an observation window of heat-resisting glass which permits the action of the burner to be observed at all times. The mixture from the vaporizer is supplied by a ⅜-in. copper pipe and enters the combustion chamber after passing through a calibrated hole in the elbow shown at *b* on top of the burner and a screen *c*. The purpose of the latter is to assist in the atomization and even distribution of the incoming mixture. The mixture is supplied by the vaporizer shown at *d*, which is composed of four main parts, the choke *e*, the jet *f*, the jet sleeve *g* and the air intake *h*. This vaporizer is intended to function as a carbureter through a limited range of depressions. It is constructed on the general principles embodied in several different types of plain-tube carbureters and relies on the fact that a submerged jet exposed to atmospheric pressure will feed a fixed quantity of fuel, and that by suitable control of the depression over this jet the flow of fuel can be accelerated in just the degree required for an increasing suction and supply of air. Accordingly the level of gasoline in the sleeve *g* rises and falls as the suction in the venturi *e* decreases or increases. Control of the mixture supplied by this miniature carbureter to meet various temperature changes and starting conditions is attained by the simple means of coupling the air intake *h* to a pipe *i* which takes its air from the auxiliary air supply of the carbureter, as shown.

In connection with the air-valve type of carbureter around which this device has been designed there is a dash adjustment that permits the driver to control the depression existing in the auxiliary air supply passage so that when starting out on a cold day both the main and the auxiliary carbureters can be made to supply a richer mixture simultaneously by means of the dash adjustment.

The high-tension current for the burner spark-plug is supplied by an independent ignition coil, the primary circuit of which is wired in parallel with the regular ignition circuit; the extra coil is controlled by a separate contact-breaker. The latter is operated by the same cam as the regular engine ignition contact-breaker. It will thus be seen that the burner spark-plug is operating whenever the engine ignition is operating, and in the case of the twelve-cylinder engine there are three sparks in the burner per revolution of the engine. I have not found it advisable to cut off this spark or control it in any way, since except for the small amount of current used by the extra coil there appears to be no disadvantage in allowing it to operate continuously.

How the Device Operates

In actual operation, when the engine is idling, combustion takes place in the burner silently and continuously and a bluish-green flame completely fills the combustion chamber. This flame diminishes in intensity as the throttle is opened and the depression in the main intake header is thereby decreased, the general result being that for ordinary driving conditions up to 25 m.p.h. a mixture temperature of 150° to 180° Fahr. is maintained, giving perfect distribution, excellent acceleration, absence of spark-plug fouling and elimination of dilution of the lubricant in the crankcase. At higher speeds and wider throttle opening the influence of the combustion heater gradually decreases until at wide-open throttle it is practically out of action, which is exactly the condition desired. This combination has permitted the running of a twelve-cylinder engine on kerosene at moderate driving speeds with practically the same results as when using gasoline, but when using kerosene there are critical temperatures below which we cannot go without considerable spark knock. The problem of burning kerosene is, of course, something that we do not yet face, but the design of this heater can be modified to permit any shape of temperature-load curve desired. The combustion heater as at present constructed does not permit us to start on kerosene, but simple modifications would permit this to be accomplished.

One question that naturally arises is: What effect has the combustion heater on gasoline economy? I have conducted a great many experiments in an endeavor to answer this question. A series of tests was made on the dynamometer, the results of which are shown in the accompanying table. In these tests the gasoline consumption of the engine and of the burner were measured separately. It will be noted that the consumption of the burner, when idling, was 0.066 gal. per hr. This is slightly over ½ pint per hr. It will also be noted that under average driving conditions the engine fitted with a combustion heater may consume approximately 3 per cent. more than one without the heater, but it is possible to save a considerable amount of gasoline under such driving conditions as call for frequent accelerating, owing to the improved performance obtained with a dry mixture. In cold weather and even in hot weather it is possible to run with a much leaner mixture when the mixture is dry, and this will more than offset the slight amount of gasoline which the burner uses. I believe that taking an average over city and country mileage there will be little, if any, difference in the matter of gasoline consumption in moderate weather between a car fitted with a combustion heater and one not so equipped, but that there will be a noteworthy saving in cold weather.

Gasoline Consumption of a 3 by 5-inch Twelve-Cylinder Engine Using Combustion Heater

Engine Speed, r.p.m.	Equivalent Car Speed, m.p.h.	Brake Horsepower	Gas Consumption, Gal. per hr.		Burner Consumption	Engine Consumption	Temperature of Manifold, deg. fahr.
			Engine	Burner			
350	Idle	.....	1.02	0.066	0.064		218
400*	9.5	2.83	1.32	0.054	0.041		210
800*	19.1	5.07	1.80	0.054	0.030		200
1,200*	28.6	10.00	2.40	0.066	0.027		187
1,600*	38.2	16.53	3.30	0.114	0.035		156
1,600	38.2	32.00	4.27	0.102	0.024		150
1,600	38.2	63.00	7.20	0.060	0.008		146

*Assumed average driving conditions.

In conclusion, I would say that it has been demonstrated that, in addition to its other advantages, this device will appeal to both the careless driver who omits to change the engine oil frequently in winter and the careful driver who has hitherto taken this necessary precaution. In the first case it will serve to prevent damage to the engine, which is the result of the poor lubricating qualities of a mixture of fuel and oil, and in the second case it will materially reduce cost of operation.

GROWTH OF GERMAN AIR FORCE

DURING a recent celebration in Berlin to commemorate the death of Boelke, the great German airman and leading ace of their air service, the Aero Club of Berlin published some interesting figures showing the growth of the air forces in Germany during the world war. The figures are very interesting and show how the air service developed during the four years in an effort to keep up with the ever growing allied aerial forces. They go to show, also, how hopeless Germany's efforts to dominate the air were after the aircraft production abilities of America were organized.

	Aug. 1914	*Nov.* 1918
Machines (fighting, bombing, scouting)	246	4,050
Escadrilles for defending interior	18	108
Pilots at the front.....	500	5,000
Personnel in the interior.	500	80,000
Monthly consumption of fuel in litres.....	600,000	7,000,000
Machines fitted with cameras	100	2,000

The above figures do not count the airplanes used in training pilots in the large aviation schools maintained for that purpose and it is reasonable to assume that at least 2,000 planes were used for that purpose.

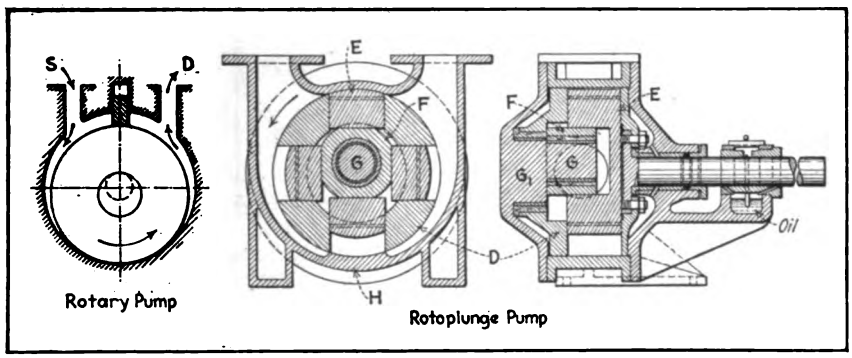
Digitized by Google

ROTARY PUMPS

CONSIDERABLE attention is being given to rotary pumps; modern machinery methods, surface grinding and the like have resulted in the production of higher efficiency in this class of appliances, by the reduction of the back-leakage. Especially does this apply to air pumps or blowers. We illustrate in the cuts two systems of construction of interest, which are of English origin.

The first one, Fig. 1, is the Avonmore pump. This is simplicity itself in design. A cylindrical casing contains a smaller cylinder, which latter, in the operation of the pump, is caused to roll around the inner periphery of the larger containing cylinder. This rolling action is the all essential feature. It will be seen that in this rolling motion a different element of the inner cylinder will be in contact with the outer one as the rolling motion goes on. In the cut the arrow indicates the direction of motion. The inner cylinder at the moment rests on the bottom of the outer cylinder, but as the motion continues it will touch more and more to the right, in each rotation touching successively all parts of the outer one in regular succession. Immediately above the center of the structure is a sliding diaphragm, which rests upon the inner rotating or rather rolling cylinder, rising and falling in its recessed seat. This divides the inner space into two parts; the space on the right communicates with the outlet, the space on the left with the intake. The diaphragm cuts off these divisions, absolutely, one from the other. If now the motion of the rolling cylinder be pictured, it will be seen that the water on the outlet side as the cylinder rolls on will be squeezed out through the outlet pipe; at the same time water will be drawn in through the intake; the latter will in turn be forced out, and other water will be drawn in. This goes on as long as the rolling motion is maintained.

The cuts, Figs. 2 and 3, show a four-cylinder rotary pump, the Rotoplunge. A cylindrical driving member, D, is bored for four pistons. It rotates eccentrically in a casing. A separating diaphragm, H, in constant contact with the rotating cylinder, D, at the top and bottom of the casing, divides the space between the casing and rotating cylinder into two divisions. As the cylinder, D, turns, it carries with it the four pistons, E, and a fixed eccentric, G, moves the pistons radially in and out. As they pass the line of the diaphragm, H, the lower one is at its extreme inward stroke, and the upper one is at its extreme outward stroke. The other two have intermediate positions, the one on the right moving outward, the one on the left moving inward. Thus suction takes place on one side of the diaphragm and delivery on the other side. There are no valves and no complication. The pistons in their reciprocations force the water out of the right hand compartment and draw it into the left hand one.



Figs. 1, 2, 3—Rotary pump designs. That at left is the Avonmore, the other sections show the Rotoplunge form

Both pumps present the feature of division into two compartments, a suction and a delivery division appearing in both. One feature of the rolling motion utilized in the first described pump, is that solid objects, if not too large, can be carried through it. A wire nail passes without difficulty.

MARKING FLUID FOR BLUE-PRINTS

THE following recipe for marking fluid for blue-prints has given me satisfaction. The fluid is composed of potassium oxalate, 1 ounce; gum arabic, 1 dram (60 grains); water, 6 ounces; cobalt-blue to color.

Italy has started working the iron mines on the island of Elba, Napoleon's transitory home. The expense is increasing as they are carried under the sea. Iron has also been found near the French frontier, and electric reduction furnaces have been started there. Coal is still a desideratum in Italy, and the iron deposits are of relatively small extent.

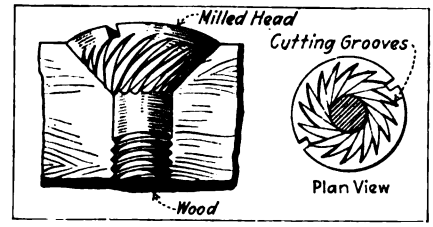
Under the sanitary laws and regulations for the prevention of phthisis in Africa, the Transvaal mines have to be washed down with streams of water to suppress dust. The water is found to carry gold, which is taken out and saved, so that not only is a revenue obtained, but a suggestion is given to do the same in other mines to save gold, which otherwise would be lost.

COAL RICH IN OIL

FOR many years lignite mined near Ione, California, has been used as fuel, though it contains a large quantity of moisture and therefore does not burn very well. Recently, however, on account of its resemblance to some oil shales that are apparently similar to cannel coals, this lignite has been tested by the United States Geological Survey. Department of the Interior, to determine whether it would not yield oil on destructive distillation. The results of the tests show that the best of the lignite, when destructively distilled, will yield 62 gallons of oil to the ton and, as a by-product, at least 18 pounds of ammonium sulphate, which is a valuable fertilizer. This lignite is remarkably "fat". Although it contains 46 per cent of moisture, analysis made by the Bureau of Mines shows that it contains also 31 per cent of volatile matter and 16 per cent of fixed carbon. The ash amounts to only 7 per cent, and the heating value is 6,060 British thermal units. Although the bed containing this lignite does not appear to underlie a large territory, it is doubtless destined to receive attention sooner or later as a possible source of oil and gasoline.

A SELF-COUNTERSINKING WOODSCREW HEAD

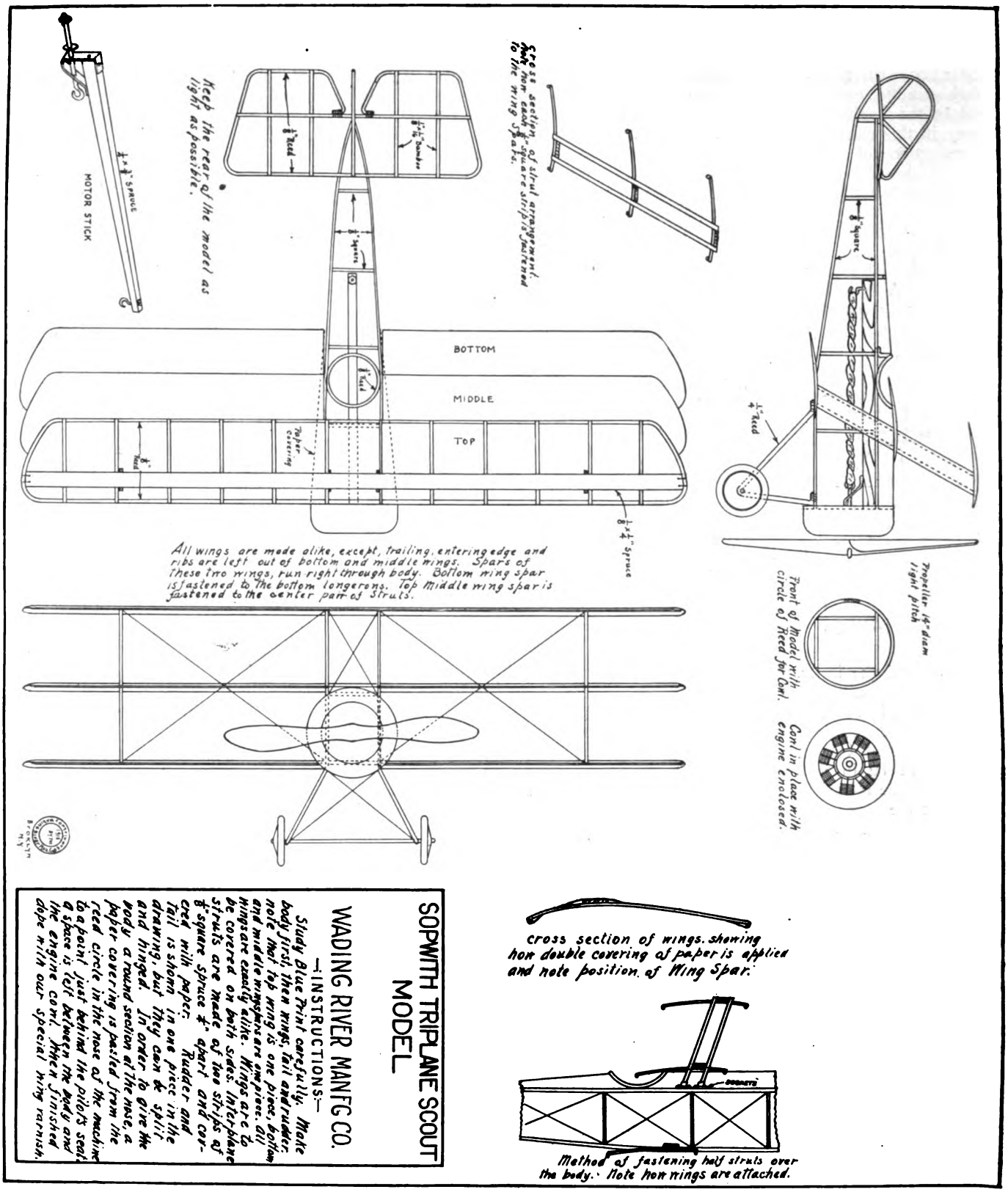
THERE is always a certain amount of extra work that goes with the use of flat-head woodscrews; for, as is obvious and well known, every hole has to be countersunk, to accommodate the head if the screw is of any size. It has remained for an American inventor to patent a uniquely designed woodscrew which countersinks itself. As will be noted in the accompanying illustration, this screw is made with a series of ribs or cutting teeth on the lower side, so that as the screw is driven into the wood these cutting teeth remove sufficient material to seat the head properly.



Woodscrew with countersinking head

Broken taps of large enough size can be often removed from the holes in which they are held by the use of the arc welder. The arc is directed on the top of the tap, not on the side of the hole, and little by little metal is melted on the broken tap until the surface is reached. Then a nut is welded on by the arc and when the whole has cooled off the tap can generally be backed out. It is important not to let the arc touch the side of the hole; it should be concentrated on the tap.

Digitized by Google



SOPWITH TRIPLANE DETAILS

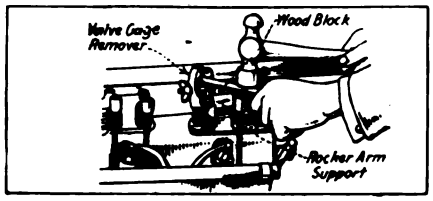
THE full size Sopwith triplane is a single seat scout plane powered with either a 110 H. P. or 130 H. P. Clerget motor and is very fast. The span of all wings is the same, or 26 feet 6 inches, and the chord of all supporting surfaces is 3 feet 3 inches. The incidence of all planes is 2 degrees. The amount of stagger of the intermediate main planes is 18 inches and the total stagger, measured by dropping a plumb line from the leading edge of the top plane and measuring from the line to the leading edge of the bottom plane with machine in normal flying position is 36 inches. All planes are given a dihedral angle of 2½ degrees. The overall length is about 20 feet, the overall height is 10 feet 6 inches. The tail plane is given an incidence, when in normal position of 1½ degrees. The wheel track is 5 feet 6 inches. Ailerons are fitted to all three sets of wings. The model shown in accompanying drawings is not a difficult type to build and is a very pretty model when completed. No detail dimensions are given as the model maker can make his machine any proportionate size of the full size machine he desires. The material sizes specified in the drawing apply to a 3-foot model, which is about ⅛ the size of a large machine.

Digitized by Google

EVERYDAY MOTORIST

VALVE CAGE REMOVER

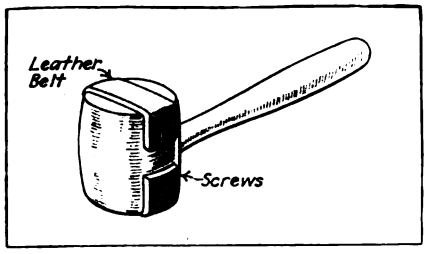
IN engines using overhead valves set in cages, such as the Buick, it is not always an easy matter to remove the valve cage, especially if it has not been taken out of the engine for some time. As it is necessary to remove the valve and cage unit to grind the valves to a



new seating, a simple clamp member which will grip the valve spring and collar at the end of the valve stem, as illustrated, is of value. A block of wood is placed between the rocker arm bearing pin supporting casting and a small pry bar used as indicated will remove the cage without damaging it or the valve.

WATER ON FORD COMMUTATOR COVER

BEWARE of water on commutator cover. It can get there from a leaky radiator, or it can get there when you are hosing the van when washing it. Water at that point can throw your firing all out of timing, so that when you next turn the starting handle you will get a backfire of the worst sort. One of the most juzzling cases of hard starting combined with backfiring arose in my own experience from this very cause. The reason is, of course, that the low-tension current gets conducted by the water to the wrong terminal on the commutator cover, so that the wrong cylinder fires—and it necessarily fires at the wrong time—before its piston gets anywhere near the top of its travel. The piston is thus driven hard back—against your cranking.

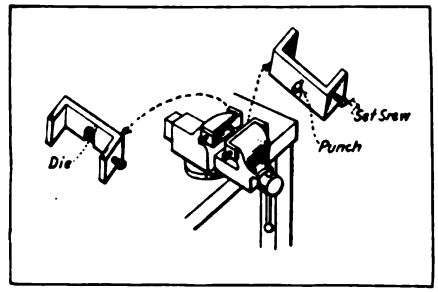


PROTECTED MALLET

IN straightening sheet metal parts or driving out threaded pieces a heavy, tempered blow is required. That struck by a wooden mallet has the right quality, but is liable to injure the finish because of the hard wood used for the ordinary mallet head. By attaching a thick piece of leather or felt over the head of the mallet, the force of the blow is softened and finished parts may be removed without injury. If the protecting material is attached by screws it may be taken off when it is desired to use the mallet in the usual manner.

PUNCH FOR USE IN VISE

THERE is a use in many small shops for a sheet metal punch for small size holes, and any handy garage men can make their own sheet metal punch in a short while from scrap ends of steel bars.

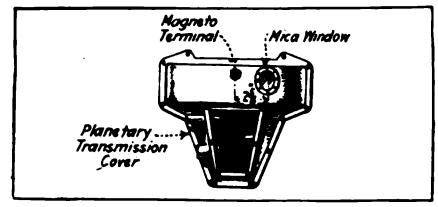


The device consists of two parts, as shown. Both of these are made from ¾ x 2-inch stock bent U shape to fit the vise jaws, and each piece is provided with a set screw to clamp it to the jaw. The die hole is drilled in one part and a slot cut on the back for the punched metal to drop through. The other part has a punch in it as indicated set in the center. The punch is of hardened steel and has a shoulder to hold it in place. The die hole is hardened and the device will punch holes in 3/16 sheet stock very easily with the aid of the vise screw.

Small size punches and bushings can be made to go as attachments for punching various sizes of holes as required.

INSPECTION WINDOW OF MICA

A MOTORIST had trouble because of stoppage of the oil tube which runs from the transmission case of the Ford engine to the front for conveying the oil, and devised the scheme shown in the accompanying illustration for making a quick inspection. A small inspection window two inches in diameter was inserted in the transmission case as shown. This window is made 3 inches in diameter, but as it is held in place by a steel ring 1/32 inch thick and about ½ inch wide, the effective opening of the window is but two inches. The ring is secured by 10/32 round-head screws. A felt or shellacked cardboard gasket is placed between the mica and the transmission cover, and the upper side of the mica is spread with shellac when it comes in contact with the retaining ring.

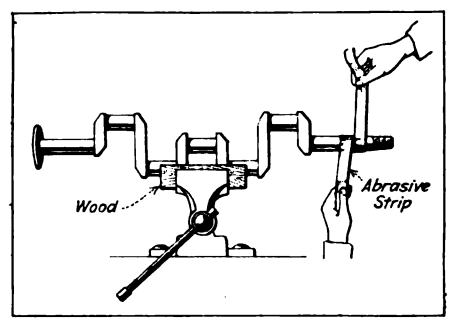


WRAP UP GOOD TOOLS

IT is an admirable idea to wrap good tools such as polished pliers, wrenches, etc., in oiled cloths before storing them away in the tool compartment, as the oiled cloths prevent them from becoming rusty or marred, which is quite likely to happen if the brightly finished surfaces are exposed any length of time. Files should be wrapped to protect the cutting teeth, for if they are allowed to rattle around they not only injure other tools but are injured themselves. Polished tools should never be carried in a tool compartment adjacent to a storage battery because the acid fumes will cause rusting of the polished surfaces.

TRUING CRANKSHAFT

THE method of holding a crankshaft when it is desired to true the crank-pin journal shown is a very practical one and is followed by a number of mechanics when overhauling an engine. The journals are often not sufficiently scored or roughed up to warrant dressing them down in a lathe so the crankshaft may be securely clamped in a vise



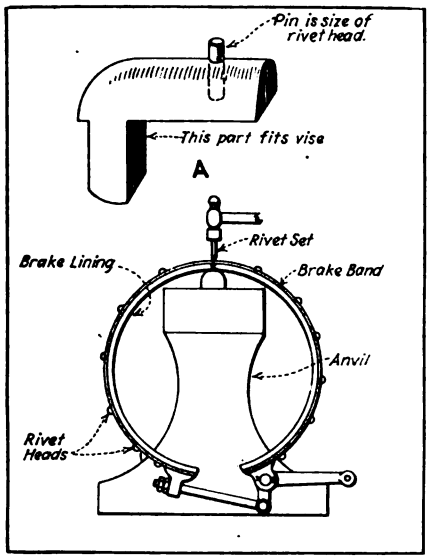
between wooden blocks and the journals dressed down with strips of emery cloth or with a leather belt or strap covered with oil and abrasive material, this be-

Digitized by Google

ing given one turn around the crank-pin and pulled up and down and back and forth to produce the requisite smoothness.

REPLACING BRAKE LINING

IF the brake lining is worn it should be removed by chipping off the rivets and driving them out of the hole in the brake band. A piece of new lining is cut to the proper length and holes are drilled through it to coincide with those in the brake bands. The best method is to drill only two holes at a time and fit the lining carefully to one end of the brake band, then drilling in the next two rivet holes and after the lining is securely fastened in place to go on to the next rivets. It is



important to use copper rivets having reasonably large heads that will not pull through the material and to countersink the material enough so the rivet heads will be firmly embedded below the surface so as not to come in contact with the brake drums. Some cases of slipping brakes have been traced to projecting rivet heads which did not permit the friction lining to come into contact with the brake drums.

A simple fitting which can be placed in an ordinary bench vise for riveting against is an ordinary steel drift having a flat point of the same size as the rivet head. The fitting shown at A in accompanying illustration may be placed in a common vise or may be formed to fit the pritchell hole in an anvil. This piece may be made of mild steel, though the punch H which is the same size as the rivet head can be made of tool steel. The body of the tool is flattened out on the under side where it rests on the anvil or bench vise top and is left oval on the top. A ⅜-inch hole is drilled in the top and tool steel punches of the form shown at H may be driven in place, some arrangement being made by which the punch may be driven out and replaced by a new one if it becomes broken or by one of smaller size if different rivets are used. A hammer and an ordinary rivet set are used to set the rivets as shown in the lower portion of the illustration. Copper rivets are easily headed up and neat heads may be formed without trouble. Never use iron or steel rivets for holding brake linings in place as projecting heads may wear grooves in the brake drums. The only remedy for grooved brake drums or members that have worn thin is replacement with new ones.

DRAIN OUT AUTO ENGINE BASE OFTEN

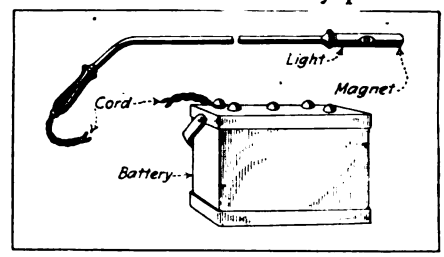
A CAMPAIGN to call attention to the necessity of changing oil in motors every so many hundred miles is being advocated. It is pointed out that there is so much kerosene in gasoline today that it has a tendency to run down past the pistons, get into the lubricating oil and thin it. The kerosene cuts the thin film of oil on the wearing surfaces of the pistons, piston rings and cylinder walls. With the film of oil on the wearing parts of the motor broken, friction, the bugbear of motor efficiency, starts in. The pistons work up and down through broken films of oil in a lubricating substance that has lost considerable of its richness and thickness.

There is little chance of changing the quality of the gasoline. Therefore, to prolong the life of the motor the only thing to do is to change the lubricating oil frequently, possibly every 500 to 1,000 miles. An experiment is instanced as proof that it is the non-lubricating qualities of the oil that damages motors.

A motor was brought into a shop with almost .015 inches wear. The motor was ground to .020 inches oversize, fitted with new pistons, put on the block and filled with good, clean oil. The motor was then run continuously for 60 hours and during this time the oil was changed three times. When the motor was taken down it showed no wear. The motor was again put together, oil was taken from an old motor truck and the motor put through the same 60-hour test without any change of oil. It showed .005 inch wear, indicating that it is the non-lubricating qualities of the oil resulting from the kerosene working past the pistons and mixing with it that causes the deterioration of motors.

ILLUMINATED MAGNET

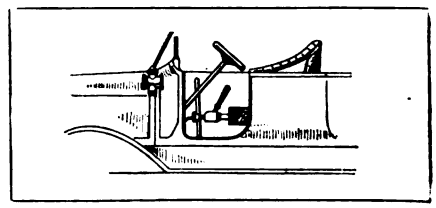
AN electric searchlight and electromagnet should prove a useful tool in the private garage and the repair shop. It consists of a handle on one end of which the magnet is placed while below the latter is an electric bulb which sends light through two windows as shown in accompanying illustration. A flexible cord passes through the instrument and is attached to a storage battery of the usual six-volt type or to dry cells. The magnet is utilized to pick up nuts, bolts or pieces of metal that may drop into the crankcase or other places not easily reached by hand, and is said to be sufficiently powerful



to attract a good-sized wrench. The light facilitates finding the parts, may be used to ascertain the amount of gasoline in the fuel tank or lubricant in the crankcase and to inspect other places. In addition to being handy in the garage it could be included in the tool equipment of a car and used in connection with roadside repairs. As most of the nuts and bolts are of magnetic material, the device will be very useful in many ways.

ADJUSTING BRAKES

AUTOMOBILE owners often neglect the adjustment of foot brakes because it usually takes two men to adjust the brakes successfully. One applies the pedal and sits in the seat



while the other turns the wheels to insure even braking power after they are jacked up. One man may adjust the brakes by using a jack, as shown in the illustration. The jack with a plank back of it, to protect the heel board, is placed between the seat and the brake pedal. The jack is applied to bring any pressure needed on the brake pedal, and the proper adjustments can then be made to make sure that the brake bands will be in contact with the drums at all points on the drum circumference.

GREASE ON BRAKES

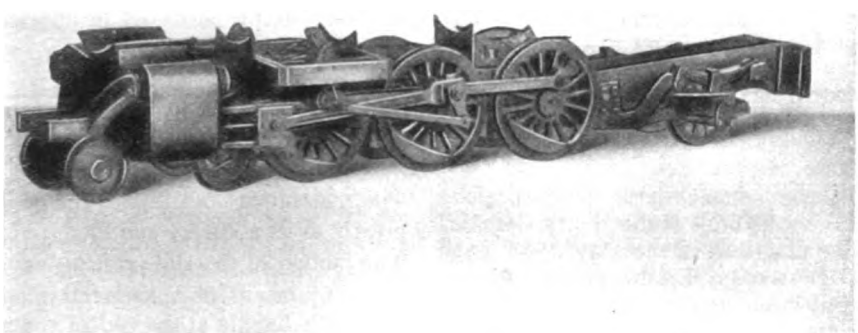
A FAULTY condition that is the result of warm weather is the leakage of grease from rear axle interiors and the attendent excessive deposits of that material on the brake drums, especially on the inner periphery against which the emergency or internal brake bands act. This reduces braking efficiency to a considerable degree and wherever such deposits are found, they should be removed by cleaning the parts thoroughly with gasoline, even if this should necessitate removing the wheels to gain access to the brake drum interior. The leakage is usually caused by the thinning out of the grease.

Digitized by Google

An Electrically Operated Model Locomotive

By Frank S. Collins

IN planning the construction of the model locomotive described in this article, the writer was confronted at the outset by the great difficulty of obtaining small castings, under wartime conditions. It was decided therefore, to dispense with castings as far as possible and with the exception of the driving wheels, none has been used in what may be termed the "chassis" of the locomotive. This condition involves a great deal more work than would be necessary were castings obtainable, but the results, in the writer's opinion, fully justify the additional time and labor. Small parts made from steel bar or plate are clean, strong and of good appearance, whereas iron castings of the small cross-section and often complicated design required for this class of work, would be expensive to



The finished chassis of the locomotive

mold, would almost inevitably be chilled, and impossible to produce cleanly unless die-cast. Die-casting, of course, would be out of the question unless large numbers were required.

The frames of the locomotive, which is on a scale of ½ in. = 1 ft., are sawed from flat cold-rolled steel bar, the annular spaces being drilled out and filed to finish. The cross frames or bracings which also form the boiler saddles, the guide bars, hangers, spring rigging, etc., are all cut from steel plate or bar.

In making these parts, the writer uses the following plan: A tracing of the piece required is made upon vellum, from the drawing, the tracing then being cut out to form a template and fastened to the steel plate with a little shellac. The piece is then sawn out to the form of the template, and centers of holes, etc., punched as located on the template. This is a great improvement upon the method of marking out with a scriber direct upon the plate, as the contrast of the India ink into lines upon the white paper template to the usual easily blurred scratches upon the steel, has to be experienced to be appreciated. Particular attention has been given to the spring rigging of the model, for apart from the matter of appearance, the locomotive ability to keep the track depends almost entirely upon all wheels being properly hung. In this particular case, the arrangement used in the prototype has been faithfully followed. The fixed suspension points are located at the front of the leading drivers and at the rear of the trailing wheels, all vertical motion between these points being transmitted through the rocking arms by which the springs are connected end to end, while a cross-compensator is supplied at the rear of the last two driving wheels in order to balance unequal stresses on either side of the locomotive.

This arrangement is of particular value in damping out any rocking motion which might otherwise reach dangerous proportions. The springs themselves are built up of clock spring steel arranged in laminæ, making a good practical spring as well as being a faithful reproduction of the prototype.

The cylinders and valve chests, which in an electrically operated model are naturally on the order of camouflage, are built up of steel plates. The coupling and connecting rods are cut from 5/32 in. steel bar, the connecting rods having split brasses with wedge adjustment.

The trailing truck frame is made from ½ in. angle iron, trimmed down to size as required and bent hot. The driving wheels are, as previously stated, the only castings used, the leading and trailing wheels being turned from the bar. All wheels except trailers are pressed on to the axles and secured by a threaded circular key. The pattern for the driving wheels was made from hard rubber fibre, and the writer would take this opportunity to urge the superiority of this material over wood for such purposes. Wooden patterns for this order of work frequently give trouble by warping, splitting and cracking, especially when, as in this instance, spokes have to be cut across the grain. Hard rubber has no grain, and is equally strong in practically any direction. It is tough and will stand very hard treatment. It is readily worked with either machine or hand tools designed for use with metal. It can be threaded with tap, die or in the lathe and takes a clean, sound thread. A pattern once made from this material, however light and apparently fragile, can be used almost indefinitely. The engine will be driven by a series-wound direct current motor, designed to fit inside the boiler shell, which experience has shown to be the best possible arrangement for small locomotives. The motor field will be a cylindrical casting with its axis horizontal, while the armature will be vertical and connected through a suitable machine-cut reduction gear to one driving axle. The coupling rods will transmit the torque to the four remaining driving wheels, and thus the adhesion of all six will be available as in the prototype. In addition, the driving wheels carry practically the entire weight of the motor, which is considerable, and the adhesion is thus increased again. A special device will be provided and located in the tender, by means of which it is practicable to reverse either a series, shunt or compound motor by merely reversing the polarity of the third and return rails. This greatly adds to the realistic effect of these models, as all their movements can be controlled without the operator approaching the track.

The writer makes no apology for presenting the description of this model while in an incomplete state, his personal experience having been that it is during construction that such work is of most interest to model builders.

Blue Print Paper

A BLUE print paper which gives good results, and is not difficult to make, is prepared in this manner:

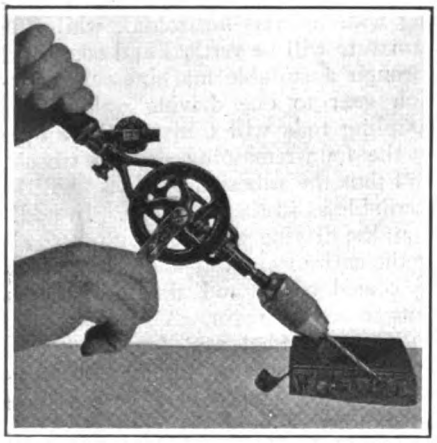
Mix 12 grains of Ferric Ammonium Citrate and 50 cubic centimeters of water in one container and 12 grains of Potassium ferricyanide and 50 cubic centimeters of water in another container. Mix equal parts of each solution in a third container and apply a brush.

Digitized by Google

SHOP PRACTICE

A LEVEL ATTACHMENT FOR HAND DRILLS

THERE has recently appeared on the market a little device which will be of great service to mechanics and experimenters who are not in possession of drill presses. This is a level that can be attached to any small hand-tool so that the operator is able to keep the drill at any desired level. These levels are being made in several styles and sizes according to the class of drill on which they are to be used. In all lines where hand-operated drills are used, the level enables the operator to drill a hole at the angle or position desired. If the angle is stated, the level tube is set at that degree. If the operator desires to drill at a chosen angle or the most convenient position,



A drill with level attachment in use

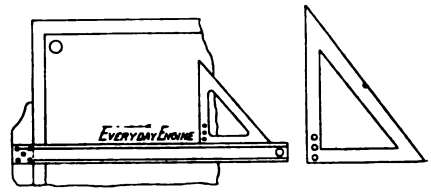
the tube is leveled to that position. If desiring to drill overhead, the level can be read from the bottom as the tube is cut away. This level will be a great aid to amateur experimenters; in a great many cases better and more encouraging results would be had if holes could be more accurately drilled. The average experimenter's shop is not equipped with a drill press, when drilling is to be done someone is called to tell one how to hold the drill, as desired.

Where it is not convenient to locate the level through the stock of the drill a small block is located, having a hole and a set-screw, which holds the leg of the protractor plate which is bent at a right angle. In all cases the level is easily removed from the drill, which prevents breaking if the drill is placed among other tools.

A DRAFTING IDEA

TO draw in the guide lines for lettering on drawings the writer devised the simple stunt shown on the accompanying sketch.

Taking a sharp knitting needle, and heating it slightly, he burned three small holes through the triangle as shown.



First of all, the holes were laid out the correct distance apart.

The rest is simple. The triangle was placed on the T square, and putting a pencil point through the holes, the triangle was drawn horizontally along the T square, which makes guide lines even and all the correct distance apart.—J. H. MOORE.

TWO WAYS OF ANNEALING STEEL

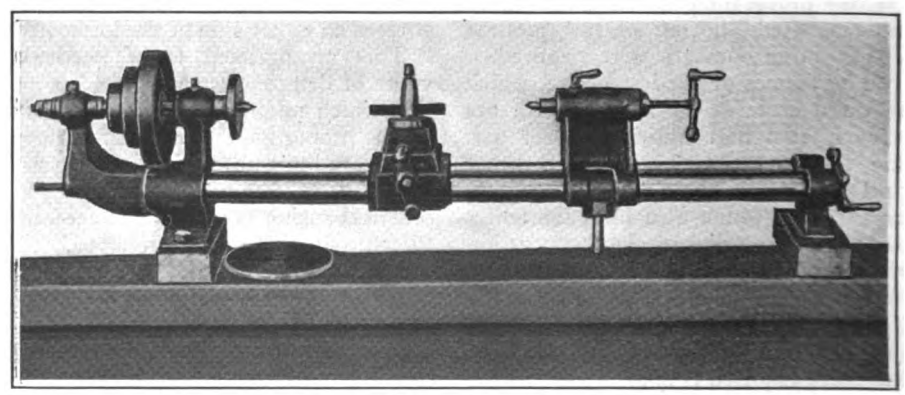
IT may be heated to a dull red heat, covered with dry, warm sand and left to cool slowly; or heat and cover it up in a forge fire, and leave it there until the fire is out and all is cold. The other method is to heat the steel red hot; heat gradually, let it "soak" as the smiths say, until it is evenly heated, then remove it from the fire and take it to some dark place. Let the steel cool until you lose sight of the dull red in the dark; then cool off in cold water. A good "dark place" may be made by throwing your coat over a barrel, leaving just room enough to look in at the iron. This method is called "water anneal", and is based upon the theory that steel softens when cooled at a certain temperature.

There are many other methods of annealing steel but most of them require apparatus and experience that are not usually possessed by the amateur.

A New Amateur Lathe

A new amateur lathe designed along the general lines of the Henry Greenley lathe described in the May, 1918, issue of EVERYDAY ENGINEERING has recently been brought out to supply the wants of those who are unable to purchase more expensive machines. The lathe shown sells complete with back gears for less than a hundred dollars.

To reduce the cost of manufacture and yet provide a workable, serviceable lathe, the bed of the machine is formed by the use of two large rods of cold-rolled steel. The work on the lathe of the bed is really limited to the drilling of holes. The lathe is also equipped with babbitted bearings, which add greatly to its accuracy and "longlivity." The motion of the slide rest is brought about by means of a long screw operated by a handle at the end of the machine. The cross feed is operated in the usual manner. The tail stock can be clamped to any position on the lathe bed.



A well-built amateurs' lathe with two cold roll steel rods for a bed

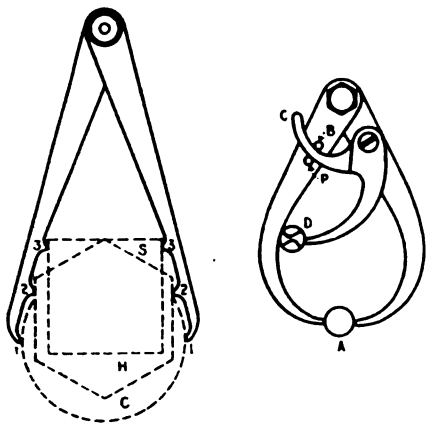
The lathe shown is a stock article with the exception of the bed being made longer in this particular instance to suit the needs of a customer. The castings and parts for this well-designed little tool are also available.

Digitized by Google

TWO NEW CALIPERS

THE new caliper shown on the left gives the minimum diameter of circular stock material from which square or hexagon pieces can be made without unnecessary waste of material and can also be used as an ordinary caliper.

For square stock the points of the caliper 3-3 are set to the distance across the flat sides. The distance between

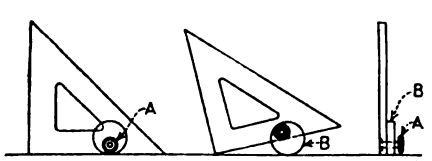


points 1-1 will be equal to the distance across the corners. For hexagon stock, the points are set to the distance (2-2) across the flat sides. The distance between points 1-1 will equal the distance across the corners.

By the use of the caliper shown at the right one is able to select at once the right size drill to suit bolt and pipe taps to cut as near a full thread as is practical for one tap without breaking it. When the diameter of the bolt or pipe is calipered as at A, the diameter of the drill to be used is given at D, for bolts when the arm C is in contact with pin B and, for pipe when C is in contact with P. The calipers can also be used for ordinary purposes.

AN ADJUSTABLE TRIANGLE

AN ordinary wooden or celluloid triangle can be so fixed that it is adjustable to various angles by the addition of a small hardwood eccentric as illustrated in the sketch. The wooden



eccentric is held to the triangle by means of a small screw and knurled nut, which, when tightened, will hold the eccentric in any position. A small piece of round hard rubber would make a very good substitute for the hardwood piece. When the eccentric is not in use it can be placed in a position where it will not be in the way.—J. H. MOORE.

TABLE OF STANDARD GAGES AND SCALES FOR MODEL RAILROADS AS EXISTING BEFORE THE WAR

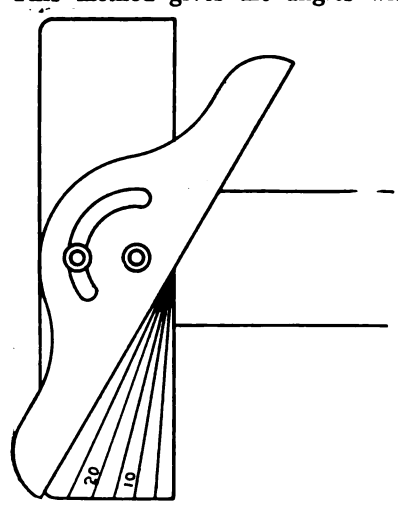
Prepared by Henry Greenley

Gage		Scale	
Toy Gages	No. 0 1¼ in.	7mm—1 foot (about 1/44th)	Quite suitable for indoor railroads where space is limited and for portable systems. Locos. driven by clock-work or electricity. Steam models not entirely satisfactory if not scale proportions.
	No. 1 1¾ ins.	10mm—1 foot (about 1/30th)	The best gage for indoor electrical steam or clock-work railroads for indoor use. The scale is a very convenient one.
	No. 2 2 ins.	11¼mm. or 7/64 in. to 1 foot (about 1/27th)	Almost the same in characteristics as the No. 1 gage but too large for locomotives. Not being continued as a standard.
For Amateur Construction	2½ in. gage	½ in. to 1 foot (so-called half inch scale)	The most popular size for amateur construction and the smallest outdoor gage. Steam locos. may be fired by alcohol, kerosene or solid fuel.
	3¼ in.	¾ in. to 1 foot	Common gages for amateur working models, outdoor use and for exhibition models.
	3½ in.	¼ in. to 1 foot	
	4¾ in.	1 in. to 1 foot	Ditto. This is the smallest passenger-carrying gage. A 2-mile non-stop run has been obtained with two passengers by locomotive of this size.
For Private Garden Use	7¼ in. gage	1½ in. to 1 foot (⅛th size)	The 7¼-inch is the most convenient, smallest gage that can be recommended for garden railways and passenger carrying. The construction is within the scope of the amateur model maker.
	9½ ins.	2 ins. to 1 foot (1/6th size)	
Estate and Miniature Railroads	15 in. gage	3 in. or 3.25 in. to 1 foot (about ¼ in. size)	One of the standard sizes for miniature railroad locomotives in parks and estates, in Great Britain. It is not subject to British Board of Trade rules and jurisdiction.

A T-SQUARE PROTRACTOR

TO get away from the use of the protractor, the writer arranged his T-square as shown on the sketch. The head was marked with lines as shown, so that one can easily set the square to any angle without using a protractor at all.

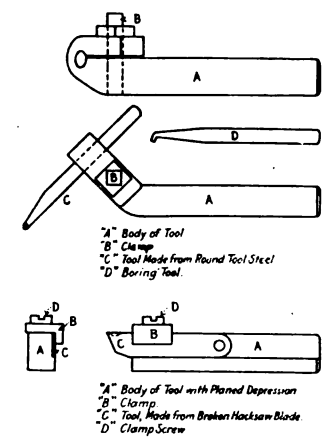
This method gives the angles with



sufficient accuracy for ordinary work. The head is really marked on both sides, but only one side is shown for illustrative purposes. These lines are 1 deg. apart, on the sketch they show 5 deg. apart, but this is in order to demonstrate the idea clearly.

TWO GOOD LATHE TOOLS

THE boring tool shown in the sketch is a very handy device with which many different operations can be done. The holder is the most difficult part of the tool and this can be made at a local blacksmith shop unless one is well able to handle forging jobs at home. When this holder is provided with a number of differently pointed



tools there are few boring jobs that do not come within its scope.

Those who have trouble with their parting tools breaking off will welcome the little suggestion illustrated at the bottom of the drawing. This is really a holder made to accommodate a small piece of a broken hack-saw blade.

Digitized by Google

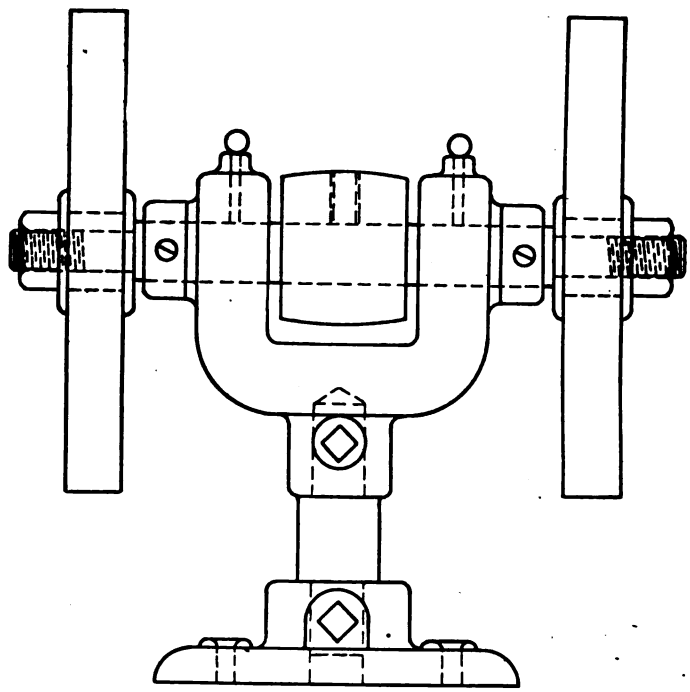
A Design for a Small Grinding Head

By Joseph Dante, Jr.

EVERY workshop should be equipped with a small power-driven grinding head. A hand driven machine is very inconvenient when it becomes necessary to use both hands during a grinding operation. The little grinder pictured is so easily constructed that no mechanic who sees it can have an excuse for going without such a machine in his home shop.

One of the few patterns needed in the construction of the machine is that for the base which is very simple. This particular pattern may be turned up on the lathe. Three holding-down bolt holes are drilled in the casting when it is received from the foundry. A 5/8 in. hole is drilled in the center to receive the standard which is a piece of cold rolled steel. This is held in place by a set screw.

The body or bearing casting must be drilled very carefully to insure a workable accuracy. The author first drilled a 3/4-in. hole through both the bearings. This operation was done on the lathe. This accomplished, a 3/4-in. steel rod was placed through the hole. The drilling of the hole in the bottom of the casting for the standard was done by allowing the ends of the 3/4-in. rod to rest in two vee-blocks. A 3/8-in. hole is then drilled and tapped out in the casting to accomodate a square-headed set screw which holds the bearing casting to the standard.



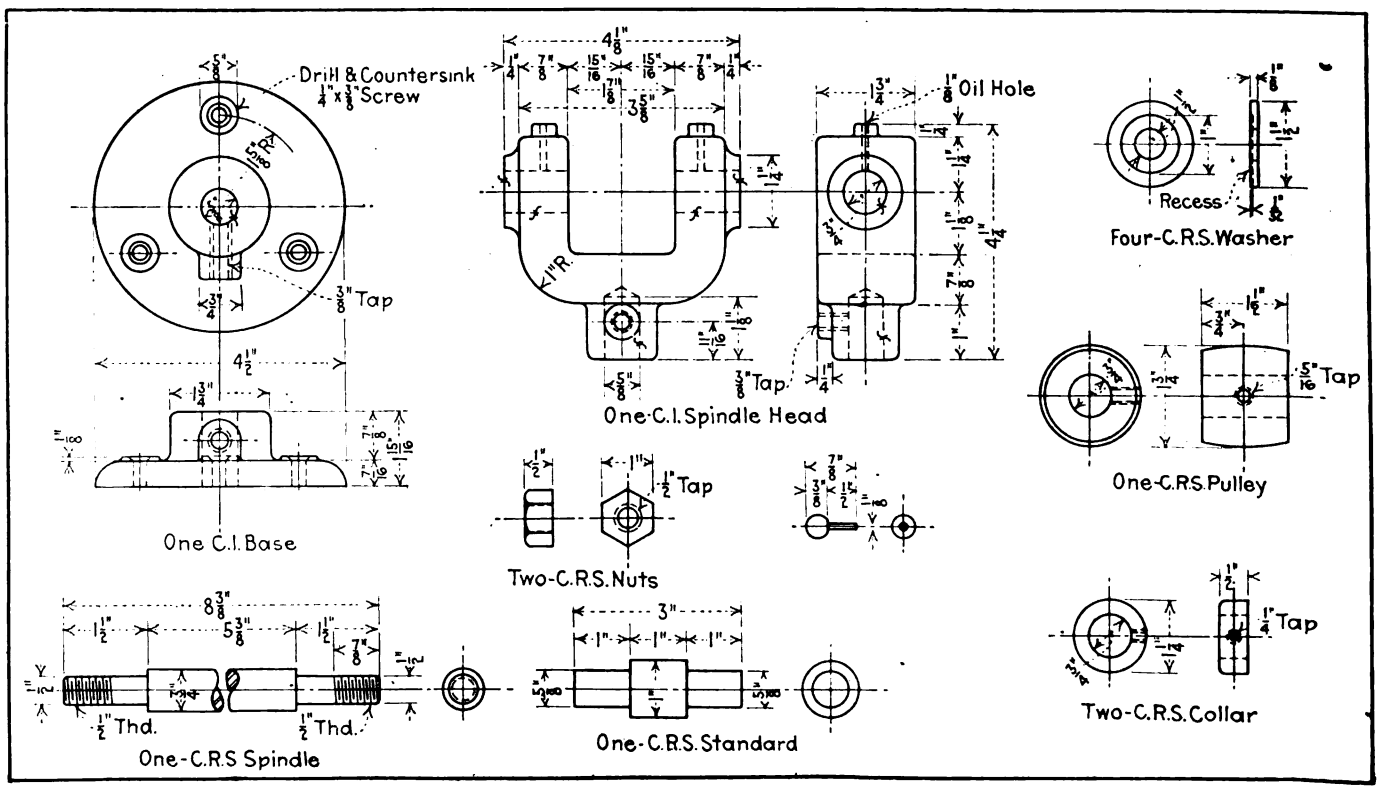
Grinding Head

The collar bearing ends are turned up from solid cold rolled stock. This work was done on a mandrel. The pieces are nicely polished before they are taken from the mandrel.

Two 1/8-in. oil holes are drilled in the casting, one on each bearing. Two small round-headed pins are turned up. These are used to place in the oil holes to prevent dust and chips from getting in.

The pulley for the machine can be turned up from a solid piece of cold rolled stock or a pattern can be made. This will depend upon the builder. No great trouble will be had in turning the pulley up from a solid piece by the use of a mandrel. The spindle is turned from cold rolled stock to the dimensions shown.

Grinding wheels of the proper grit and grade and with the proper sized arbor can be purchased from most any large hardware store or by mail from manufacturers.



Complete detail drawing of the machine described on this page

Digitized by Google

Our Readers' Workshops Page

THE shops pictured this month belong to E. P. Bradbury, of Los Angeles, Cal., and H. C. Smith, of Chicago, Ill. One is a chemical laboratory and the other a mechanical workshop. Both are very well equipped along their respective lines.

Mr. Smith describes his laboratory in the following words:

"My laboratory contains the following: Over 150 solid chemicals, including such metals as mercury, arsenic, antimony, etc., about 100 chemical solutions, including various acids such as nitric, sulphuric, hydrochloric, phosphoric, acetic, sulphurous, acetic anhyd., etc., and about 25 solutions, solids and stains for bacteriological work.

"My apparatus consists of the following (part of which is shown in the picture):

"Ringstand, rings for same, bunsen burners, tripods (for retorts), burette clamps, burettes, pippettes, various sizes of flasks, beakers, retorts, evaporating dishes, crucibles, watch glasses, graduated tubes, long chemical flasks, test tubes, filter pump, suction filter (heavy glass), filter paper, sterilized cotton, forceps, porcelain and glass mortars, graduates, test tubes with side outlet, hydrometers, chemical thermometers and an 'imported French microscope', also a balance and platinum inoculatory needle (for bacteriological work).

"My work in the laboratory consists of chemical analysis of various materials, such as food, iron and steel, oils, etc., also microscopical and bacteriological analysis ,and urinalysis. In conclusion I would like to say that my laboratory also contains a fine assortment of scientific books (mostly chemical) and I spend many profitable evenings and Sundays in my laboratory."

The workshop of Mr. Bradbury, illustrated at the top of the page, is described by him as follows:



The laboratory of Mr. Norris E. Bradbury, of Los Angeles, Cal. Mr. Bradbury is shown at work at his lathe

"Our workshop is located in a space of about ten by twelve feet. The equipment consists of a one-quarter horsepower motor, a nine-inch screw cutting-bench lathe, a circular saw with adjustable table, and a grinding and polishing stand holding ten-inch wheels. Space is left for a jig saw which is soon to be added to facilitate pattern making.

"The lathe is equipped with universal and independent chucks, drill chuck, etc. We have made, and added to the lathe, stops with micrometer adjustment for cross and longitudinal feeds, a thread pick up dial, a milling attachment with vise and a gear cutting attachment which is complete except the index plates which are still to be made. The grinding head and saw are home-made, the parts being cast from our own patterns. Even the saws were cut out of an old hand saw, drilled and filed. While they cut perfectly, the amount of work involved makes it cheaper to buy them. The line shaft runs along the floor to economize belting and the pulleys are made of thin boards nailed across grain and turned while in place. The soldering outfit consists of a special low voltage transformer which heats a soldering iron of very simple construction and also supplies sufficient current to sweat large surfaces together. In the absence of gas we chose electricity for its convenience and absence of fire risk.

"As for the purpose of the workshop, our activities are not confined to any particular line. We make play room furniture, transformers, drum controllers and accessories for miniature railroad, and are at present engaged in the construction of wireless apparatus, high frequency coil, etc. We intend in the near future to build a model steam engine. When we do we shall draw our plans, make our own patterns and cast them ourselves in brass, as we have a complete foundry outfit for small castings, except a brass furnace. Up to the present we have only used babbit for casting in sand. We have successfully cast in this metal grooved pulleys or sheave wheels from split patterns, a job that requires considerable care. Finally, we may add that our shop policy requires every piece of work to be as good as our skill will permit. No matter how small a piece of work it is it must be *right*."



Part of the chemical laboratory of Mr. H. C. Smith, of Chicago, Ill.



Another view of the laboratory of H. C. Smith

Digitized by Google

Aeromarine Limousine Flying Boat

A Well Appointed Type for Sporting and Commercial Use

PERHAPS the most interesting of the new peace models is the Aeromarine Limousine, a flying boat unique in the combining of safety, comfort, and service. This cabin boat is the principal feature of the large Aeromarine exhibit at the aeronautical exhibition in New York.

To explain why this model has been developed to so remarkable a point of refinement—when even the upholstery, carpet, and interior decorations have been the subject of much thought—it should be stated that on this flying boat was focused the care and attention of the staff and men of the entire Aeromarine plant. It was felt that this flying boat would be the first of a large number of similar "ships" to be used in pleasure flying in the United States. The Aeromarine company is devoting itself entirely to the production of air-and-water machines. This specialization aided in the time and effort which the plant could afford to put into one super-flying boat.

The Aeromarine limousine, known as the 50 B-2, is a three-passenger pusher flying boat with a speed of seventy-five miles an hour. The pilot sits in the bow and just behind him sit the two passengers, side by side. Over all three, in a graceful, stream-lined curve, rises the roof of the cabin. The roof is built as a solid part of the hull, and consists of transparent celluloid sheets set in strong frames, so that the view of the pilot and passengers is unobstructed.

A Well Finished Cabin

The hull or cabin is finished in blue leather and polished mahogany. Within the roomy compartment one gets the impression that one is seated in a beautiful sedan. As a matter of fact this is true, but instead of wheels this sedan has wings. The upholstery, the furnishings, the compartments and drawers lining the sides of the boat and also the bow, the many little comforts, are all specially planned to make the aerial tourist feel that in exchanging the road for the air he has gained not only speed and wonderful, ever-changing scenery, but luxury as well. The wide doors entering the cabin are watertight.

The merits of the cabin lie not only in its appointments, however. The roof not only shelters the passenger and pilot from the cold and rush of the wind, but also from spray, rain, and the noise of the powerful motor. These advantages make long trips possible without fatigue.

One of the many unique features of the limousine which deserves comment is the removal of the usual and heretofore necessary clutter of wires, pulleys, etc., from around the control wheel and rudder bar. A special Aeromarine invention replaces those about the wheel, which operates ailerons and elevators in the customary manner of the Deperdussin system, by a single tube. The rudder bar also, communicates its motion to a duplicate bar beneath the floor. This adds not only neatness to the interior of the cabin, but safety, for no wraps or other material can jam the controls. A self-starter is provided for the convenience of the pilot.

An eight-cylinder V type motor of 150 horsepower, every part of which is built in the Aeromarine factory and known as the B-8, furnishes the power. The motor is set between the wings some distance behind the cabin. A wind-driven pump lifts the gasoline from this tank to a smaller tank in the upper wing, whence it flows by gravity pressure to the motor. Forty gallons of gasoline may be carried, enough for about three and a half hours at full speed. This means a range of approximately 250 miles.

Specifications

The characteristics and specifications of the "50-B-2" are as follows:

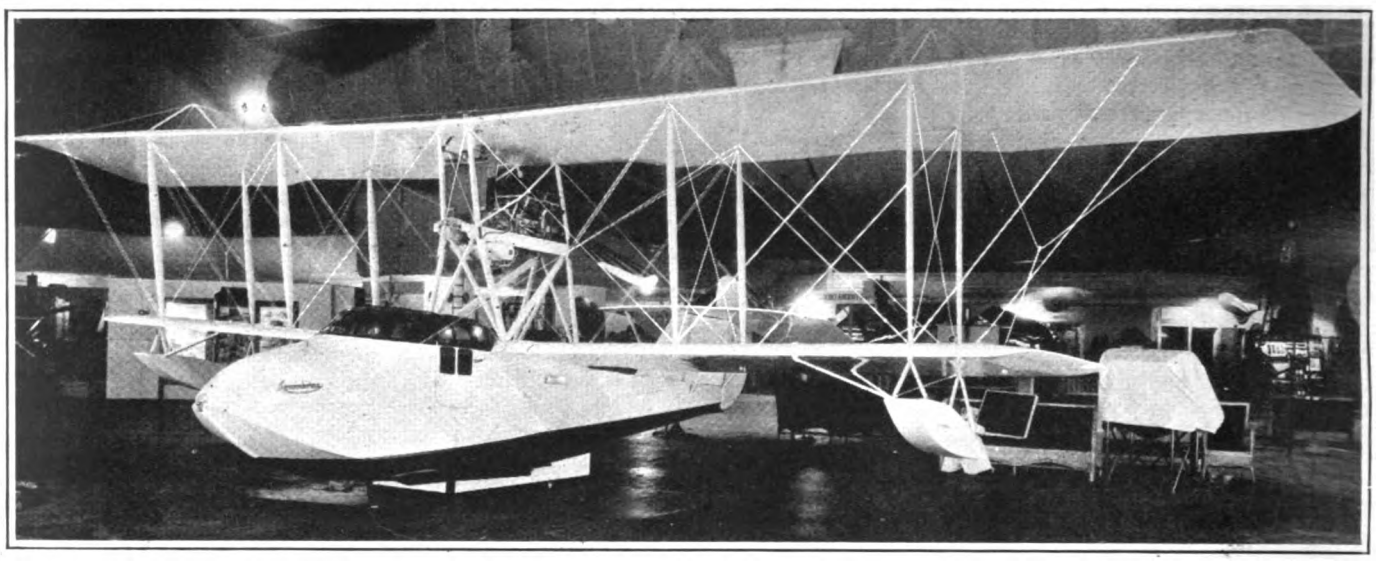
Overall length	28′ 11 5/16″
Overall heighth	12′ 7″
Weight (light load)	2280 lbs.
Weight (full load)	3225 lbs.
Useful load	945 lbs.
Span	48′ 6″
Total area	504 sq. ft.
Wing curve	R.A.F. No. 6
Maximum speed	75 MPH
Minimum speed	44 MPH
Climb in ten minutes	2200 ft.
Endurance in hours	3.4 hrs.

Upper Wing

Span	48′ 6″
Area	304 sq. ft.
Chord	6′ 3″
Angle of incidence	4′ 20″

Lower Wing

Span	37′ 8″
Area	200 sq. ft.
Chord	6′ 3″
Angle of incidence	3°



The aeromarine limousine flying boat, a new type intended to foster commercial aviation

Digitized by Google

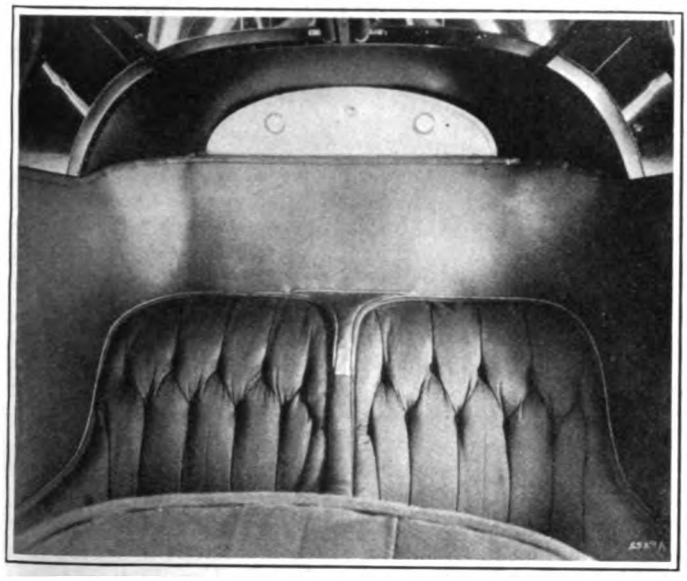
Stagger	12"
Gap	6' 6"
Sweepback	None
Decalage	1° 30'
Area of ailerons (2)	58 sq. ft.
Area of elevators (2)	25.6 sq. ft.
Area of rudder	17.5 sq. ft.
Area of stabilizer	39.0 sq. ft.
Area of fin	15.0 sq. ft.
Skid fins	None

MOLYBDENUM STEEL IN AUTOMOTIVE PRODUCTS

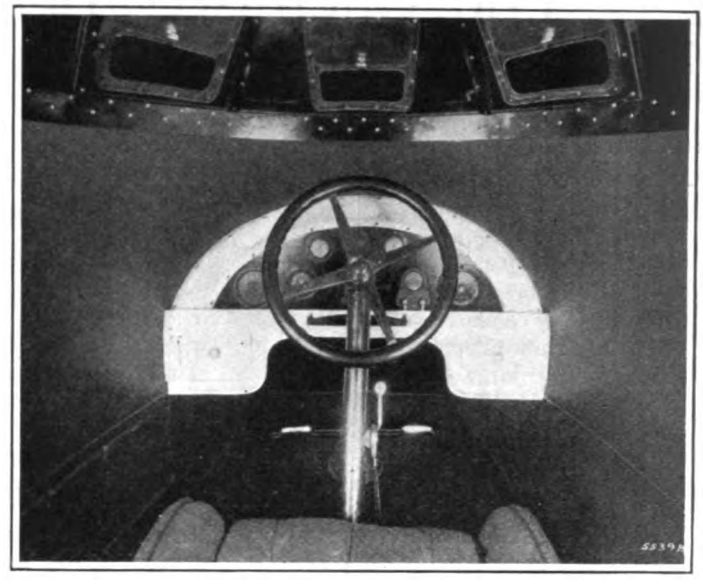
ONE of the most significant sidelights of the Aeronautical Exposition is the appearance of the new super-steel, a molybdenum alloy, in parts of airplane motors. The timely evolution of molybdenum steel gave Liberty motors connecting rods and crank shafts of the toughest and lightest material ever turned out by steel mills. Incidentally, it also provided an armor plate for the Renault "baby" tanks far superior to the heavy, cast turrets that were in use before American experts succeeded in perfecting a uniform steel with the metallic element molybdenum as an alloy. The helmets of Yankee "doughboys" also were made lighter and safer protection from German gun-fire through molybdenum steel.

Airplane designers have been impressed by the fact that molybdenum steel makes possible a lighter finished product of the same strength than that produced by other alloy steels. The lightening of the aggregate weight of a plane, through the use of lighter parts, is now more than an engineer's dream because a material has been found with which to execute the most advanced structural ideas. Makers of automobiles, trucks, tractors, and accessories are even more interested in the new steel that war evolved. It is predicted that automobiles made of molybdenum steel will weigh from one-fourth to one-third less than today's models. Radical changes in the automotive industry, in fact, are pending because of molybdenum's growing part in realizing "the American light-weight car". The saving on gasoline, tires and wear in a car one-third lighter than those of today are obvious.

The United States has a practical monopoly on molybdenum, controlling about 80 per cent of the world's supply of the metal. The largest known deposits in the world were discovered in a mountain near Climax, Colorado, about the time of the outbreak of the World War. Airplane makers, with the entire automotive industry, view this situation with relief. It not only enables them to secure a steel alloy without the previous difficulties and delays attending importation of chromium, vanadium and other alloying elements, but it assures them certain continuance of steel manufacture in the remote event of a war that would cut off alloys now secured only outside the United States.



The seating arrangement for the passengers in the aeromarine limousine flying boat



The pilot's seat and control wheel is at the front of the passenger compartment

Engine	45° "B" type
Horsepower	150
Tank capacity	58 gal.
Load per H.P.	23.8 lbs.
Load per sq. ft.	6.15 lbs.

For those who prefer to be snug inside a cabin in winter or bad weather and out in the air when summer breezes blow the Aeromarine company has devised another "ship" which may best be described by calling it the touring car of the air. The hull of this flying boat will also be exhibited at the show. In this type the pilot sits alone in a cockpit in the bow of the boat. In a larger opening behind him two passengers sit side by side. They are protected, like the pilot, by a windshield, but the cockpit may at any time be completely enclosed and made proof against wind and water by the use of a removable celluloid top. This plane, too, is most carefully finished as well as most carefully constructed. There is no roughness or crudity such as marked the first planes. An electric self-starter is also used on this model.

In reporting on the waste of natural gas in this country, the Bureau of Mines reports that the efficiency of gas used for cooking is as low as 13 per cent., for heating houses, 25 per cent., for hot water boilers, 10 per cent. In good practice these efficiencies should be trebled. It is calculated that there is a domestic waste of 80 per cent., certainly a good basis on which to establish better practice.

We have already spoken of the utilization of water-power of France, designed to reach the most remote parts of the country, and to be at the service of the farmer as well as of the great manufacturer. Now it is announced that on the river Rhone alone, two billion francs are to be expended; twenty power stations are to be established, giving 715,000 horsepower. For the work fifteen years are allowed and the work is to be paid for by bonds guaranteed by the state.

A pipe line across the ocean has been proposed. It is to be of flexible construction so as to be fed out as fast as constructed. The interior is to be rifled and water is to be fed in with the oil, as it rotates the centrifugal force throwing it to the outer portion of the tube, forms a sort of pipe of water, which reduces the friction of the oil in its motion. The novelty of the proposition is in its size and the difficulties to be overcome in putting it in position.

In the tidal waters of Canada, as at Halifax, much trouble has been experienced with concrete piling. Often with an atmospheric temperature of forty degrees below zero, while the sea water is above the freezing point, conditions destructive to concrete are established in the alternate freezing and thawing in the portions within the tidal range. It is proposed to protect the portion within the tidal range by wooden sheathing.

Digitized by Google



The Chemistry of the Common Metals

Part II. Potassium

By Henry L. Havens

THE history of potassium is very similar to that of sodium, which was covered in the last article of this series. Potassium is chemically very much like sodium and holds many properties in common with this element. Both elements are very abundant and each form a large part of the earth's crust. It has been found that potassium actually forms 2.49 per cent of the lithosphere. This percentage compares very favorably with sodium. Potassium is also found to some extent in sea water and the future supply of the world may come from this source. The giant kelp plants in the sea absorb potassium compounds to such an extent that it will some day be profitable to develop this source for commercial needs. At the present time other sources of the element are much less difficult to work.

Potassium, much like sodium in its appearance, is a silvery white metal which very quickly tarnishes upon exposure to the atmosphere. It melts at 62.5° and boils at 758°. The vapor of potassium is blue in color and has been found to have a molar weight which is identical with its combining weight—39.1. Like sodium, potassium is soluble in liquid ammonia. This produces a blue colored liquid which is an extremely good conductor of electricity. Potassium also forms an alloy or amalgam with mercury in much the same manner as sodium. In fact, this forms one of the methods of obtaining metallic potassium from its compounds. A solution of a potassium salt is electrolyzed with a mercury cathode. This method was explained in connection with the article on sodium which appeared in the previous number of this publication. This alloy of potassium and mercury decomposes water but acts more slowly than the pure metal in this respect.

Sodium and potassium can be made to form a very interesting alloy. If the alloy does not contain too much sodium, it will be a liquid at ordinary temperatures.

Potassium can be obtained by the electrolysis of the fused hydroxide. Owing to the fact that potassium oxidizes much more rapidly than sodium it is necessary to place a layer of oil over the surface to protect the metal.

Since sodium can be produced much more cheaply than potassium and since it will do everything that potassium will do in a chemical way, potassium is not produced to a very great extent in a commercial way.

The compounds of potassium are many and varied. This is another way in which it is very similar to sodium. In the following lines a description of the more important compounds of potassium will be found. The author has made no attempt to outline all of the compounds of this metal as it would require too much space.

Potassium chloride (KCl) is probably one of the best known of the compounds of the element. This substance is found in great abundance in the potassium deposits of Stassfurt and it has become known as sylvite. It is found as double salts with magnesium chloride ($KClMgCl_26HO$). In this form it is recognized as carnallite. The larger part of the potassium chloride used in commerce is obtained from this mineral.

Caustic potash or potassium hydroxide (KOH) is almost exactly the same as sodium hydroxide in regard to its chemical properties. It is prepared by the electrolysis of potassium chloride. It can also be prepared by acting upon a boiling solution of the carbonate with calcium hydroxide, calcium carbonate being precipitated. The potassium hydroxide is left in solution. The process of electrolysis first explained is by far the most popular method of producing the hydroxide. In the last named process the hydroxide crystallizes from the solution with various amounts of water forming $KOH.H_2O$, $KOH.2H_2O$, $KOH.4H_2O$, $2KOH.5H_2O$ and $2KOH.9H_2O$. In the process for producing KOH in a commercial way the solutions are evaporated until nothing but the molten hydroxide remains.

KOH is a very strong base but sodium hydroxide is generally used in preference whenever possible. Sodium has a very small combining weight and therefore less of it is required for a given amount of work. The hydroxide of sodium is also cheaper than that of potassium. KOH is used considerably in the soap industry and in the manufacture of oxalic acid.

Potassium can form two oxides, a monoxide (K_2O) and a peroxide (K_2O_4). The former dissolves in water to form potassium hydroxide and the second dissolves in water for the formation of the hydroxide, hydrogen peroxide and oxygen.

Potassium bromide ($KBrO_3$) is formed when bromine is dissolved in a solution of potassium hydroxide as: $6KOH+3Br_2=KBr+KBrO_3+3H_2O$. It will be seen that potassium bromate is also formed during the reaction. If the resulting solution is carefully heated and evaporated to dryness the bromate will decompose into bromide and oxygen. If pure bromide is desired it may be obtained by recrystallization.

Potassium bromide has a density of 2.7 and its melting point is 750°. Its solubility is much greater than the chloride of potassium.

Potassium iodide (KI) can be readily prepared by any of the methods used for the bromide. This substance has a density of 3.05 and crystallizes in anhydrous cubes with a melting point of 705°. One hundred grm. of water is capable of holding 148 grm. of KI in solution at 25°. Iodine has been found to be much more soluble in a solution of KI than in water and when brought in contact with it tends to form the salt KI_3.

Potassium chlorate ($KClO_3$) is the most important salts of potassium without question. It may be prepared by passing an excess of chlorine into a concentrated solution of KOH. The hypochlorite is first formed:

$$2KOH+Cl_2=KCl+KClO+H_2O$$

$$3KClO=2KCl+KClO_3$$

Owing to the fact that the chlorate is much less soluble than the chloride, the solution can be allowed to cool and concentrate, the chlorate gradually separating out with very little of the chloride. Potassium chlorate occurs in nature in large quantities and therefore

Digitized by Google

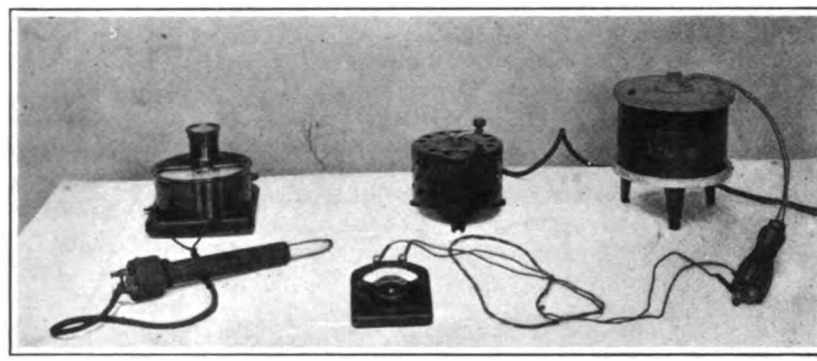
The Measurement of High Temperatures in the Laboratory

By E. P. Hurley

IN the experimenter's laboratory it is often desirable to have some method for the measurement of temperatures above those possible with the ordinary mercurial thermometer. The various devices now on the market for the determination of high temperatures are usually beyond the reach of the amateur experimenter. However, the author has made at a small cost an efficient instrument for the measuring of temperatures up to and including 1200° C.

The operation is based on the principle that the ends of two unlike metals welded together create when heated an electromotive force and if small rods or wires are used and the ends brought into contact with each other, will produce a small electric current. These wires are known as the "Fire End" or thermocouple. For temperatures as high as 1650° C. a thermocouple of one wire platinum and the other wire platinum 10% rhodium is generally used. This couple is very expensive and requires a very sensitive recorder as the electromotive force produced is but 18 millivolts at 1600° C., while that of the cheaper base metal couple or nickel alloy couples is approximately 80 millivolts at their highest temperatures. Where the maximum temperature does not exceed 900° C. the nickel alloy known as Constantan, which consists of about 41% nickel and 59% copper is used as a negative element against either copper, iron, or nickel chrome as a positive element. These couples produce very high electromotive force. The writer has used an alloy of chronium with nickel as a negative element and one of pure copper as a positive element. This makes an excellent couple.

This offers a big field for investigation and experimenting with the various metals and alloy wire to form couples. For each half of the couple use a wire 24 inches long with a cross section of 1/16 to ⅛ inch. The ends of the wire constituting the couple must now be welded together by oxy-acetylene flame or by an electric arc. The couple should now be annealed. This can be done in an electric resistance furnace or by other methods devised by the experimenter. Each wire of the couple should now be wrapped with a close spiral of asbestos cord to within one inch from the end. This can be done in a lathe or other rotating devices. Paint the asbestos cover with a paste consisting of 100 parts silica flour, 50 parts sodium silicate and 20 parts fire clay. Any other good heat insulating paint can be used. Heat the wires in a tube furnace until hard. Base metal couples used at high temperatures must be protected and a porcelain or fire clay tube can be obtained from pyrometer manufacturers for this purpose at a very small cost. The mounting can be turned from wood.



The apparatus necessary for the experiments

The quantity of energy available from a thermocouple is so small that a sensitive millivoltmeter must be employed for its measurement. The author has found the Weston Model No. 280 millivoltmeter reading from 0.75 millivolts an excellent instrument for this purpose.

Calibration of the Thermocouple

As the recorder or millivoltmeter measures the electromotive force produced in terms of millivolts in order to establish the connection between the reading and that of temperature, calibration is necessary. This is easily done by determining the melting points of a number of substances.

The following is a list of pure substances with the boiling and melting points:

Water	B. P.	100° C.
Tin	M. P.....	232° C.
Bismuth	B. P.	271° C.
Lead	M. P.....	327° C.
Zinc	M. P.....	419° C.
Sulphur	B. P.	445° C.
Antimony	M. P.....	630° C.
Silver	M. P.....	960° C.
Copper	M. P. (in air)	1083° C.

With the couple used by the writer the readings were as follows:

Temperature in degrees C.	*Millivolts*
100	4
200	11
400	27
600	43
800	58
1000	72

The experimenter will find it a great assistance to plot a curve for the millivoltmeter readings. This can be referred to when desired and will not necessitate marking the degrees of temperature directly on the millivoltmeter scale. Fig. 1 shows a curve for the couple used in the above experiments. While it is not a straight line, yet sufficiently accurate for ordi-

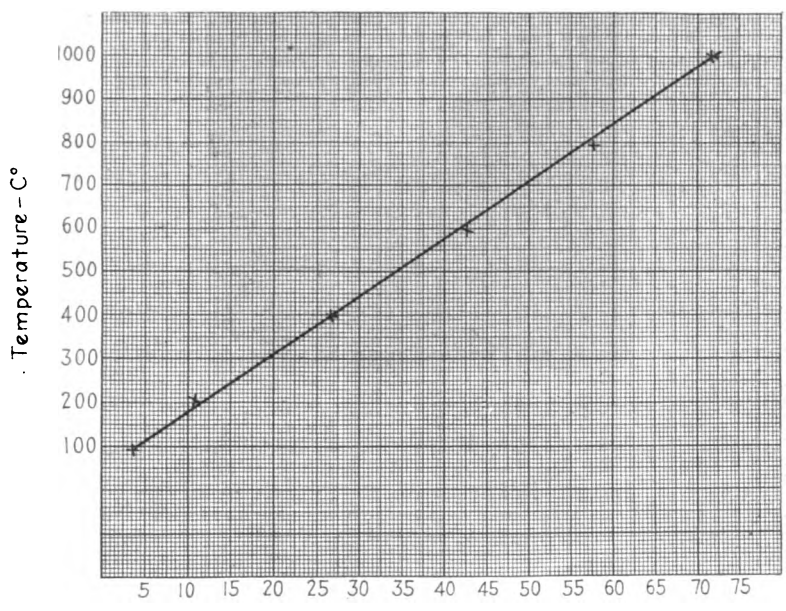


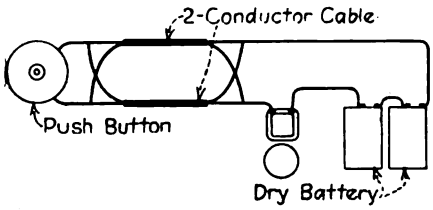
Fig. 1

(*Continued on page* 70)

Digitized by Google

A BURGLAR-PROOF ALARM CONNECTION

A DIAGRAM of connections for a perfectly burglar-proof electric alarm is given herewith. It will be seen that two independent circuits are made. If one is cut, the system will still be in



order as the other circuit will be left intact. This circuit can be employed in many cases where it is necessary to expose wires. The two circuits should, of course, be as far removed from one another as possible. No advantage would be derived from placing them together.

CHARLES DIEHL.

SIX USEFUL WRINKLES

A wood filler can be made with equal parts of wax (the kind that is used for sealing jars, etc.) and clear varnish. Mix well and leave the mixture to set. This wood filler is suitable for instrument bases, etc.

To remove paint from a window glass, rub it well with hot vinegar.

To frost a window, paint the glass with a strong solution of Epsom salts in hot water. This may be quickly washed off if clean glass is required afterwards.

An acetylene lamp will give a far more intense light if a little hydrogen peroxide is mixed with the water in the generator.

To know whether your telephone has rung while you are absent, place a piece of thin paper and a piece of carbon paper between the bell and the clapper. When the bell rings the clapper will make a mark.

Dip lamp wicks in vinegar and let them dry before using. They will not smoke if this is done.

JAMES A. UPTON.

TO ENGRAVE ALUMINIUM

ONE of the very interesting peculiarities of aluminium is its resistance to the direct action of the graver; the tool slips off like from a hard surface of glass. However, by using a varnish of 4 parts of oil of turpentine and 1 of stearin, mixed with 1 of rum, the graver penetrates the aluminium like pure copper.

Aluminium is also very difficult to drill. This can be partly overcome by using plain kerosene as a lubricant. Nothing has been discovered that is more suitable as a lubricant for this metal.

American Society of Experimental Engineers

WHO'S WHO IN THE A. S. E. E.
EUGENE LETSCH, M.E.

As a boy of 16 and released from high school, I had the choice between a "Mister Minister" and a school teacher, but my ideal was something in the direction of "Everyday". After a hard battle and many sleepless nights I left goal as a winner and a week after was hustling around a speed lathe as a mechanic apprentice boy. Contract was signed for four years; machinist helper first year, handy man second year, instructor mechanic third year, and testing laboratory fourth year.

Tools and dies for watches was an interesting field for me. Diesel and automobile practice held me for about two years. My father then insisted on sending me to the technical college for mechanical engineering, of which I am a graduate.



"Real money I'm going to make now," I told my father, and two weeks after was sailing for the country of my dream. Not mastering the English language, I was forced to work as machinist helper, but soon took advantage of the night school and the I. C. S Since that time a new road was open to me.

Analyzing all the possibilities within the range of scientific societies, the A. S. E. E. seems to have the basic spirit I was looking for. Experimental engineering is one of the most interesting occupations. It is an art where ability and knowledge are combined. As a hobby in general it is the reflex of intense interest in the things before us.

The A. S. E. E., with proper cooperation of the members, is qualified to create great things, and with the efficient board of directors we have now, it is an easy matter for every member to become prominent through the work and ability in experimental engineering. It is indeed a pleasure to state here that it is largely to the enthusiastic manner in which the board of directors, especially Mr. Raymond F. Yates, advocated the discussion of some of my matters in preparation for EVERYDAY.

E. LETSCH, M. E.

NEW MEMBERS

Ulmont A. Diel, Jersey City, N. J.
Chas. J. McArdle, Richmond Hill, N. Y.
Stephen Ward Blackwill, Cleveland, Ohio.
Royce M. Strickland, New Haven, Ct.
Milton T. Seldon, Lincoln University, Pa.
F. Emery Eikenberg, Kansas City, Mo.
James T. Watson, Lynchburg, Va.
Wm. Derrick, Newark, N. J.
Paul H. Nelson, Wenatchee, Wash.
J. L. Hodge, Villa Grove, Ill.
F. G. Rogers, New Zealand.
M. R. Potter, Syracuse, N. Y.
Harry C. Karcher, Mansfield, Ohio.
Floyd Bookwalter, Mansfield, Ohio.
Francis MacKert, Sharpsburg, Pa.
Felix J. Gillis, Palisade, N. J.
Warren L. Loomis, Mansfield, Ohio.
George W. Pawlson, Buffalo, N. Y.
James Angelotti, Wilmerding, Pa.
Ray Haines, Washington, Ct.
Binney Woodward Earl, on board the House Boat El-Nido, Miami, Fla.
Arthur Edward Fitz, 66 Kensington Hts., Meriden, Conn.
Hum Chu Moon, 205 Albert St., Ottawa, Canada.
Joseph Mellon (no address).
John J. Barragar, 1227 9th St., Santa Monica, Cal.
Edward Kiefer, Northport, L. I., N. Y.
Herbert W. Hill, c/o Hill Logging Co., Bunker, Washington.

WHY NOT SEND FOR SOME APPLICATION BLANKS?

PROBABLY few members of the society realize what great good they can do by inducing their friends to join

Members who feel that they can make good use of a few application blanks will be gladly furnished with them by addressing a post card to the offices of the society with this request.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

A NEW DIRECT-CURRENT METER

A new single-pivot direct-current meter of the portable type is illustrated in the photograph. This instrument is hand calibrated and has an accuracy guaranteed to be within one-half of one per cent. This accuracy is maintained throughout the full scale value and the action is entirely dead-beat. The moving element is normally so damped that it almost immediately comes to rest at zero or in any deflected position.



This instrument, which is of the Rawson make, has its moving coil supported at the center of an iron sphere, thereby allowing it to oscillate freely in every direction without touching. The instrument has been designed so that it can be used successfully on ships, trains, blimps and airplanes. It can also be operated in proximity to heavy machinery. No leveling of the meter is necessary.

NEW APPLICATION OF THE X-RAY

THE X-ray has recently been applied to the testing of wood. The detection of knots, resin pockets, cracks and grub holes can be made in timbers up to 18 inches in thickness. Owing to the importance of obtaining perfect wood in the construction of airplanes, this method will prove invaluable. The use of X-ray apparatus has also been applied to the testing and examination of insulating materials. Electrical defects can be instantly detected by the use of X-rays. Small pieces of metal or other conducting material that has become accidentally mixed with the dielectric is very visible.

Communicating With Infra-Red Rays

DURING the war French scientists perfected a new method of communication by the use of infra-red rays and it is only recently that the details of this development have reached this country.

The infra-red ray transmitter of the new system is a very simple device, being merely a source of light rich with infra-rays. Both the visible and insible rays of the transmitter are concentrated and the invisible rays projected in a thin pencil in the direction of the receiver by means of a parabolic reflector. Before the rays leave the transmitter they are passed through a ray filter which effectively cuts off all visible rays and allows only the invisible rays to be projected. The filter consists of black manganese-dioxide glass or colored gelatine or cellophone. The electric arc has been used with great success as a source of infra-red rays.

The transmitting apparatus is provided with a quick-action shutter which breaks up the invisible light stream into the dots and dashes of the Morse code.

Infra-red rays possess all the properties common to heat waves and they are often referred to as heat waves owing to the fact that they heat all objects upon which they fall. Infra-red rays can be refracted, absorbed, polarized and diffracted.



The infra-red ray transmitter

The infra-red rays are caused to fall upon a parabolic reflector at the receiving station where they are concentrated and made to fall upon a thermopile placed at the exact focal point of the reflector. The thermopile or electric thermocouple forms the sensitive part of a circuit containing several audions arranged for amplification. The concentrated infra-red rays falling upon the couple cause a temperature change which in turn alters the electrical resistance of the circuit. This change in resistance is further amplified by the audions and an audible signal is produced in the telephone receivers.



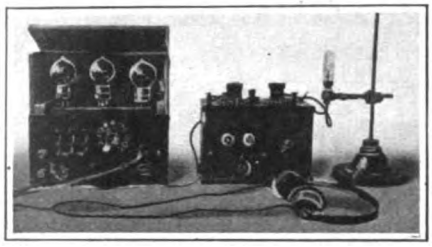
The new infra-red ray receiver in use

One of the most efficient thermocouples for this purpose is made by sealing a plate 0.01 mm. thick to a crystal of great thermo-electric power. The thickness of the plate and the diameter of the point of contact are as small as possible to obtain maximum sensitivity to the waves. The best results to date have been obtained with platinum as the metal and tellurium as the crystal.

By the aid of a powerful source of infra-red rays and with a very sensitive receiver communication has been carried on over a distance of several miles with very good results. It is said

Digitized by Google

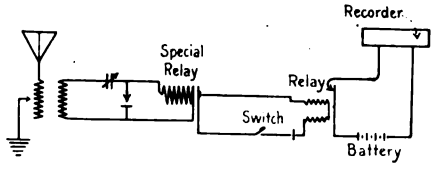
that the real value of this new apparatus lies in the fact that it is possible to carry on absolutely secret communication.



A non-electrical method of carrying on communication with infra-red rays has been devised. One of the illustrations show the use of this outfit. The rays are caused to fall upon a parabolic reflector where they are reflected to a special receiver in which they heat the air and cause a sound to be made.

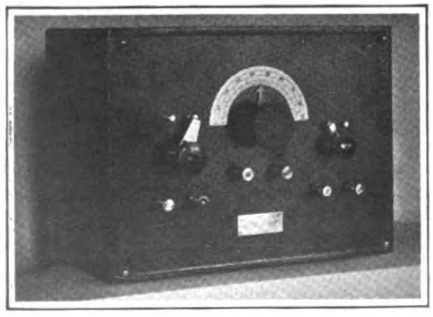
A RADIO RECORDING DEVICE

MR. WILLIAM G. H. FINCH, an Associate Member I. R. E. and Fellow Member of the American Society of Experimental Engineers, has recently perfected a radio device which will record wireless messages with an ordinary tape register similar to those employed on wire lines. This is made possible by



The wiring diagram

a super-sensivite relay which is designed and constructed along entirely new lines and which will function upon the receipt of extremely weak impulses. This sensitive relay closes the circuit of a second relay which controls a rather heavy current for the operation of the tape recorder or whatever device may



The cabinet containing the relay and its auxiliary apparatus

be connected in the circuit. It will be seen that lights can be lit, motors started, horns operated and bells rung by this system which is very simple.

An elementary wiring diagram is shown which will give the reader a general idea of just how the device works. The circuit is brought to a point of resonance in the customary manner by the use of variable inductances and capacities. A detector and a pair of head 'phones are used to tune the circuit. Both of these members may be switched out of the circuit when it has been brought to resonance. Maximum current will then flow through the special relay device which will in turn operate the second or heavy-current relay.

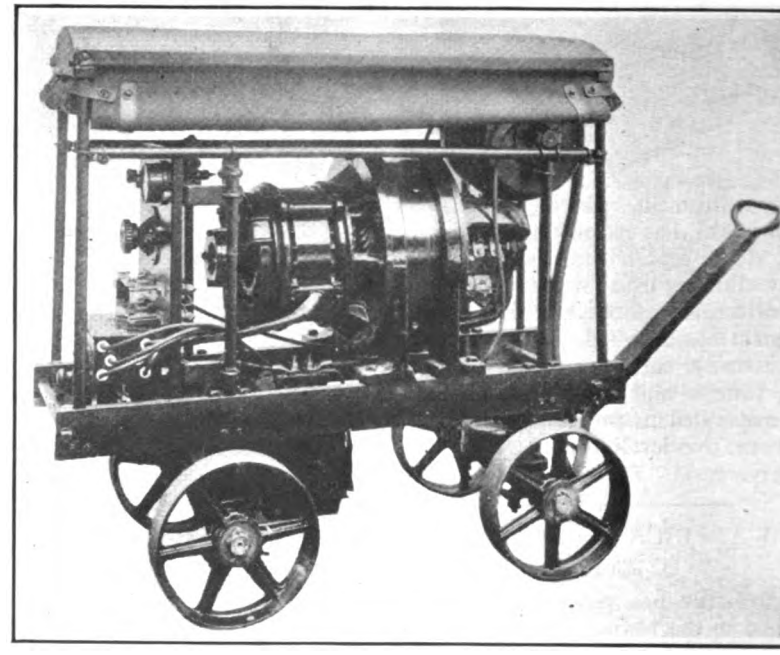
Under test this new relay worked perfectly over surprising distances and when used in conjunction with other efficient apparatus it can be depended upon to render very good service. It is simple and there are no extremely delicate parts exposed. By using the special relay in connection with at least one audion amplifier the distance over which it will operate can be increased considerably. With several stages of amplification the relay will operate over real long distances.

Radio engineers have long been endeavoring to perfect a device that would function on very weak currents and if the present development proves successful it will certainly receive a good welcome. It is said that the English engineers of the Marconi Co. recently perfected a device along these lines that will operate a bell upon the receipt of a radio distress signal at sea. This is to be employed for emergency use only and will not be used for ordinary communication. The fact that the Marconi Co. has been interested in this problem proves that its importance to the field is well recognized.

New Arc Welding Equipment

THE electric arc is being used more and more for purposes of welding. A very late and practical development along this line is shown in the illustration.

This is a motor generator outfit with absolutely automatic regulation. The

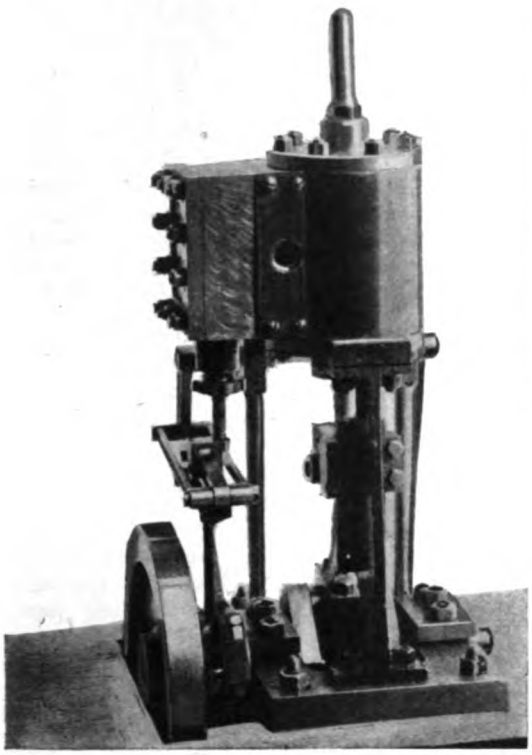


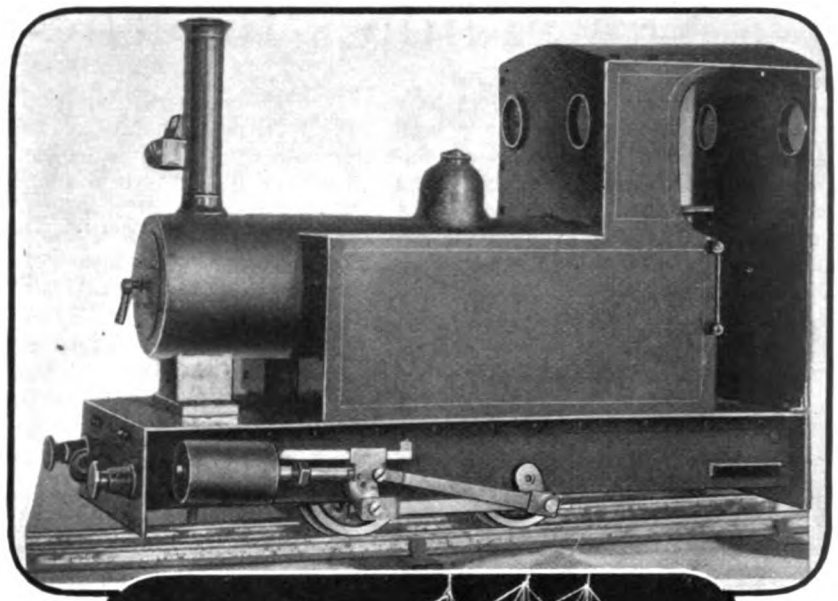
direct-current generator is a machine of exclusive design and is capable of delivering a current strength of 200 amperes at the voltage required for arc welding. This equipment is intended for the use of a single operator and unlike the old outfits does not need several men to take care of it during operation. A switch and meter panel, a motor generator, stabilizing reactor, electrode holder and face shield comprise the outfit. The entire outfit is mounted upon a small truck of rugged construction and readily portable without power.

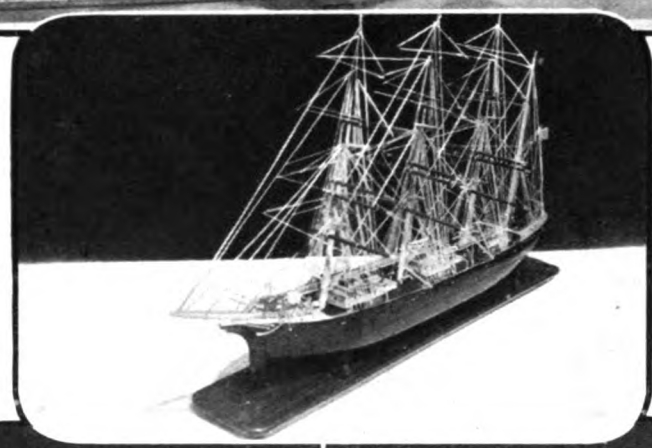
To enable the operator to vary the current to meet his requirements, this arc welder is provided with both a voltage adjusting rheostat and a current-adjusting switch. The latter has four points giving, with slight variations of voltage and current desired, from 50 to 200 amperes. The voltage adjusting rheostat enables the operator to vary the open-circuit voltage from 35 to 65 volts. With an open-circuit voltage of 40 the approximate currents obtained with the different settings of the current adjusting switch are 65, 105, 150 and 200 amperes. The machine is equipped with well-built commutators and very liberally proportioned windings. The machine, although very complete, requires but little space.

Digitized by Google

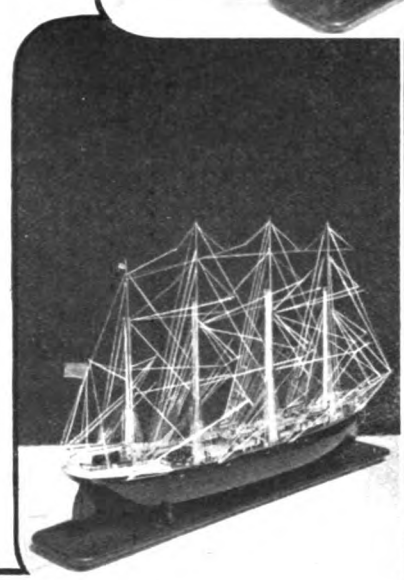
Models Made by Our Readers

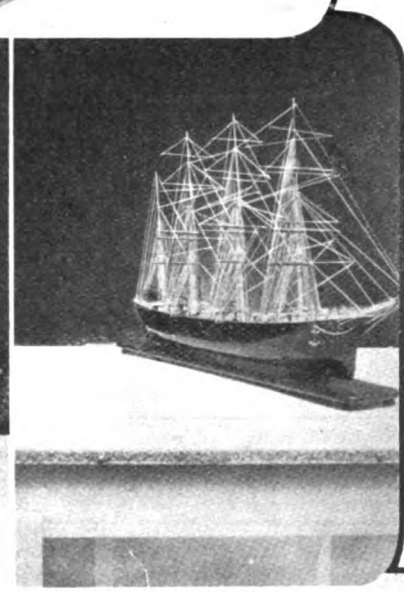


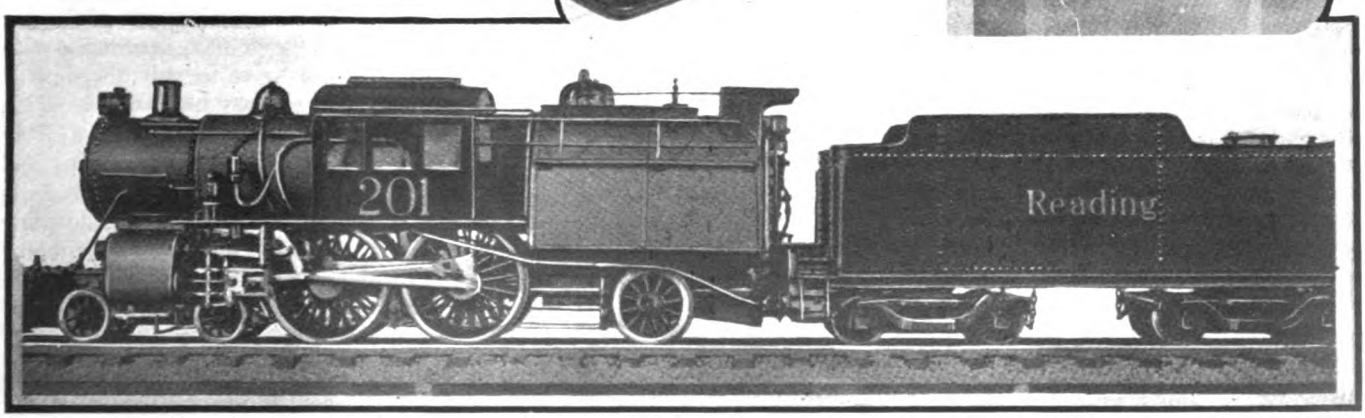




SEVERAL very interesting models made by the readers of EVERYDAY ENGINEERING are shown on this page. The little donkey type of engine in the upper right hand corner is the work of Mr. Carlin, of Pittsburgh, Pa. The single-cylinder marine engine above is the handiwork of Mr. F. A. Wardlaw, of New York City. The splendid little four-masted bark "Star of Scotland" shown is the work of Mr. Edgar L. Brown. The execution of this model demanded a great amount of time, patience and labor from its builder. The "Reading" loco. at the bottom of the page was made by one of our Bloomfield, N. J., readers, who is too modest to have his name mentioned. This is one of the best model locos. that has come to our attention in some time.







Digitized by Google

New Things for the Automobilist

A VAST number of devices have been invented and have been marketed with a view of supplementing the regular equipment of the automobile or providing items to increase the comfort and safety of motoring that are not ordinarily supplied by the car manufacturers. Many of these devices have real merit, but an equally large number have no real reason for being and are of doubtful value. An automobilist who loads up his car with all kinds of junk he has little use for is making a mistake, not only because his money has not been expended wisely, but it takes gasoline to carry the added weight along. The task of selecting accessories of value from the mass of such material on the market is a difficult one for the novice motorist. The appliances shown in accompanying illustrations are of late development and should be useful to motorists.

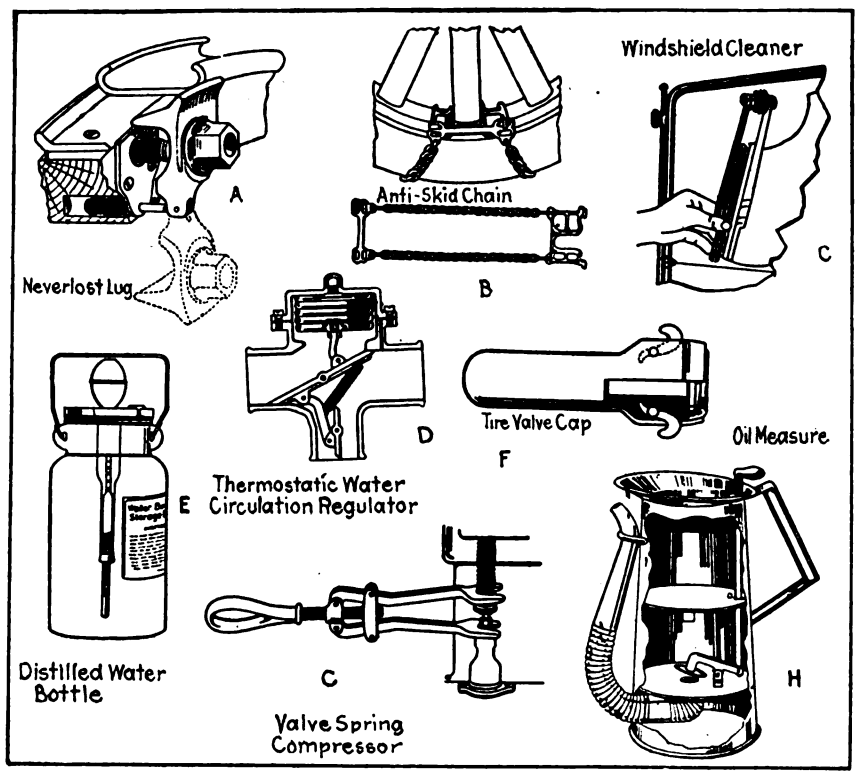


Fig. 1—Recently developed devices for the automobilist

There is one annoying point in connection with changing a demountable rim, and that is the liability of dropping the lugs into the mud or slush when they are removed from the bolts. The swiveling lug as shown at Fig. 1-A is designed so it can be easily removed from the rim retaining bolt and swung down out of the way without any danger of loss because it is securely held to the wheel felloe by a retention pin and spring in the manner indicated.

Quick detachable non-skid chains which are made in various sizes suited for both trucks and passenger cars are shown at B. This is a simple chain device consisting of a pair of cross-chains attached to a fastening device that attaches to the wheel spoke as indicated, permitting quick attachment and removal.

When driving in rainy or snowy weather, the windshield becomes covered with moisture or ice and is hard to see through. The cleaner shown at C is made in two forms, one to be attached to the windshield frame, another that is installed by boring a hole in the windshield glass as illustrated. The cleaners are made of chemically treated felt.

The motor thermostat shown in section at D is very useful in these days of low-grade fuel, because it allows the motor to "warm up" quickly in cold weather by regulating the circulation of water through the cylinder block. When the motor attains its efficient operating temperature promptly, the pistons and rings expand to their proper fit and the escape of raw gasoline past the pistons into the crank case where it will dilute the oil is minimized.

One of the important points in connection with the care of the storage battery is the periodical replenishing of the water evaporated from the electrolyte. It is also necessary to test the specific gravity of the solution from time to time to make sure the battery is properly charged. The combination shown at E is very useful, as it consists of a jar to hold distilled water, provided with a cover that keeps foreign matter out of the liquid and also serves to hold the hydrometer syringe that is so useful in testing electrolyte or introducing water into the battery cell jars.

Many motorists run their cars without putting the dust caps on the tire valves because of the time it takes to screw the cap down and remove it when it is necessary to gain access to the valve for inflating the tire. This practice results in dust working into the valve and causing air leakage or rusting and damage of the valve parts. The quick action dust cap shown at Fig. 1-F is designed to offer all the protection afforded by the threaded style and offers the added advantage of quick application and removal. To install, the cap is simply pushed down over the valve stem and the spring-actuated pawls catch in the thread and hold the cap in place. To release, the spring pawls are pressed out of engagement by pushing in their exposed ends with the fingers and the cap is easily lifted off.

A new valve lifter, which is shown at G, will prove useful to the automobile mechanic or to the motorist who enjoys taking care of his own car. As the ends that spread apart to compress the valve spring are actuated by a thread and inclined plane arrangement, the stiffest valve spring may be compressed with ease and the valve spring collar retention key may be easily removed or inserted, as the case may be. The lifter will keep the spring compressed as long as necessary and enables the operator to use both hands in removing the valve.

The oil filler openings of automobile engines are not always located in accessible places and it is often difficult to pour the oil in with the ordinary measure or funnel. The combined funnel and measure shown at H is a recently devised accessory that is equally valuable to the car owner or garage proprietor. The spout is made of flexible tubing and the delivery opening is controlled by a valve so only the desired quantity of oil may be supplied. This valve is easily controlled by a lever close to the handle of the measure. All the oil passing out of the measure is screened by a wire gauze baffle plate through which it must pass. With the valve closed, the measure may be used in the ordinary way and oil poured out of the top.

Unless a storage battery is kept properly charged during the winter season,

Digitized by Google

especially if a car is operated very little owing to the severity of our northern climate, there is apt to be a marked decrease in battery capacity due to sulphation of the plates, and besides the electrolyte of a depleted battery is apt to freeze if the car is kept in an unheated garage. The rectifier shown at Fig. 2-A is the product of a large producer of electrical appliances and permits the motorist who has only alternating current available to give his storage battery a "boosting" or conditioning charge whenever necessary and thus keep the battery in condition even if the car is not used for extended periods.

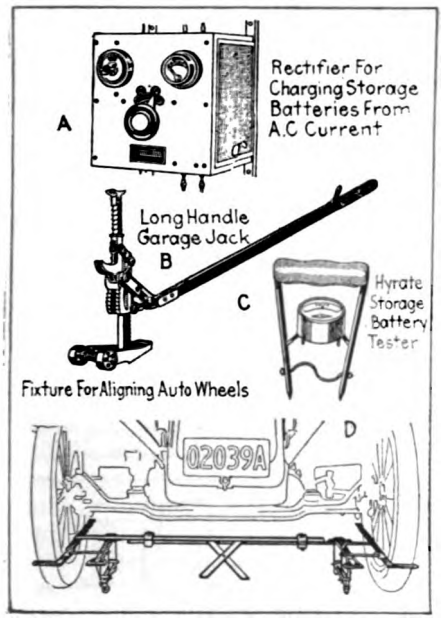


Fig. 2—Useful devices for the garage

The extension-handle jack shown at B is a very strong appliance intended for garage or service station use and is a quick-acting jack for heavy duty. The operating lever or handle is five feet long and makes it easy to lift heavy cars. The length of the handle makes it possible to place the jack under the axles or other hard-to-reach places.

The storage battery cell tester shown at C is a device that consists of a recording meter and a special nichrome wire resistance which connects the prods. The sharp pointed steel prods establish a suitable connection with the lead cell terminals or connection bars, and the cell voltage is indicated on the special voltmeter.

One of the factors that promotes tire depreciation is improper adjustment of the front wheels and their alignment with the normal path of car travel. A gage that makes it possible to line up the automobile wheels very accurately and secure easy steering as well as lessening tire wear is shown at Fig. 2-D, which also outlines the method of using it.

POWER SAVED BY DIFFERENTIAL

SOME figures regarding the loss of power which results when a vehicle is operated with its two driving gears solidly locked together, that is, without a differential gear, were given in a paper by C. G. Conradi, read before the Institute of Mechanical Engineers.

Tests were made with a ¾ ton Electromobile truck. The vehicle during the tests was run over the same course by the same driver, and under the same weather conditions. It was designed for a speed of 15 m. p. h., and weighed, complete with battery, 3,400 lbs. The electrical equipment consisted of a 60-cell A. 4 Edison battery supplying current to a double commutator motor and with a modified series parallel system of control. The chassis was arranged with an all-gear drive, the motor driving the live axle through double reductions, double helical gear, while a bevel differential of normal type was fitted. The differential was securely locked when required, by the insertion of brass blocks between the pinions and meshing with the same movement being then possible. The current consumed was measured by a Sangamo ampere-hour meter, and showed current as charged to the battery, not battery output as is more generally the case.

Condition of Differential	*Load*	*Miles*	*Ampere Hours*	*Ampere Hours per mile*	*Saving per cent.*
Locked	Light	18.1	100	5.52	..
Free	Light	18.1	93	5.13	7
Locked	11 Cwt.	18.1	125	6.90	..
Free	11 Cwt.	18.1	110	6.08	12

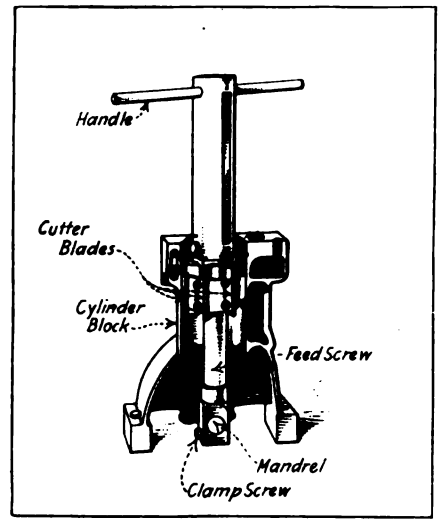
It will be observed from the tabulated results that both light and loaded consumption of current is greater when the differential is out of action, the percentage difference increasing with increase of load. This is to be expected, as with increased load the tires will grip the road better and more power be required to cause one wheel to slip when traveling on a curve.

SIMPLE MIXTURE INSURES CLEAR VISION

TO maintain a clear vision through the windshield in rainy weather when the glass usually clouds up is vitally important to the safety of the motor car and its occupants. A variety of rubber wipers that scrape off the accumulated moisture are used to keep the glass clear in wet weather, but many believe that the old-fashioned alcohol and glycerine solution, which is carried in a small bottle and rubbed on the glass as needed, is best. If the bottle containing the mixture is wrapped in a cloth and stored away in the side pocket it will always be ready for use and a cloth to apply it will also be handy when needed.

A NEW CYLINDER REBORER

A NEW cylinder reboring apparatus is being placed on the market and is shown in accompanying illustration. It is said that this tool will bore an absolutely straight, round smooth hole. The reamer used with this tool has a wide adjustment and is said to run true at all adjustments. Another advantage is that the cutters can be sharpened by anyone on an ordinary grinder.



Hand-operated cylinder boring tool

By referring to the illustration it will be seen that the fixture which guides and feeds the reamer uniformly consists of a screw, which occupies a central position in the cylinder, and is clamped to a short shaft which in turn is secured in two crankshaft bearings and suitable bushings provided to fit any particular bearing. The reamer can be turned by hand or power as desired.

USING UP OLD COMMUTATOR WIRES

WHEN the commutator wires of a Ford get oily at the lower end and are electrically leaky, turn them bottom upward—that is to say, put the commutator terminals on to the low-tension binding-posts on dash, and the upper (dash) terminals on to the commutator binding-posts (seeing, of course, that you do not shuffle them). There is little tendency for electricity to leak at the dash end, because there is little metal there to short-circuit it and the wires are spread further apart, whereas, at the commutator end there is metal everywhere.

Digitized by Google

The Construction of a Chanute Glider

By Percy Pierce

Late First Lieutenant, U. S. Air Service

PART II.

The struts are of next importance. These are oval or of streamline form, 1 in. by 9/16 in. in section and 3 ft. 11 in. long. Sixteen are required, and they should all be of carefully picked stuff, quite straight grained, without knots of any description. For attaching the struts to the planes, I have decided, after experience with several other methods, that nothing can be more simple or conducive to sound construction than the cast aluminum or aluminum alloy socket, and for glider work I have just designed a socket which requires no eyebolts or lugs for bolting down. This is shown in Fig. 7, which sketch gives detailed measurements, while Fig. 8 shows the socket in perspective. A single black iron carriage bolt only is required to secure the socket to the spar, which bolt passes through a hole in the base, the head being inside underneath the strut. The socket is prevented from turning by the tension of the wires. There are four lugs provided to take the bracing wires, but in the majority of places on the glider only three of these will be required, the fourth being cut off with a hack-saw and the metal filed smooth. It will be noted that the socket is so designed with the base at an angle to the vertical center line that it fits on the dipping edges or camber of the plane; thus the same pattern suffices for the sockets at both top and bottom of the struts. The positions of the lugs are such that the wires make a direct pull through them to the bolt.

Fig. 6—Sketch showing method of fitting the steel wire for trailing edges of aerofoils and method of bracing end rib by short strut. Fig. 8—the strut socket in perspective shown at right

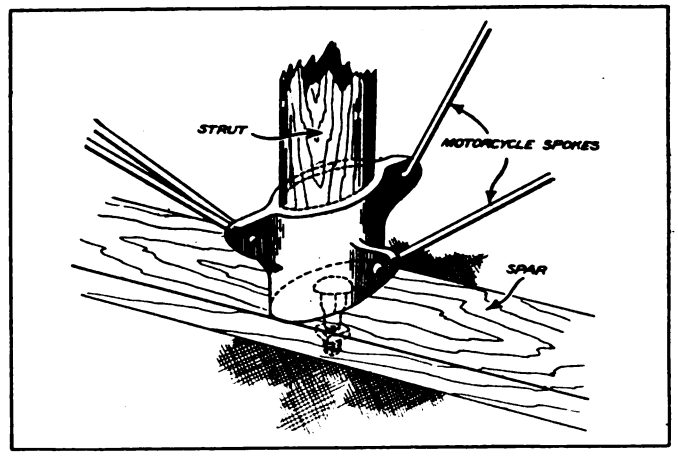
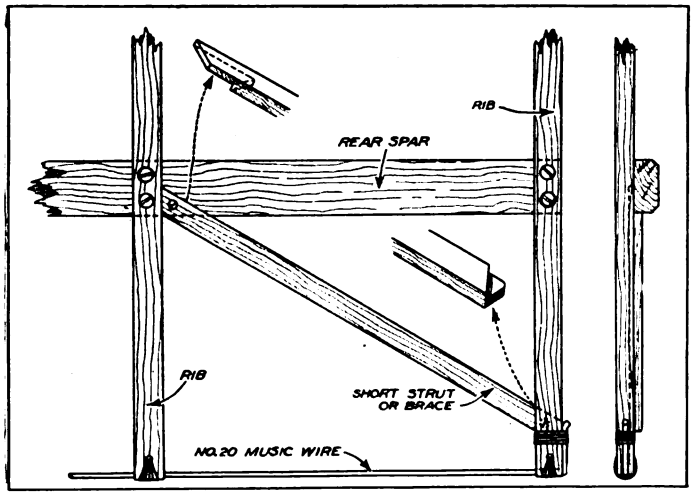
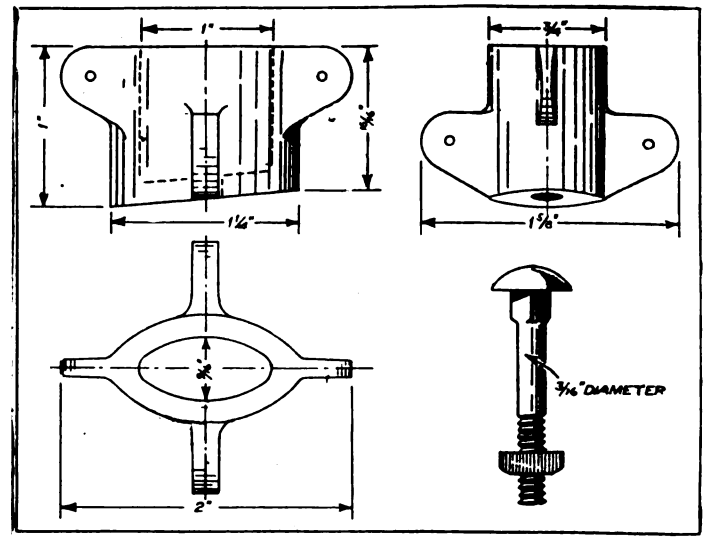


Fig. 7—Dimensioned drawings showing details of cast aluminum strut socket which may be cast from a simple, easily made pattern. The carriage bolt by which the socket is attached to spar is also shown





The ailerons or flaps are shown in plan in Fig. 9. The ribs are here figured as though they were of equal thickness from back to front, but they may very well taper slightly from the main spar to the trailing edge. The pivots on which the flaps hang are to be of No. 18 gauge cold rolled steel and are shown in detail in Fig. 10.

Bolster and Crossbar

In Fig. 11, I have shown a perspective sketch of one of the bolsters and front end of the outrigger; it also shows the manner in which the outrigger, and the additional piece running parallel with the outriggers and bridging across between the struts to help carry the bolsters, are lashed to the struts. The struts—that is to say, the four center ones—should be prepared to receive these by having additional pieces of wood glued on each side of them; these pieces are then notched to a depth of about ¼ in., and the lashing, which may be either of strong fine cord or fine tinned iron wire, is then put on.

The crossbar in front should also be lashed in as shown. This bar must be of ash or birch, in order that an easy steamed bend may be obtained. I ought to mention that, if tinned wire is used for binding, it is a good plan to pass the soldering iron over the whole of the wire; this converts the lashing into what is practically a jointless metal band.

The bolsters or arm nests may, if the pilot is not very keen on personal comfort, take the form of a plain round piece of wood, but it will be found well

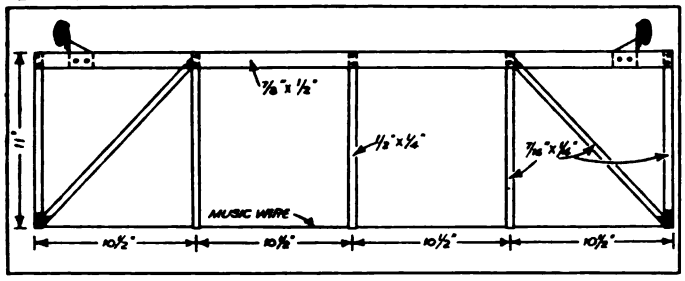
Digitized by Google

worth the trouble to pad them with millpuff and cover with strong cloth, leather or any other suitable material. A section of the bolster and outrigger are shown in Fig. 12.

into the top hems the outriggers are passed, and into the bottom ones the bent wood strips. The lacing is then done tightly, to keep the cloth in place. The cloth should, of course, be turned

sary only half the number of copper terminating tubes or ferrels that would otherwise be required. The spokes may be used just as they are, and the head with the turned over end makes quite

Fig. 9—Dimensioned drawing below shows the details of frame for aileron flaps



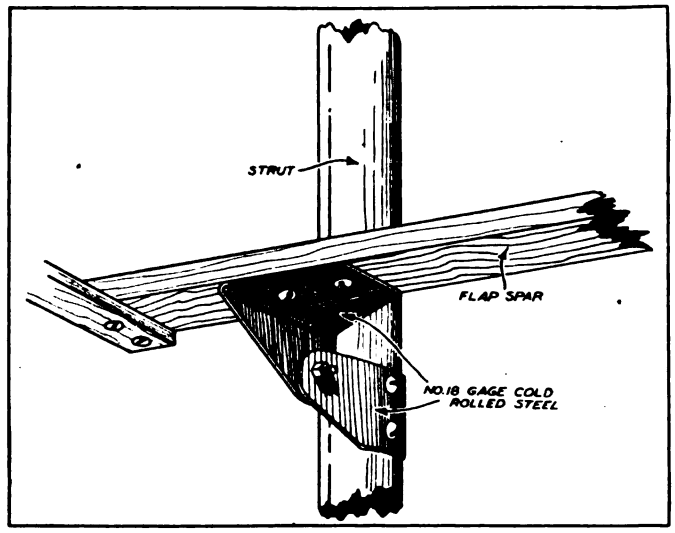


Fig. 10—Perspective sketch at right shows how easily the bearings for the aileron flaps are made

Tail Plane Construction

The tail plane can next be made. As it is clearly shown in the plan view, Fig. 3, no special sketch is needed. Ribs measuring ½ in. by ⅜ in. will be screwed to the spars, and wired at the trailing edge in the same way as the main planes. No steaming of the ribs will be required, since there is no camber, the tail being quite flat and acting only as a stabilizer to steady the glider longitudinally in flight. The main spars are clamped to the outriggers with four V-bolts, as shown in detail in Fig. 13. As shown in the perspective view of the glider (Fig. 2), there are two

over and stitched along the front and back edges, a part of the lacing cord or wire being also sewn in. Three or four screws with countersunk heads are then passed through the skids into the bent wood strip. A sketch of the short strut which requires to be placed in the fork of the outriggers and skids is given in Fig. 14. The drawing shows plates of brass of about No. 20 or 22 gauge secured to the outrigger by wire binding; the wire may well be soldered to the plates as additional security against slipping.

Spokes and Nipples for Turnbuckles

With the object of lessening the cost

a simple attachment on the lugs of the aluminum sockets. A steel plate, shaped as shown in Fig. 15, is needed for each brace to take the wire and spoke nipple. To stiffen this plate and also to act as a bearing surface when tightening the spoke—a piece of No. 20 gauge brass between the steel and the nipple head is used.

In the sketches, Fig. 16, I have endeavored to illustrate the method of attaching the spokes to the outriggers, at the points shown in the side elevation (Fig. 3). The binding here is of wire, and soldered.

With regard to the fabric of this ma-

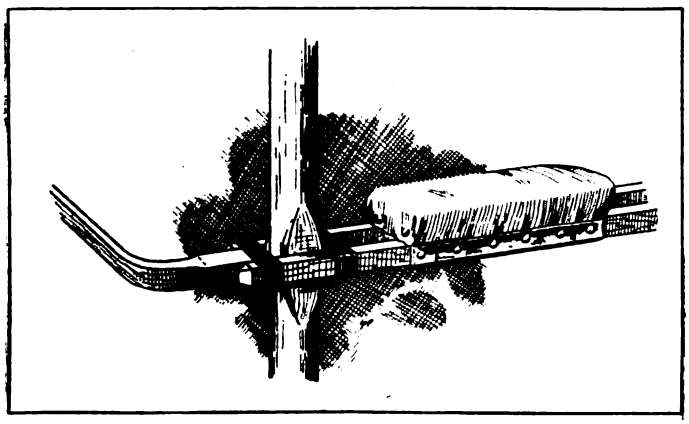


Fig. 11—The bolster support to go under the arms of the pilot is well padded

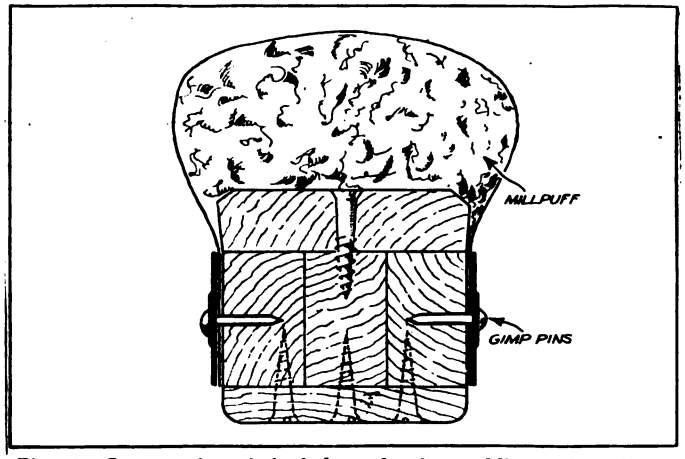


Fig. 12—Cross section of the bolster showing padding and method of attachment

vertical directional vanes or fins underneath the tail plane. The method of securing these is indicated in Fig. 3, namely by lacing with fine cord to the outriggers and a strip of bent wood screwed to the trailing skids. The fabric is carefully cut to shape after the skids are bent, and a deep hem sewn along the top and bottom;

of this glider, I have shown no turnbuckles of the right and left-hand screw type, with the exception of those two which are used to regulate the angle of the tail. Instead, I suggest the use of motorcycle spokes and nipples. This will not only save the cost of the barrel turnbuckles, but will also render neces-

chine, almost any light cloth is suitable, from calico to oilcloth. Proofed cloth, such as oilcloth, for gliders, especially when the planes are single-surfaced, is not at all necessary and a good strong unbleached muslin can be obtained at less than a quarter a yard, 38 in. wide, weighing somewhere in

Digitized by Google

the neighborhood of 2 ozs. to the square yard, the cloth is fastened to the ribs with waterproof glue (ordinary glue containing linseed oil), the edges where the fabric is turned over the entering edge or over the wire at the trailing edge being cut into a few gores. An overlap of about two inches should be allowed. The cloth should run with the warp across the plane, so that the width will be just sufficient to stretch over three ribs with, at the ends, an allowance for turning over on to the sides of the ribs. Glue and brads will be used on the ribs where one piece of cloth overlaps another. The fabric is, of course, applied on the underside of the planes.

The normal angle of incidence of the sustaining surfaces will be about 1 in 8 or 7°, so that the tail plane, being non-lifting, will be set at this angle to the main planes.

How to Use a Glider

The art of using a glider is an important point to consider. Two methods confront us, namely,—towed and free flight. For one who has never flown a glider, the latter is by far the best and safest. Locate a hill with a gradual slope of about 1 in 8 and with the aid of two assistants you can readily be launched into the air. For free flight it is necessary to have a wind of from 10 to 15 miles an hour blowing. The pilot takes his position in the center of the machine, supporting its weight. The assistants grasp the ends of the glider to steady and when the signal is given all three start running downhill in the face of the breeze, the pilot keeping the glider at a negative angle as much as possible until ready to soar, when by pulling the nose of the machine up a bit, he will soon find himself dangling in the air. The assistants should release the glider as soon as they feel it tugging. Towed flight is carried out in about the same manner, except that ropes are securely tied to the lower, front sockets next to the end struts and by these ropes two or three assistants on each, tow the glides in flight. The speed or pull of the helpers in this case merely substitutes for the wind in free flight. An automobile or motor boat can be resorted to for towed flight, but it is advisable to first master free and hand-towed flights before attempting something of greater power.

The weight of the glider, which I have described, should come out at between 50 to 55 lbs., the latter figure being the maximum permissible for a glider of this size.

By using two megaphones, one at each end of a base line twelve feet long, the position of an aeroplane can be located within a few tenths of a degree by the sound of its exhaust.

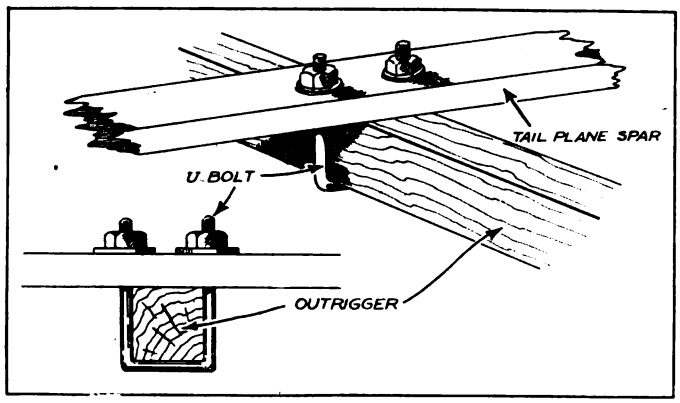


Fig. 13—Details of the clamps used to attach the outrigger to the main tail spars

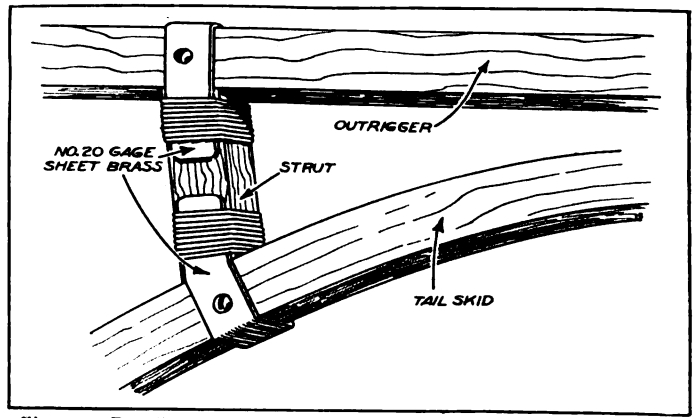


Fig. 14—Details of attachment of the strut between outrigger and skid

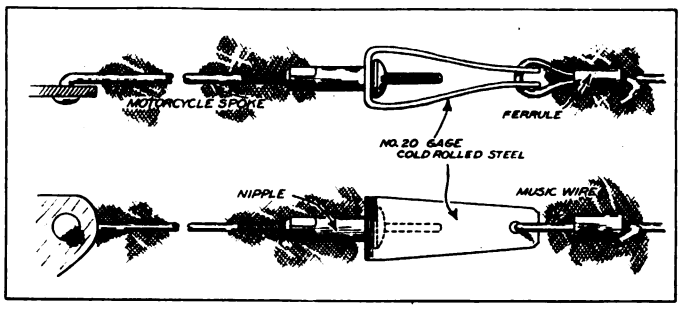


Fig. 15—A simple improvised turnbuckle shown above made of a motorcycle spoke

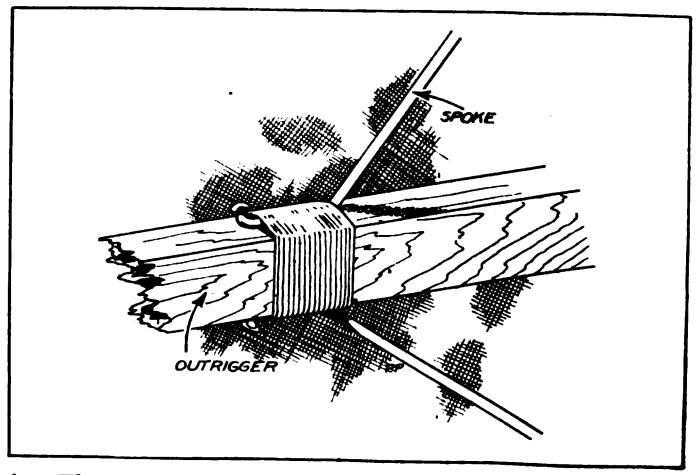


Fig. 16—Detail at right shows how spoke ends are wired to outriggers

TECHNICAL TERMINOLOGY—

THE old engineer, says an exchange, had become tired of the deeply technical talk he heard from various young engineering students he met at his club who liked to air their newly acquired knowledge to their non-technical friends. One evening he began: "This morning I went over to see a new machine we've got at our place, and it's astonishing how it works." "And how does it work?" asked one. "Well," was the reply, "by means of a pedal attachment a fulcrumed lever converts a vertical reciprocating motion into a circular movement. The principal part of the machine is a huge disk that revolves in a vertical plane. Power is applied through the axis of the disk, and work is done on the periphery, and the hardest steel by mere contact may be reduced to any shape." "What is this wonderful machine?" was asked. "A grindstone," was the reply. This brings out very well the weakness of most technical writers, the effort seems to be to make easy things hard instead of the most desired end to attain, that of making difficult things understandable.

It is now claimed as the result of experiments that cyanamide has a toxic effect on corn; it does not decompose into urea and so gives no useful nitrogen to plants.

Digitized by Google

The Berliner Gyrocopter

A Man Carrying Flying Machine Without Wings That Works

THE gyrocopter illustrated herewith, Henry A. Berliner's new adaptation of the old helicopter principle, when tilted forward will fly horizontally, the tilting being accomplished by changing the center of lifting pressure. The weight of the machine is given as 620 pounds and the lifting power is over 900 pounds. The lifting propellers are 13 feet in diameter and revolve on a horizontal plane. They are driven by an 80 H.P. La Rhone motor.

It is believed by the inventor that this principle could be applied to an airplane and enable it to rise from a small area or descend in a small field, a very desirable feature. The propellers are driven by bevel gears, and turn in opposite directions and at the same speed. The driving gearing is housed in an oil-tight casing at the bottom of the vertical bearing member that serves as a housing for the propeller shafts, the inner one telescoping into the outer one. The inner or longer shaft drives the upper propeller, the lower propeller is driven by the outer and shorter one.

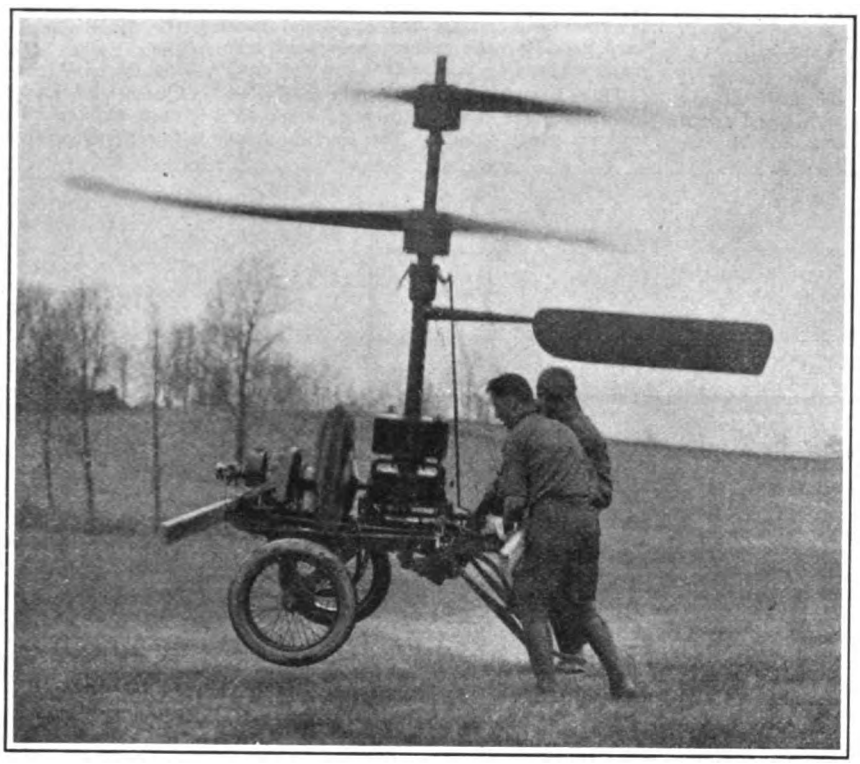
The fuel and oil tanks are disposed around the central mast, which also carries a rearwardly extending vane member presumably to steer the machine to the right and left. The construction of the machine is very simple, and not only the lifting force but that resulting in forward motion is derived from the large propellers. The reason the propellers turn in opposite directions is that this neutralizes the forces tending to rotate the machine around its vertical axis, as would be the case if both propellers turned in the same direction.

The machine illustrated is the result of years of development by the father of the present experimenter, Mr. Emile Berliner, and the basic principles of this class of aircraft were known several decades ago. The formerly existing lack of light power plants retarded development of such apparatus, as more thrust is required for flight than is needed to take an airplane of the same weight off the ground. The photograph of the machine herewith is a particularly interesting one because it shows the wheels and rear skids clear of the ground and that the pilot is seated in the frame so the machine has lifted his weight as well as that of the machine. The efforts of two assistants are needed to hold the machine down and keep it from screwing its way through the air.

No extended flights have been made to date with this type of aircraft so the efficiency of the methods of controlling its flights can only be conjectured. A drawback of the machine as at present built is that there seems to be no safety devices to prevent rapid descent in event of the engine stopping in mid-air. Some adherents of this principle have stated that in such an emergency, the large propellers will act as a windmill and as they rotate, they will prevent rapid falling of the apparatus. It is also claimed that a parachute will safeguard the aviator in such an event.

These devices are yet in the experimental stage, but considerable progress has been made in the practical application of theoretical principles that have long been held workable by experts. Multi-engine helicopters may be developed in the future that will provide safe and rapid aerial transportation, but at the present time the other types of aircraft using the sustaining power of gas or the litfing effort of the air under inclined aerofoils fixed to a rapidly moving central fuselage are the most practical for aerial navigation.

Other helicopter types have been devised, some having a third propeller for imparting horizontal thrust and secure forward motion without having to tilt the apparatus and have the lifting screws exert an angular thrust instead of a purely vertical lifting effort. It is recognized by its inventor that considerable experimental work will be required in perfecting the machine so it will be readily controllable. It was the intention of the originator of this form of aircraft, Mr. Emile Berliner, to try his experiments over water with a machine equipped with floats and fly low so even if the engine did stop during the preliminary experiments, it would be attended by no more serious effects than ducking the operator and wetting the machine. While considerable development work is yet to be done, this machine offers interesting possibilities for the future.



Photograph showing the Berliner gyrocopter lifting its weight and that of the pilot clear of the ground by its own power

TO REMOVE GREASE FROM MERCURY

TO cleanse mercury, first put a ten per cent solution of nitric acid in an iron ladle, and then the mercury to be cleaned; place same over a blacksmith's forge until the nitric acid boils. The dirt will then rise to the top, and leave the mercury perfectly clean in the bottom. Care must be used not to let the mercury boil, as the fumes are very poisonous.

The formation of iron ore by bacteria has been investigated by E. C. Harden of the U. S. Geological Survey. He found "iron bacteria" actively engaged at considerable depths below the surface. Laboratory cultures were successfully made for investigation.

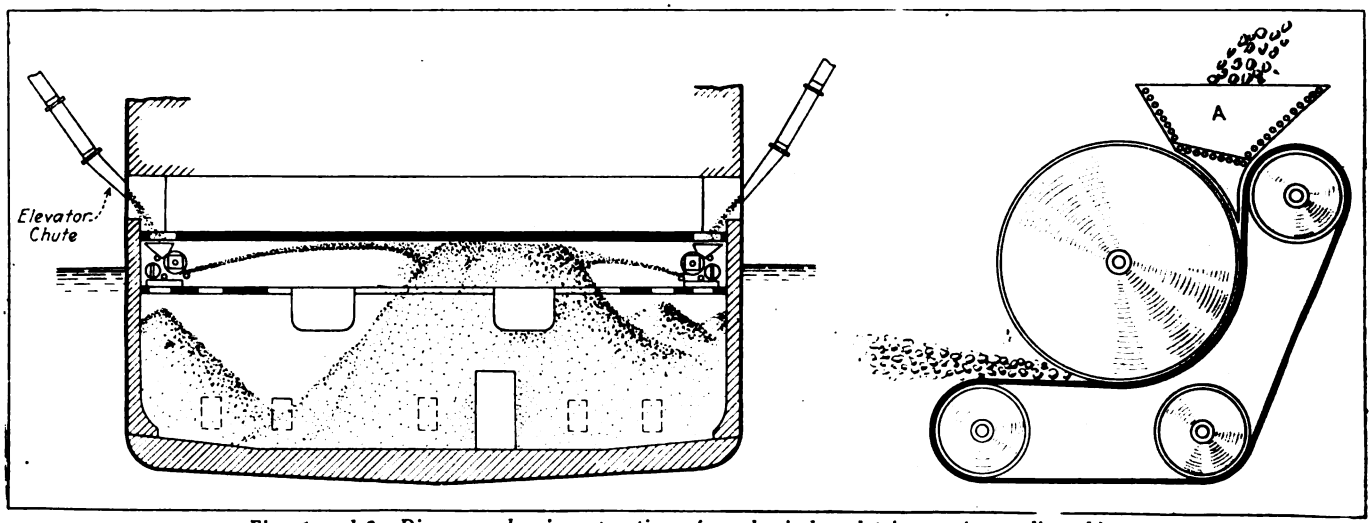
Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

A MECHANICAL COAL TRIMMER

The hand-trimming of coal in loading a ship or in filling her coal-bunkers is at once an expensive and anything but a sanitary operation. The work is done shovelful by shovelful, by a large gang of men in an atmosphere charged with coal dust. The illustrations show an apparatus for trimming by power, and thereby dispensing with hand labor. The machine is comparatively simple and compact, and lends itself to the present system of coaling. In Fig. 1 the details of the appliance are shown. The coal is delivered by spout or any other type of conveyor to the hopper A. The large drum shown in section is some thirty inches in length, and the belt is 27 inches wide. The drum is grooved. The belt travels at high speed, varying with the work it has to do—3,500 feet a minute is a speed adapted for mixed coal. A thirty horse-power electric motor does the driving. The speed is varied by a controller. As the coal falls into the space between the belt and the drum it is driven through at high speed, and flies out at the other side to any desired distance, and can be directed to any part of the bunkers. The relation of machine to the ship is shown in Fig. 2. The coal is shown arriving in the ordinary way through tubes. As it falls from the ends of the spouts, instead of being trimmed back by hand to the remote corners of the bunkers, it is seized between drum and belt and projected, as indicated, clear across the bunkers to the back upper corners, so as to fill them in the most complete manner, certainly more thoroughly than would be possible with shovel-trimming. The operator at the controller regulates the speed of the motor from 900 to 1,200 revolutions per minute, according to requirements.



Figs. 1 and 2—Diagrams showing operation of mechanical coal trimmer for coaling ships

---

In England efforts or experiments in the use of compressed gas for driving automobiles have not ceased with the war. It is found that coal gas compressed to thirteen atmospheres is thirteen times as bulky as gasoline of the same propelling value. This feature alone is held to limit the use of gas to a radius of action of only ten or twelve miles.

A new high-speed steel, with vanadium and molybdenum instead of tungsten is reported as having given excellent results. Ingots of molybdenum steel are liable to show cracks and tools made from it are erratic in behaviour. The use of vanadium is said to overcome these troubles. Another steel containing cobalt and chromium is reported as holding its volume, when hardened, so that it is adapted for standard taps and dies. Stainless steel, with about 13 per cent. of chromium has been hardened from a temperature of 1740° to 1830° F., which are very high hardening temperatures. The same steel has to be drawn at a low temperature. Among its uses it proved to be very good for the exhaust valves of aeroplane engines.

There has been much difficulty in England in bringing the manufacturers to work to a uniform gauge system. The English manufacturer is individualistic, but during the war limit gauges had to be worked up to, and it seemed as if the old system had been disposed of, but it is said that it is reasserting itself, and some factories, it is said, never did reform their methods. Just before the armistice, 10,000 inspection gauges per week were being turned out. Limit gauges, one too large and one too small, were made so much of a size as to exact an accuracy many times that employed in the standard English engineering practice.

The annual report of the Panama Canal Sanitation Department shows that the mosquito is not so completely disposed of as had been believed. The insect can and does go further afield from his breeding place than was formerly believed. He travels over a mile, which implies that the drainage must be more extensive than was formerly believed necessary. The sanitation of the Isthmus is not so perfect, but that the recommendation is made that the staff should be away for two months every year. A curious note is to the effect that it is important to keep cattle away from dwellings, because their deep foot-prints fill with water and form breeding places for the mosquito. It is definitely known that the mosquito is the disseminator of fevers.

Australia has long been afflicted with a rabbit plague. Now a new trouble is making itself felt; this time it is prickly pear plague. These annoying and almost useless plants are invading vast areas of country. To kill them, various forms of arsenical poison are employed and the government in Queensland is taking a part in the work of extermination. It costs about 50 shillings an acre to kill the plants, so it is of poor economy to do it except on valuable land. Potassium compounds can be made by the aid of the ashes, but the expense of transportation makes this process of little value. The ashes are 10 per cent. of the weight of the dried plants, and they give about half their weight of the potassium salt. The plants have covered 22 million acres in Queensland, and are spreading over an area of a million acres annually. Some alcohol can be made from them, but in small percentage only; it has proved to be of little use for paper-making; attempts to use it as a reserve food for cattle have had a measure of success.

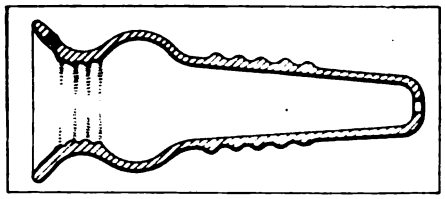
England is expressing some anxiety about the gasoline supply. The consumption is in the neighborhood of three thousand millions of gallons per annum. Potatoes may be made a source of alcohol, as a gasoline substitute, but the yield is only twenty gallons per ton. The mahua tree flowers which grow in India do much better, giving ninety gallons per ton of dried flowers. The cost of a ton of the flowers is put at thirty shillings sterling. Cheap denaturing is a problem not yet solved in Great Britain. It costs about six pence a gallon. There are hopes that benzol and the distillates from shales may help to solve the problem. In Norfolk, England, wells are evolving natural gas, and hopes are entertained that oil may yet be obtained there.

Froth separation, or oil separation, long in use for certain ores by floating them in a sort of oily foam, is being extended to other minerals, and is being developed to cover a larger range of minerals. Its applications promise to become far more numerous than hitherto in the near future.

Digitized by Google

THE BI-JET WATER HOSE NOZZLE

The cut shows a new hose-nozzle, recently introduced in England, to be used for washing automobiles and other purposes, which gives as desired a strong jet of water or a distributed and soft stream. The jet is formed by the round aperture in the inner end of the nozzle. As long as it is left un-



disturbed the strong jet, once started, continues. But if the hand is placed over the larger open end of the jet for an instant the effect is to break up the stream, and, on removing the hand the soft and distributed stream continues to flow indefinitely. To restore the strong jet, all that is necessary is to give the nozzle a sweeping transverse jerk. The nozzle then returns to its old function and a continuous strong defined jet is again produced.

As a lubricant for wood the use of graphite, rubbed off from a lead pencil, of talc powder or of paraffin wav from a candle, is recommended in preference to the much used soap. The latter sinks into the wood and is therefore not permanent. The above recommendation was made especially to photographers for lubrication of shutters where wooden surfaces come in contact.

The vibrations of a reinforced concrete chimney in Saganoski, Japan, have been measured. The chimney is 750 feet high and 26 feet 3 inches internal diameter at the top. In a 50-mile gale it vibrated less than one inch; in a 78-mile gale the vibrations had a range of 7.32 inches. It is calculated that with a wind velocity of 110 miles per hour, the vibrations would extend to 15 inches. Such winds are to be anticipated in that locality. The period of vibration was practically constant, 2.52 to 2.56 seconds. The maximum amplitude of vibration was curiously enough at right angles to the direction of the wind.

A gas well in California recently caught fire. It is thought that the friction of sand carried up with the rush of gas heated the upper two feet of the pipe red hot and effected the ignition. Dynamite and streams of carbon tetrachloride were used to put it out. The dynamite proved successful. On the explosion taking place, a deep red glow appeared, followed by a black puff and the fire was out.

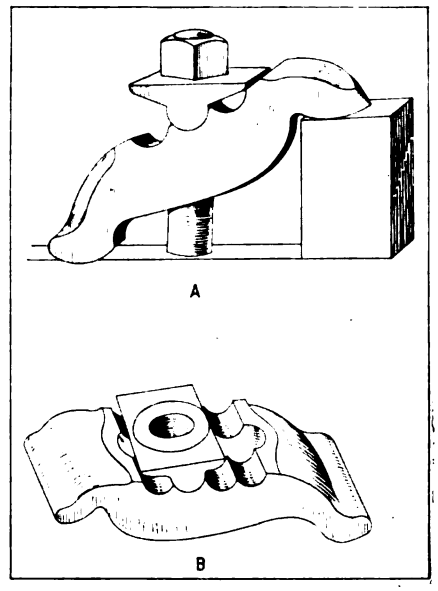
A recent investigation of the failure of the Ridgeway storage dam in Tasmania brought out the interesting fact that the sand used in making the concrete contained considerable magnesia and that this accounted for the failure. It is seldom that it occurs to an engineer to have sand analyzed, although the cement may be subjected to the most rigorous requirements.

In West Virginia near Fairmont and Clarksburg there are wells which reached a depth of 7,579 and 7,386 feet, respectively. They were bored to reach the Clinton sands for oil. At Czuchow, Germany, there is a 7,348-foot well, and near MacDonald, Pa., there is one 7,248 feet deep. These are said to be the deepest wells in the world. The deepest metal mine is said to be at St. John del Ray, Brazil. It is 6,326 feet deep and increases 1° F. in temperature for each 120 feet of depth. Some of the workings are as hot as 110° F. It is a gold mine, and is 80 years old.

A rapid and approximate analysis of air to determine the percentage of carbon dioxide present is effected by drawing it at the rate of two litres per hour, through a solution of barium hydrate in water. It is calculated that the formation of a precipitate in two minutes will indicate the presence of 4 volumes of carbon dioxide to 1,000 volumes of air. If twenty minutes are required to show a precipitate the proportion is only 5 parts is 10,000 parts of air. Interpolation will give the results for intermediate periods. Carbon monoxide is oxidized by passing the effient from the above test through a tube electrically heated, the air being mixed with or acted on by iodic acid. The reaction precipitates iodine, which may be determined by titration, and the percentage of carbon monoxide calculated therefrom. As a check the air after this treatment may be passed through baryta water, just as before, for the carbon monoxide has now been converted into carbon dioxide. Silver nitrate solution will absorb and precipitate sulphuretted hydrogen and sulphur dioxide is absorbed by potassium permanganate. The two last named impurities can be determined in the two solutions by the regular methods.

THE AUTOSET CLAMP

A clamp or dog for holding work on the tables of drill-presses and other machine tools is shown in the cut. Its construction is so simple that a description is hardly needed. A single bolt holds it down, clamping the work upon the bed plate of any machine tool with a slotted table. The

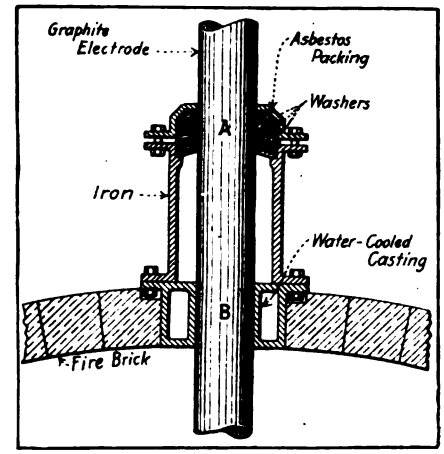


distinguishing feature is the peculiar shape, which has been studied out, so as to make the clamp self adjusting. The semicircular grooves receive a washer with a semi-cylindrical base, and through this washer the holding-down bolt passes. The shape of the washer fitting the groove gives the feature of self-adjusting. The general contour of the clamp carries out this feature still further. The holding-down bolt passes through a slot, and the washer can be bedded in any one of several transverse grooves. The bolt stays vertical in all conditions, and a three-groove clamp will hold work varying from ⅜ to 1½ inches in thickness. A four-notch clamp will hold work up to 2¾ inches in thickness.

A step in the direction of decimalization of standards is a bill for the consideration of the British Parliament, Lord Southwark's bill, to divide the sovereign into 1,000 mills, instead of the 960 farthings it now contains.

PROTECTING FURNACE ELECTRODE

In an interesting paper on electric steel furnaces, by Victor Stobie, what would seem a minor difficulty with electric arc furnaces was spoken of. The trouble, really a very serious one, is the difficulty in saving the electrode from wasting away where it passed through the top arch of the furnace.



The joint there cannot be a tight one and the carbon electrode burns away and makes the leakage greater than ever. The cut shows how this trouble has been overcome. An iron tube, 24 inches long, surrounds the electrode resting upon a water-cooled bushing, and is considerably larger in diameter. At the top there is a reasonably tight joint. As the part of the electrode which passes through this joint is far enough from the furnace to be comparatively cold, it does not burn away, there is no leakage of gases through it, and there is no trouble in keeping it in good working order. When as in former practice the joint was at B, there was endless trouble. It was calculated that 75 per cent of the waste of electrodes was due to burning at the upper ends. The securing of a tight joint and the coolness of the electrode end makes the use of water cooled heavy bronze connections unnecessary, and makes the top of the furnaces more accessible to the workmen on account of the reduced heat.

The area, whose drainage is generally assumed to be effected by some river, is termed the river's watershed. Thus the Mississippi is accredited with an enormous watershed or drainage area, in extent equal to the area of many states. Now it has been calculated that the water flowing in the bed of the Father of Waters as it passes St. Louis is only equal in amount to the rain which falls over the area of the one state of Mississippi. The rest of the rain which falls over the vast watershed disappears by evaporation. The extent of the influence of evaporation on the delivery of water from or by open conduits is taken very full cognizance of by irrigation engineers; they use open channels and wooden trough conduits in their work, and allow a large loss for evaporation. Were it not for the enormous evaporation from the Great Lakes the volume of water pouring over the falls of Niagara would be incalculably large. Besides this loss there is also the evaporation in the land areas before the water of the rainfalls reaches the lakes. The total annual rainfall of the United States has been calculated at six thousand billion tons.

In Derbyshire, England, the government has sunk wells in the neighborhood of 4,000 feet deep in search of oil. Success is thought quite probable. One well has yielded oil for over four months.

Digitized by Google

New French Aviation Engines

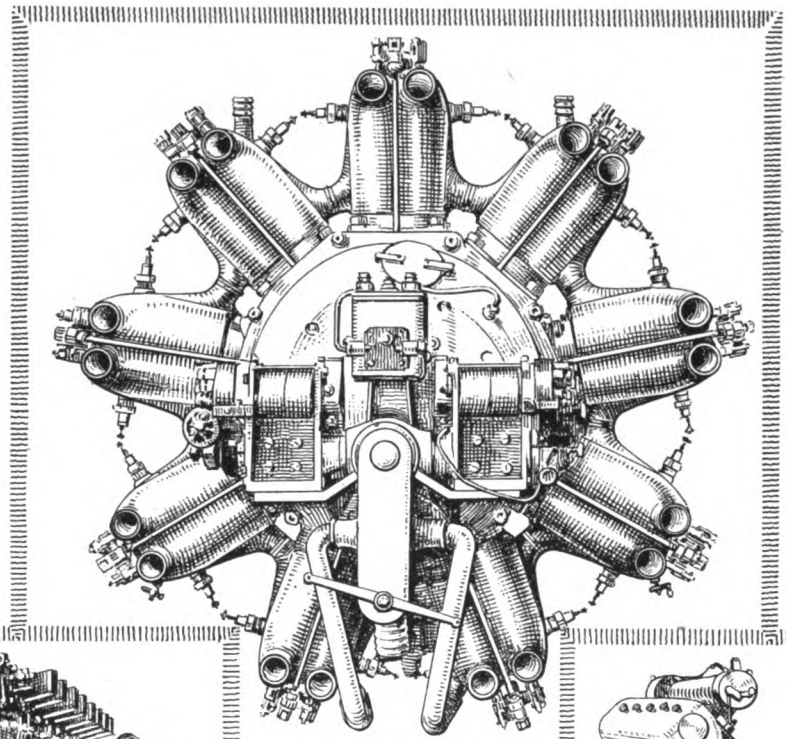
Some Unusual Designs Shown at the Recent French Aero Show

A CAREFUL examination of the engines shown at the Paris Aero Show shows that the aviation engine of the future will probably be of the fixed cylinder water-cooled type with more than six cylinders. This does not imply that the air-cooled engine has been abandoned, but, as power in a single unit is rising, the advantage is more and more with the water-cooled type. Units are being built with 600 to 1200 h.p. and the fixed cylinder, water-cooled type only can be used when high power engines of this type are contemplated. There is a revival of small aviation engines, developing from 30 to 60 h.p., all of the air-cooled type, some having only two cylinders placed horizontally.

The trend of design is discussed by the foreign correspondent of "Automotive Industries" in a lengthy article from which the following notes have been taken. Engines with geared down propellers are on the increase. As a consequence, piston speed is being increased and higher efficiency is being obtained. At present, piston speed is not high compared with automobile racing practice. The most advanced aviation engines are limited to 2500 r.p.m., giving a piston speed of a little more than 40 ft. per second compared with 70 ft. for racing practice. During the war, engineers were not encouraged to increase engine speed, most of those in authority being prejudiced against and afraid of high-speed engines. Many of the earlier engines, too, developed trouble with reducing gears, and such defects could not be eliminated owing to lack of time.

Large Lorraine Engine

The largest engine in the show was the Lorraine-Dietrich 24-cylinder W-type. It has separately forged steel cylinders of 126 by 200 mm., with a sheet steel water jacket common to a pair of cylinders. The four valves are in the head, but are operated from a crankcase camshaft and push rods. The engine is of a direct propeller type and is shown at Fig. 1. It was designed toward the end of the war for use on the big 1919 bombers which were rendered unnecessary by the Armistice, but is now being produced for commercial purposes.



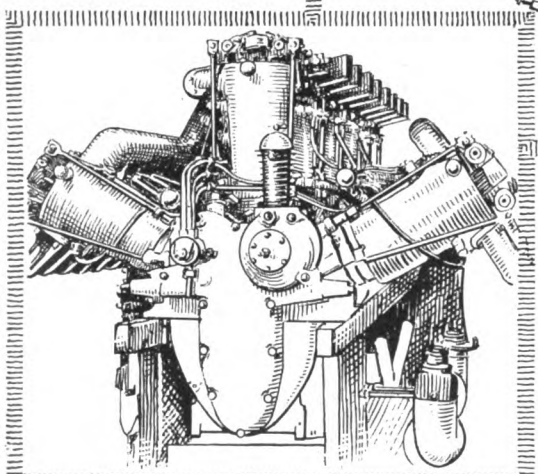
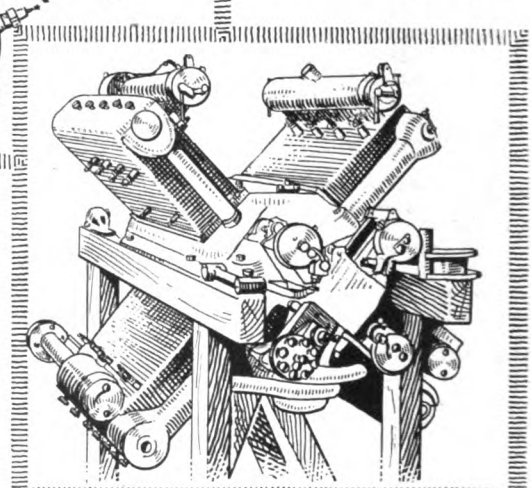


Fig. 1—the Lorraine-Dietrich 24-cylinder engine has three banks of eight cylinders. Fig. 2—The new F. I. A. T. radial or star engine. Fig. 3—The Peugeot 16-cylinder power plant



F. I. A. T. Radial or Star Engine

As an indication of the tendency in Europe, the F. I. A. T. has been built in the water-cooled star type shown at Fig. 2, somewhat like the Salmson engine which gave such a good account of itself during the war. This engine has nine cylinders, measuring 130 by 150 mm. and are steel forgings with sheet steel welded-on jackets, mounted around a circular aluminum crankcase. One of the features of this engine is the ingenious manner in which all the intake pipes are put inside. The carburetor is bolted direct to the lowest portion of the front of the crankcase and delivers its mixture to a distributing chamber cast with the case. The intake pipes are steel tubes welded in position when the cylinders are built up and before the sheet steel water jacket is put on. With this arrangement, the intake pipes are entirely inside the water space and the mixture is uniformly heated on the whole of its passage.

New Peugeot Motor

A novel Peugeot design, depicted at Fig. 3, is an entirely different type. Sixteen cylinders, in four groups of four, form an X and have rods connecting up to a four-row, three-bearing crankshaft. This is the only X type engine in the Show; the idea, however, is not entirely new, having been adopted by Gobron and others in the

Digitized by Google

early days of aeronautical science.

In this construction, the cylinders are steel forgings, each group of four being welded to a base plate, and a sheet aluminum water jacket fitted round the group. The heads, which are cast iron and welded in position, also serve to unite the four. There are four valves per cylinder, slightly inclined in the head and operated by an enclosed overhead crankshaft, with a single rocker arm for each pair of valves. Cylinder dimensions are 130 by 170 mm. and the power developed is 500 at 1400 r.p.m.

This engine has a center crankshaft ball bearing and plain bearings for the ends. The tubular connecting rod consists of one master rod, mounted direct on the crankpin and three auxiliary rods, one being in the prolongation of the master, and the two others at 180 deg. to it. Camshaft drive is by bevel gearing and an enclosed vertical shaft for each group of four cylinders. From the camshaft drive gear the magnetos are operated, there being one for each group of four cylinders. The water pump, mounted immediately below the magnetos, is common to the entire engine.

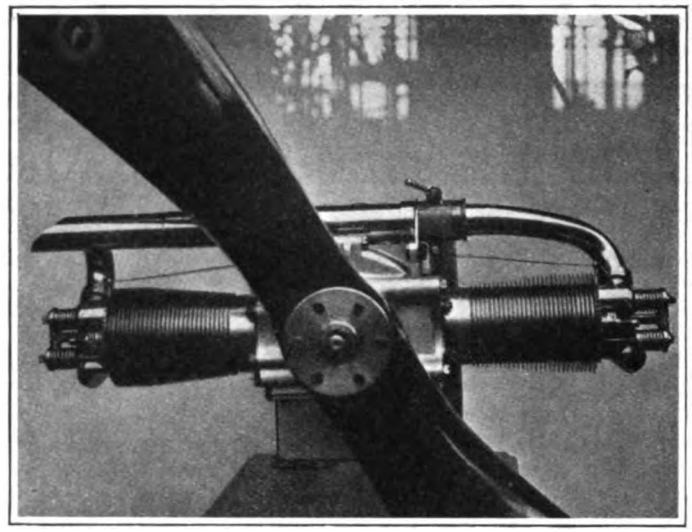


Fig. 4—The small Clerget air-cooled engine for light airplanes

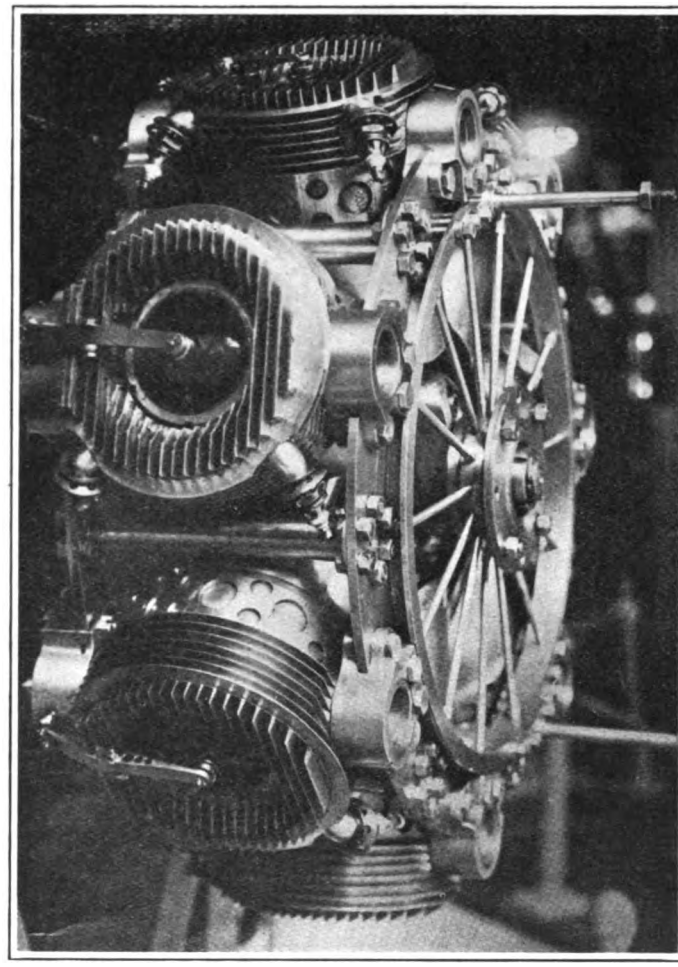


Fig. 5—The Seja seven-cylinder engine is an unusual design, having oscillating cylinders supported by trunnions

Small Clerget Engine

So far as Continental makers are concerned, there has been considerably less development in air-cooled engines than in the water-cooled variety. Gnome, Clerget and Anzani have remained true to the air variety and have adopted improvements. There appears to be a demand for small engines for single seater runabouts, and here, of course, the air-cooled engine is supreme. One of the smallest is a twin-cylinder horizontal built by Clerget, and illustrated at Fig. 4.

The cylinders, which are only 85 by 100 mm., are steel forgings with machined fins and valves in the head operated by push-rods and rockers. It is stated to develop 16 h.p. It has roller bearings for both the crankshaft and the connecting rods, aluminum alloy pistons, and forced lubrication. The weight is only 48½ lbs.

Gnome has a new low-powered machine, the Z-9, rated at 60 h.p. with cylinders of 84 by 106 mm. The valve in the piston head has given way to a mechanically operated valve in the cylinder head. The internal lock ring holding the cylinders to the crankcase is replaced by studs and nuts. The crankshaft is hollow, but this is used only to cool the internal parts of the engine. The carburetor delivers its mixture to the intake valves by external intake pipes, and in many respects the engine resembles the La Rhone more than it does the Gnome, with which Aviation enthusiasts are familiar.

Seja is an Unusual Design

The Seja, while a rotary air-cooled type, has distinctive features. The connecting rods are rigidly connected to the aluminum piston, without the use of a wrist pin. The cylinders, however, can oscillate, for they are hung in trunnions, near their head, between a couple of heavy steel rings forming the frame work of the engine. These rings or hoops, have a hub, connected by spokes to the former, and it is in the hub that the single-throw crankshaft is carried. The crankcase is open and the cylinder barrels are cut short, so that at the end of the stroke the greater portion of the piston skirts is uncovered. One valve is mounted in the head and the other is placed horizontally. Cylinder dimensions of this engine are unusual, being 186 by 130 mm. It does not appear that this engine has been in service.

INSPECT WHEELS FREQUENTLY

ON all cars having the rear wheels secured to tapered shafts, and most of the popular cars use this construction, care should be taken that the hubs are kept seated tightly on the taper end of the axle by means of the clamping nuts. The rear hub caps should be taken off and the lock nuts screwed up as much as possible without injuring the threads. If this is not done the hub may work loose on the shaft and by knocking against the key will certainly spread the key-way in a comparatively short time. The car should be jacked up when the wheels are tested because a wheel may apparently be tight if the car weight rests on it and yet be loose when relieved of its load. Wire wheels are usually installed over master hubs and locked in position by lock nuts. It is good practice to inspect these lock nuts frequently and tighten same. If a wheel becomes loose on the inner hub it will creak and wear the hub.

Digitized by Google

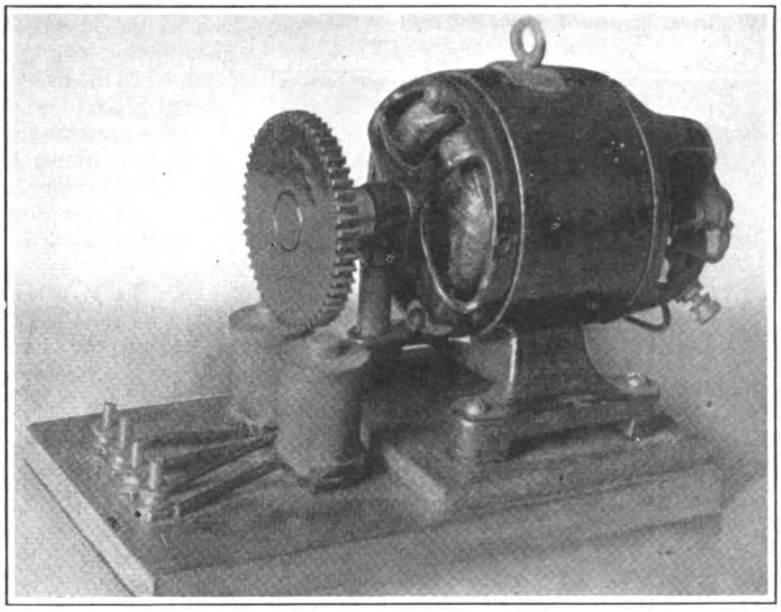


THE JUNIOR EXPERIMENTER

A Small High-Frequency Alternator

By Joseph Jordon

THE little machine illustrated in the photograph is easily made and many very interesting experiments can be performed by its use. All that is needed for its construction is a small battery motor, an old gear wheel and a pair of magnets. The motor can generally be found about the junior experimenter's laboratory and the gear wheel can be obtained for the asking at some local garage. The magnets can be wound at home, although those shown on the machine are sold at all large electrical supply houses.



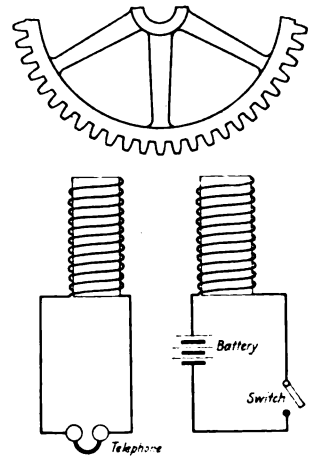
The finished high-frequency alternator

The gear wheel is mounted upon the shaft of the motor. If the hole in the center of the wheel is too large it can be plugged up with a piece of soft brass and drilled out again so that it will fit upon the shaft of the motor. It can be made a tight fit or it can be held to the shaft of the motor with a small set screw. Although the builder should try to make the gear run as truely as possible on the shaft just as a matter of neatness and good workmanship this is not necessary to the working of the device. The size of the gear wheel is not of great importance, but the builder should try to obtain one between the diameters of 2½ and 3 inches. A small battery motor will not drive one beyond this diameter with sufficient speed. Of course, if a larger and more powerful motor is used for this purpose a larger gear can be employed. If the gear is hardened it should be heated to redness and allowed to cool slowly. This process will anneal it and make it more efficient for the use to which it is to be put.

The gear wheel or rotor of the high-frequency alternator should be mounted on the motor shaft so that it revolves over the two magnets which are mounted on the motor base. It should be so mounted that its teeth will come as closely to the poles of the magnets as possible without touching them when it is revolved at high speed.

The connections for the generator are shown in the sketch. When the gear wheel on the shaft of the motor is revolved each one of the teeth on it will act as a pole and these poles will be alternately arranged—one North and the following one will be South. The one magnet of the generator is connected to a direct source of current such as a few dry cells. This sets up a uniform magnetic field and the rotating wheel sets an alternating current in the opposite magnet. This alternating current field will be indicated in a telephone receiver by a hum which will vary in frequency with the speed of the motor. If a rheostat is used in connection with the motor practically any frequency can be obtained. The frequency of the current produced will depend entirely upon the number of teeth in the gear wheel and the speed of the wheel. The intensity of the current will depend upon the winding. The winding of the magnets should be done with very fine wire. No. 28 single cotton covered will be found most suitable. This will produce just about the right E.M.F. in the second circuit which contains the 'phones. The current strength will be very small.

This little machine is an inexpensive experimental device with which many very entertaining experiments can be conducted. Aside from this it can also be used for a very practical purpose in connection with a wireless telegraph outfit. In this work it can be used to replace the conventional buzzer test with which the detector is brought to a



The diagram of connections for the alternator

(*Continued on page* 90)

Digitized by Google

A Few Facts About Patents

An Explanation of Some of the Fundamentals of the Patent Law

THE patent system is the outgrowth of a very odious system of monopolies which were originally granted by the English Crown in the form of an open letter, from which comes our expression "Letters Patent". This was an open letter under the seal of the Crown, conferring the exclusive right to practice some business in the Realm. These monopolies became particularly objectionable during the reign of Queen Elizabeth, and not long after her reign they were abolished. A statute of James I contained a provision against monopolies being granted excepting to those who introduced new manufactures into the Realm, and this theory still survives in England in the patent of importation, or "communication".

In this country the patent law is based on a clause of the Constitution of the United States which gives Congress the right to grant to inventors, for limited periods of time, the exclusive right to enjoy the fruits of their inventions. A patent, therefore, is a Federal thing, that is, a thing of the Federal Government and not of the States. It is a grant of the exclusive right to make, use, and sell a certain invention for a certain period of time. An infringement consists in the making, using, or selling of the thing concerning which the grant was made, by some other person without authority. Patents are granted by the Government of the United States, under the seal of the Patent Office, and, of course, in accordance with the Statutes of the United States, and the Patent Law is a Statute Law. A patent is a creature of these statutes, and can only be considered with reference to them.

In this country an ordinary patent runs from seventeen years from the date of issue, not from the date of filing the application.

The following paragraph is Section 4886 of the Revised Statutes of the United States, as now amended. It is the fundamental basis of our patent law, and is worthy of careful reading, as every word means something.

"Any person who has invented or discovered any new useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceeding had, obtain a patent therefor."

Considering the separate phrases, we have, first—"Any person who has invented or discovered." This means that the application must be made by the inventor; no one else can make it; otherwise it is void. If two persons jointly invent, and one files a sole application, or if two file a joint application, on an invention made by one of them, no valid patent can issue on that application. So the person who furnishes the money, or a mere assignee, cannot make the application—it must be made by the inventor.

Next in the statute are the words: "Any new and useful". Of course a thing must be new, for this is the fundamental idea of a patent.

If a thing is not "useful", no patent should be granted, but on the other hand, a small degree of utility will support a patent. If a thing is really harmful, the patent is void. For example, a device for perpetrating fraud on the public would be void.

There was a case in Connecticut of a patent on a process for producing tobacco in imitation of certain high-grade Cuban tobacco. It was found at one time, that in a certain district in Cuba there was a parasite or fly which by biting the leaves of the tobacco plant caused little white spots to appear, and the public got into the habit of looking for these spots and recognizing them as the mark of the tobacco of this particular district. This man in Connecticut conceived the idea of going out in his tobacco fields and spraying a certain solution on the leaves, and thus reproducing these white spots. He got a patent on this, though with considerable difficulty, as the Patent Office held that it was a fradulent thing.

He stated, however, that this invention made the cigars more free-burning, and on that ground a patent was granted. He prospered in this business for some time, until some other man decided that he would try it also. This brought up litigation, and the judge without hesitation held the patent invalid, resting his decision on the grounds of lack of utility. He said that there was no proof that the cigars really were more free-burning, though he seemed inclined to rest his decision on the broader ground of the essentially fraudulent nature of the business.

What constitutes novelty? "Not known or used by others in this country before his invention or discovery." If used in a foreign country, it does not affect an American patent, unless it can be shown that it is an idea brought home by the inventor, in which case the patent is void. If a man goes abroad and seeing something over there that seems to him meritorious, comes home and patents it, obviously he has not invented it. If, however, a man in this country invents a thing in good faith, the fact that it was used abroad is no bar to the patent, provided the thing was not "patented or described in any printed publication in this or any foreign country before his invention or discovery thereof." This relates to the date of his invention and not to the date of his patent. To grant to a man a patent on a thing that has been described in a printed publication before his discovery of it would be bad practice, because he might have read that publication, and in any event it would not be new, for the world would be in possession of the invention. But if he had invented it in good faith before this publication was issued, he could file his application in this country within two years of that publication; otherwise it would be void.

Referring again to the statute we find the phrase: "Not in public use or on sale in this country for more than two years prior to his application." This means that a man cannot make an invention and allow his device to go into use or to be sold to the public for an indefinite period, and then obtain a patent; he must file his application within two years from the time such public use begins. The question is, what constitutes public use, and this question is a very difficult one.

For example, in the case where a pavement has been laid for six years on a toll road near Boston, it was held not to be in public use. The reason for this decision was that the pavement was held to be experimental, having been put down to determine whether it was serviceable. It was placed in front of a toll-gate, where the horses had to stop and start, and where the work on the pavement was the heaviest. Every few days the inventor would examine the pavement, would discuss it with the men, and find out every detail regarding it. He was held to have been experimenting, but that was an extreme case.

When a man has finished with his invention when he is satisfied the thing is good, although capable of further improvements, then the use becomes public use under the statutes. Ordinarily, when he begins to derive profit, it constitutes public use.

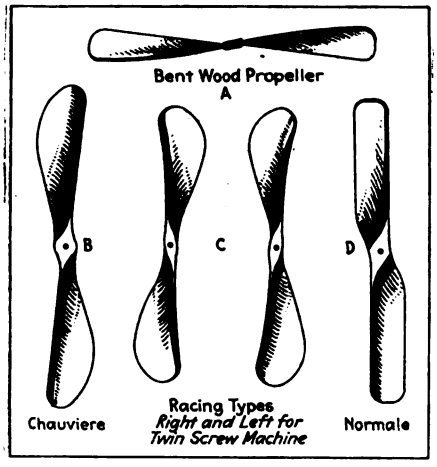
Digitized by Google

How to Make a Small Propeller

By Paul F. Wilber

TO make an air propelled ice boat, wind wagon, canoe, or possibly a light aeroplane to fly with a motorcycle engine; it will be almost necessary to make your own propeller. It will take a very small amount of wood, but some time and patience. If you are successful the first time, you will feel well paid for your work.

There is very much experimenting going on with propellers today, and for



Forms of model propellers

an engineer to design a propeller, figure the different stresses, and estimate what it will do when completed, he will have to use as many different formulae and mathematical rules that would fill a real large text book.

In designing this propeller we will use a lot of guess work, just plain every day figures, and some good common sense. For an example, we will take a propeller seven feet in diameter, six feet pitch, a blade eight inches wide, and a hub four and three-eighths inches thick. After studying this closely you should be able to design a propeller with whatever dimensions you would think best for your needs, and no doubt it will work as good as any propeller you would purchase.

Small propellers can be made of white pine or spruce, but for a motor of fifty horsepower or more, it should be of some heavier wood, as mahogany, walnut, ash or gum. We will use spruce; five boards seven feet long, eight inches wide, and three-fourths of an inch thick.

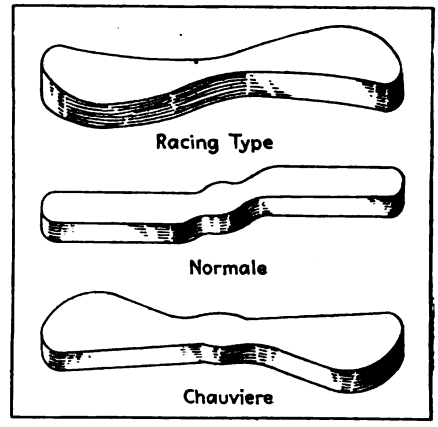
If you have no clamps, Fig. 5 shows how to make seven clamps that will answer the purpose very well. All you need is fourteen pieces of some hard wood, twelve inches long, four inches wide and two inches thick. Bore holes for half inch bolts one inch from the end. Also fourteen carriage bolts eight and one half inches long and a good wrench to draw them down.

The propeller should be glued up in a warm room with hot glue and the clamps screwed down until the glue comes out between all the layers of wood.

After it is glued up as in Fig. 1, lay out the shape as in Fig. 2. This will be called the face side of the propeller. The hub is five inches in diameter. Square a line through the center, down the side, and across the back, to get a center on the edge. Draw the line L through the center. The lines E come to the edge of the hub. The radius H and I to be what ever looks good to the eye. After sawing this out on the band saw, you have a block as in Fig. 3.

Now we will explain the pitch and how it is figured that anyone with a small knowledge of arithmetic can arrive at intelligent conclusions.

The pitch of a propeller is the number of feet or inches it moves ahead in one revolution *without any slip*. In



Blanks for small model propellers

other words, the blades of a propeller, with a pitch of six feet, are placed on such an angle as to screw it through the air six feet in one revolution, providing it was revolving in a solid medium, but as air is yielding there will be slip. A propeller is not efficient unles there is a slip. Too much slip and a propeller would be inefficient and also too little slip and it would also be inefficient. Some air must be

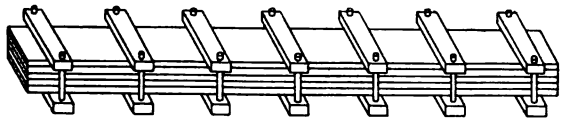
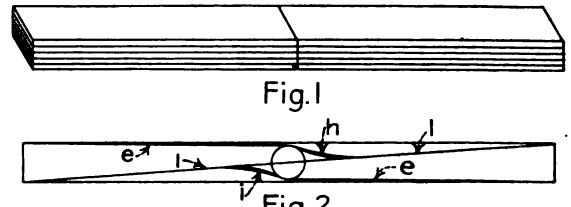
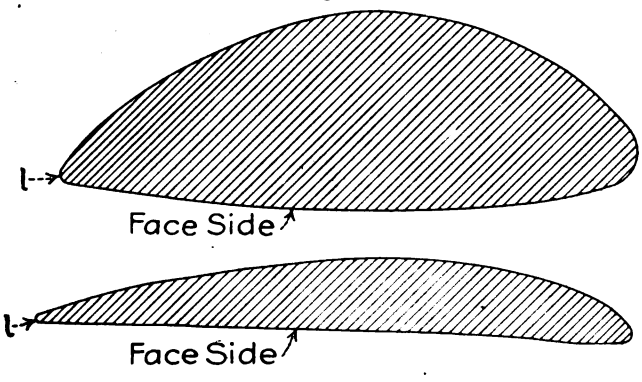
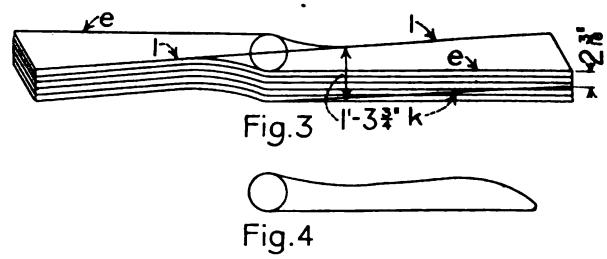


Fig. 5







Diagrams showing steps in constructing small air screw described in accompanying article

Digitized by Google

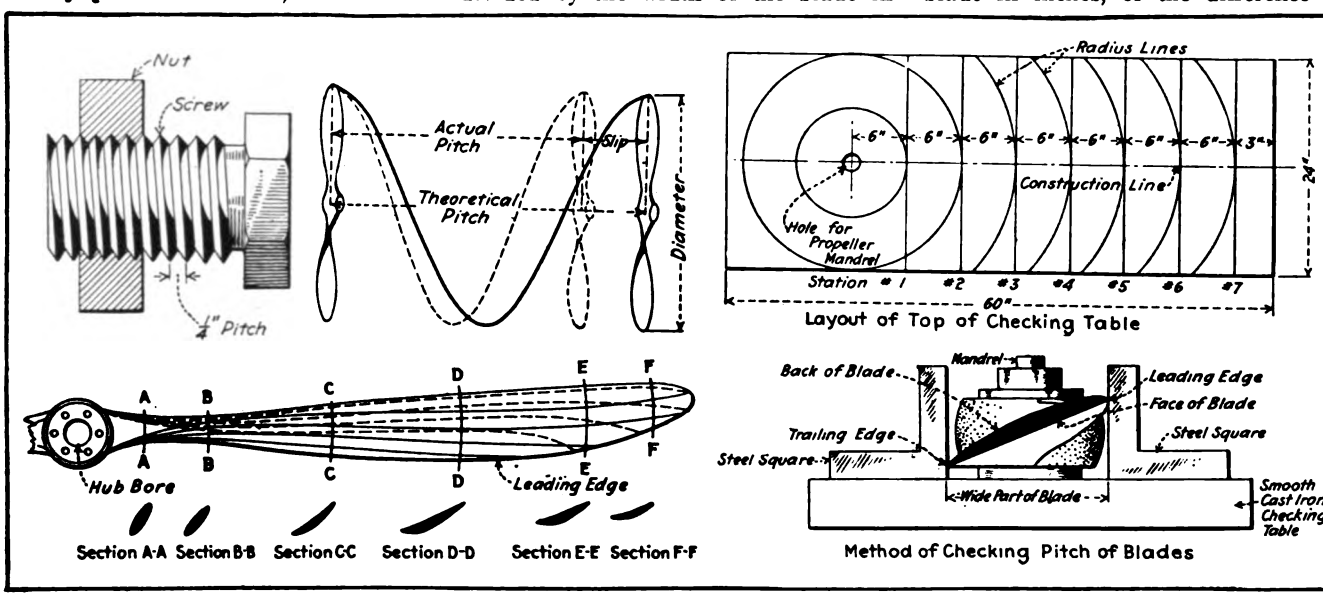
piled up back of the propeller to produce a reaction on the volume of air driven back. A slip of ten to twenty per cent is most efficient, although some propellers are very efficient at twenty-five per cent. Anything over this would be very poor. Therefore, an efficient propeller should have a slip of not more than twenty-five per cent.

The efficiency of a propeller begins to fall off at about fifteen hundred revolutions per minute, some at a lower speed than this; about twelve or thirteen hundred revolutions. Most aerial propellers run at about fourteen hundred revolutions. You should judge your pitch according to the speed of your motor and the speed you expect to make with your machine. A simple formula in plain figures to find the pitch follows:

The diameter in inches, times 3.1416, divided by the width of the blade in inches, times the angle of the blade in inches. This gives the pitch of the propeller in inches, but the next step in making the propeller is to find the angle of the blade in inches. The pitch in our case is six feet.

First multiply the diameter in inches, which is eighty-four, by 3.1416 to get the circumference, which will be two hundred and sixty-four inches. Divide by eight (the width of the blade in inches), which will give thirty-three. The pitch in inches is seventy-two, divided by thirty-three, is two and three-sixteenths. The angle of the blade in inches, or the difference between the leaving edge of the propeller, which is the line L, and the entering edge, which is the line K. Measure two and three-sixteenths inches down from the face side of the block, as in Figure 3, which will be one of the points for the line K, and the entering edge of the propeller when finished.

A propeller should have the same



Diagrams explaining actual and theoretical pitch of propellers, also showing blade sections and layout of checking table

The illustration at the right depicts the method of weighing and balancing the small propellers used for models. The use of a jig saw in cutting out laminated blanks is shown below



After model propeller blanks are roughed out they are worked down to approximate size and blade form with a draw knife and are finished on a small sanding wheel before varnish is applied





Digitized by Google

pitch near the hub as at the end of the blade, but as it does not move as fast at this point as at the end, the angle of the blade will have to be greater, so we will go through the same formula as we used to find the blade angle at the end of the blade to find the blade angle one foot from the hub, making the other point for the line K.

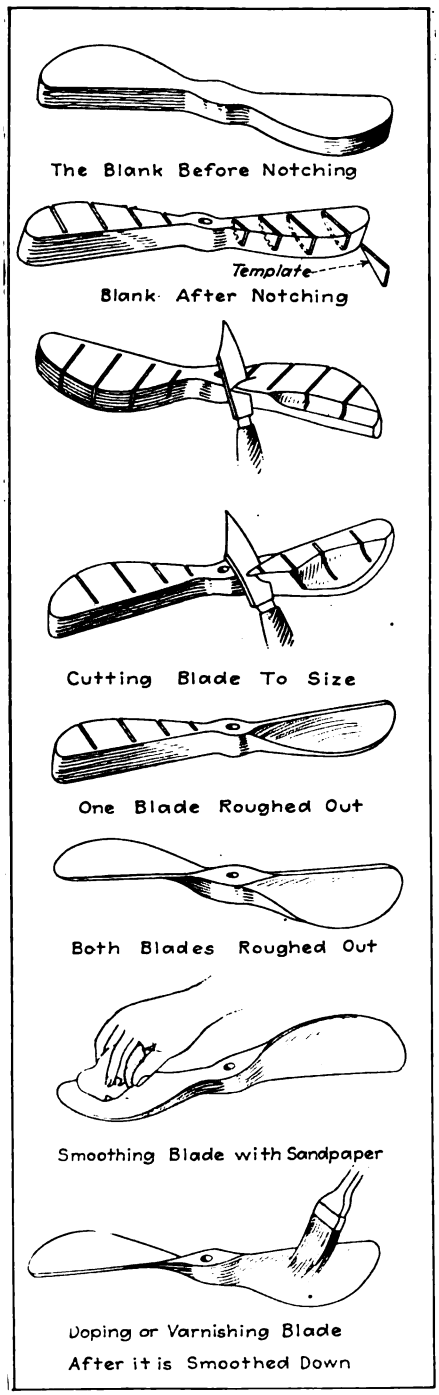


Diagram showing steps in working down small model propeller blank to finished product with ordinary knife

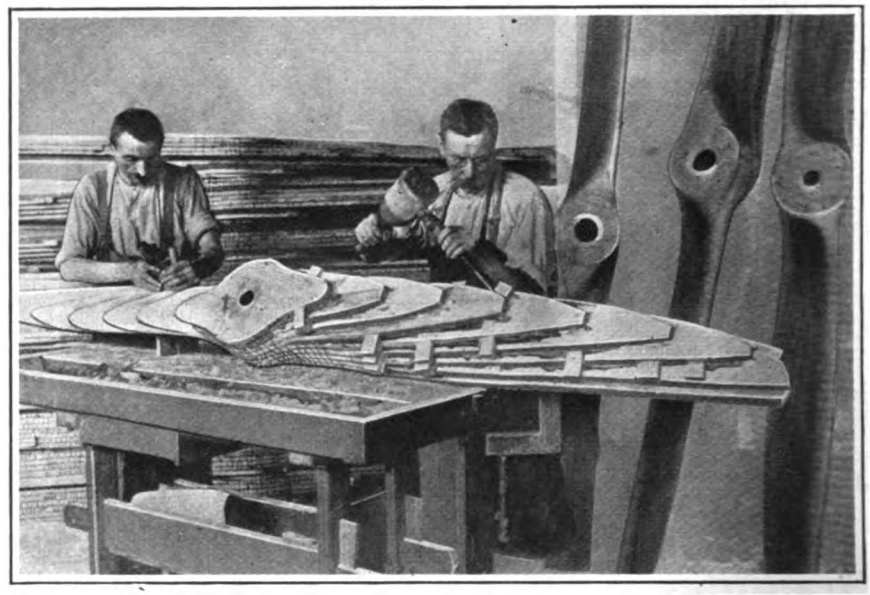
One foot from the center of the hub will be circumference of two feet, or twenty-four inches, times 3.1416 will be seventy-five and one-half inches, divided by the width of the blade at this point, which is four inches, = nineteen. The pitch (seventy-two inches) divided by nineteen = three and three-fourths inches. The angle of the blade in inches at this point.

Measure down the face side one foot from the hub three and three-fourths inches, making the other point for the line K. By laying a straight edge on the two points and drawing a line, will give the pitch line or the line to cut to. Now cut the face side down, cutting from the line L to the line K with a draw knife, gouge, or paring chisel. When nearly to size use a spoke shave or block plane. This side will be the face side or front of the propeller when finished and should be slightly concaved, about an eighth of an inch, but close to the hub it will round out the shape of the hub. Fig. 6 shows a cross section of the blade one foot from the hub and Fig. 7 shows a cross section near the end of the blade.

Make a pattern as in Fig. 4 of some heavy paper; mark the shape out on the finished side of the propeller, afterward cutting the shape out on the band saw.

The back is easy and one is more liable to get it too thick than too thin. By using a pair of calipers and calipering each blade at different places you can get them about the same thickness. Some of the manufactured propellers have a variation of three-sixteenths of an inch.

The entering edge should be rounding, about one-quarter of an inch, but the leaving edge should taper to almost nothing. In shaping the hub, use the eye entirely. It will be very easy, as it tapers off quickly into the blade.



In making large airplane propellers skilled workmen work them the laminated blanks down with plane and chisel

The blades must be balanced, by driving a nail in each center and resting the propeller on two sticks. Take off the back of the blade that is the heaviest.

The whole propeller should be well sanded with first coarse and then fine sandpaper, then given two coats of shellac and one coat of varnish. Be sure and get it on smooth, as two coats on one blade and one on the other will throw it very much out of balance.

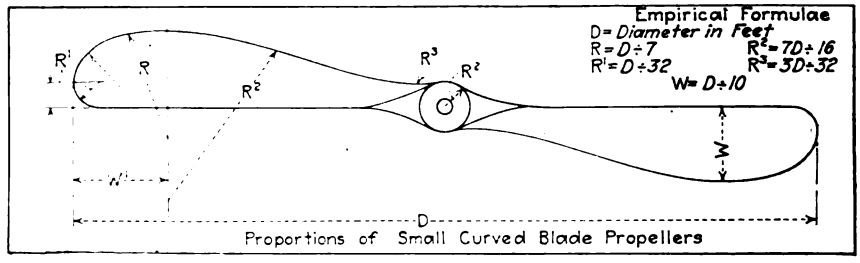


Chart showing empirical formulae for proportions of small propellers

If you use a motor running from fifteen hundred to two thousand revolutions, it should be geared to the propeller, so the propeller will make from one thousand to twelve hundred revolutions.

If the motor is to run one thousand revolutions and the propeller is too large for it, so as to lower the speed of the motor, cut off the ends of the propeller inch by inch until the motor develops its full power.

If the propeller runs ten hundred and fifty revolutions and has five-foot pitch, it will travel 5,250 feet in one minute, less fifteen per cent slip, will be 4,464 feet, or fifty miles per hour.

Digitized by Google

If your machine only makes thirty miles, the propeller has too much pitch and cannot be changed, so make a new propeller and give it less pitch and more blade area.

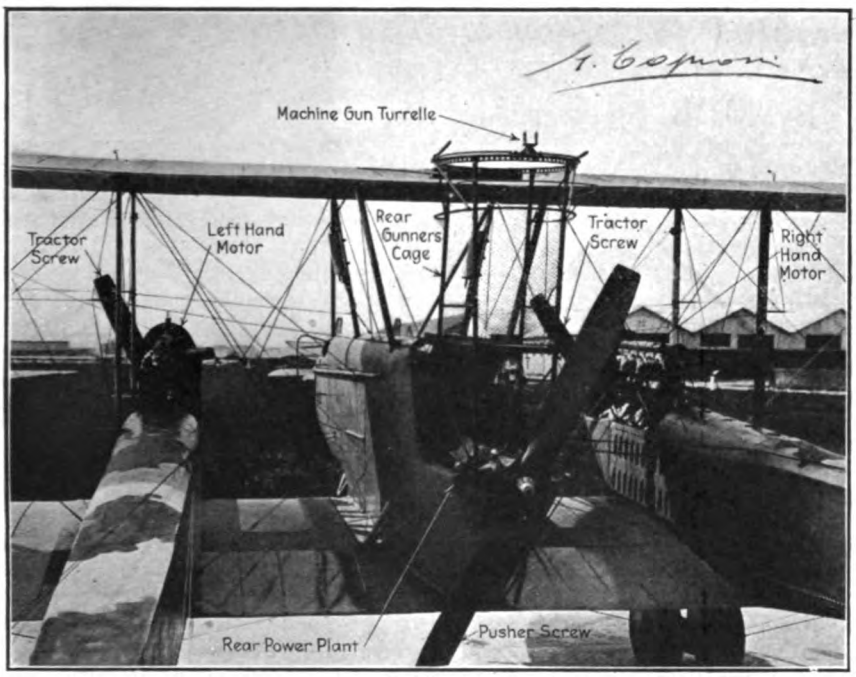
WHAT THE U. S. AIR SERVICE DID

ON the declaration of war the United States had 55 training airplanes, of which 51 were classified as obsolete and the other 4 as obsolescent. When we entered the war the allies made the designs of their planes available to us and before the end of hostilities furnished us from their own manufacture 3,800 planes.

Aviation schools in the United States graduated 8,602 men from elementary courses. More than 5,000 pilots and observers were sent overseas. The total personnel of the Air Service, officers, students and enlisted men, increased from 1,200 at the outbreak of the war to nearly 200,000 at its close.

There were produced in the United States to November 30, 1918 more than 8,000 training planes and more than 16,000 training engines. The DeHaviland-4 observation and daybombing plane was the only plane the United States put into quantity production. Before the armistice was signed, 3,227 had been completed and 1,885 shipped overseas. The plane was successfully used at the front for three months.

The production of the 12-cylinder Liberty engine was America's chief contribution to aviation. Before the armistice 13,574 had been completed, 4,435 shipped to the expeditionary forces, and 1,025 delivered to the allies.



When three motors are used, as in the Caproni design shown, the propellers are preferably placed so one will not be forced to revolve in the slip stream of the others, as indicated

COLLOIDAL FUEL

WITHIN the last year and a half attention of the fuel engineers has been called to a new kind of fuel called colloidal fuel. This fuel consists of a mixture of powdered coal and fuel oil. The making of this colloidal fuel consists of a certain process which keeps the powdered coal in suspension in the oil so that the coal does not settle to the bottom of a tank supplying the furnaces with fuel. Numerous demonstration tests were made, which showed that there is a possibility of using such fuel successfully. However, the writer does not know of any test on a large practical scale showing that success with this fuel has been already attained and it is therefore difficult to foretell what may possibly happen in future along this line. The main advantage of the colloidal fuel seems to lie in the fact that the process would increase the effective supply of the available fuel oil by 40 to 50 per cent. Colloidal fuel appears to have the same advantages in burning as the fuel oil alone.

TO PRESERVE SCREWS

SOME toolmakers and experimenters like to save their small screws, nuts, etc., the common practice being to keep them in small tin boxes where they soon become rusty and unfit for use. A good way to keep such scrap or new screws of various size, is to keep them in small large-neck bottles, each provided with a cork and labelled if desired. In this way one can always see instantly just what they have and how many of each and the pieces never get rusty.

STARTING FROM COLD ON ALCOHOL

THE problem of starting internal combustion engines on alcohol without application of internal heat is said to have been solved by Ralph McKay in experimental work for the Australian Institute of Science and Industry. The compression of the engine was reduced by controlling the admission of air and it was found that the engine fired regularly with initial compression pressures of from 35 down to 25 pounds per square inch. With a leather disk, punctured to allow enough air to be drawn to provide the correct mixture, placed over the air intake on the carburetor a 25 horse-power car was started without difficulty on methylated spirit. It is reported that another engine was started from cold without fail on the first attempt on 70 consecutive mornings.

FRICTION AND ENERGY

THE effect of friction is to convert energy into heat. Small bodies manifest the effect of heat more quickly than large bodies because they are not capable of absorbing the heat generated. The parallel is made of course in reference to the same expenditure of energy in both bodies.

The specific heat of iron is 0.0038 B.t.u. per lb. per °F. rise in temperature or lb. X. deg. X 10.1138 = B.t.u. absorbed, and each B.t.u. equals 778 ft.-lb.; therefore, each pound of iron heated 1° F. has absorbed 0.1138 × 778 = 88.5 ft.-lb. of energy.

The co-efficient of friction means the proportion of the pounds pull (or push) to the pounds (weight) being moved over a given horizontal surface. For instance, wood on wood without lubricant may have a co-efficient of 0.5; that is, it will require a ½-lb. pull to move a pound along slowly. In plain language, the co-efficient of friction represents the ratio of force required to slide a body along a horizontal plane surface to the weight of the body.

Quite an extensive business is done in Birmingham in the renewal of burned out or rejected tungsten lamps. The filament is replaced, the bulb having been previously cleaned of internal stains, and the lamp is restored to a perfect condition. It is all done through a hole in the apex, which hole is only a quarter of an inch in diameter. It is claimed that the renewed lamps last longer than new ones. About fifteen cents are saved on a lamp.

Molybdenum has been used with success as the characteristic element in high speed steel. At first results incident to its use were uncertain, sometimes the steel would be good at other times it would be unsatisfactory. At last it has been found that cobalt acts as a stabilizer to secure an even product.

The following is given as the composition of duralumin. Copper 3.5 to 4 per cent; Magnesium, 0.5 per cent; Manganese, 0.5 to 1 per cent; the rest is aluminum.

Digitized by Google



RADIO
TELEPHONE AND TELEGRAPH APPARATUS



Some Ideas for a Crystal Receiver

New Instruments, Made by the Standardized Panel Method, Combined into a Crystal Receiving Set

By M. B. Sleeper

THE versatility of the standardized panel system of building radio instruments is shown by the set illustrated in detail by the photographs accompanying this article.

In addition to the regular 5- by 5-in. panels, there are four panels 5 by 2½ ins. These save considerable space as well as expense where full size panels are not actually necessary.

The set is of the closely coupled type, designed for wavelengths from 200 to 2,000 meters, the B-C range. Adjustments are made by the three-point inductance switch and the 0.0006 mfd. condenser.

Figs. 1 and 2 show the arrangement of the controls, and the layout of the instruments. Across the top are the galena detector, adjustable telephone condenser, 'phone connectors, and buzzer test. The inductance, tuning condenser, and buzzer practice key are at the bottom. The usual single-slide tuner circuit is used, except that the switch replaces the slider.

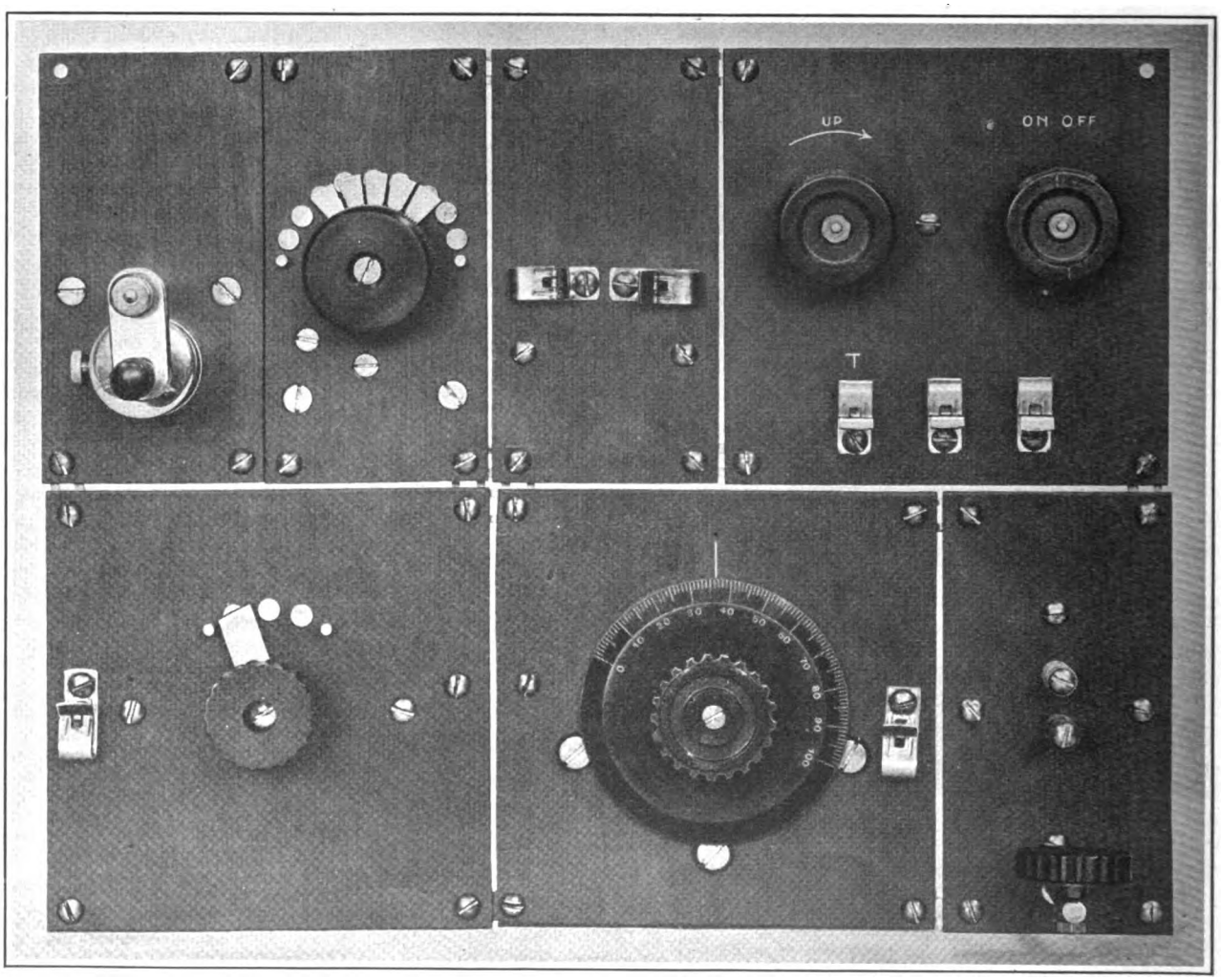


Fig. 1. The instruments assembled, ready to wire

Tuning Inductance

Complete details for the tuning inductance were given in the March issue of Everyday Engineering. It is, in short, a three-bank coil of 3 x 16 No. 38 high frequency cable, with three taps brought out to the switch.

Sufficient overlap is allowed that, with a Short Range antenna, the set will tune as follows:

Tap 1, 179 to 473 meters.
Tap 2, 377 to 997 meters.
Tap 3, 800 to 2,116 meters.

Digitized by Google

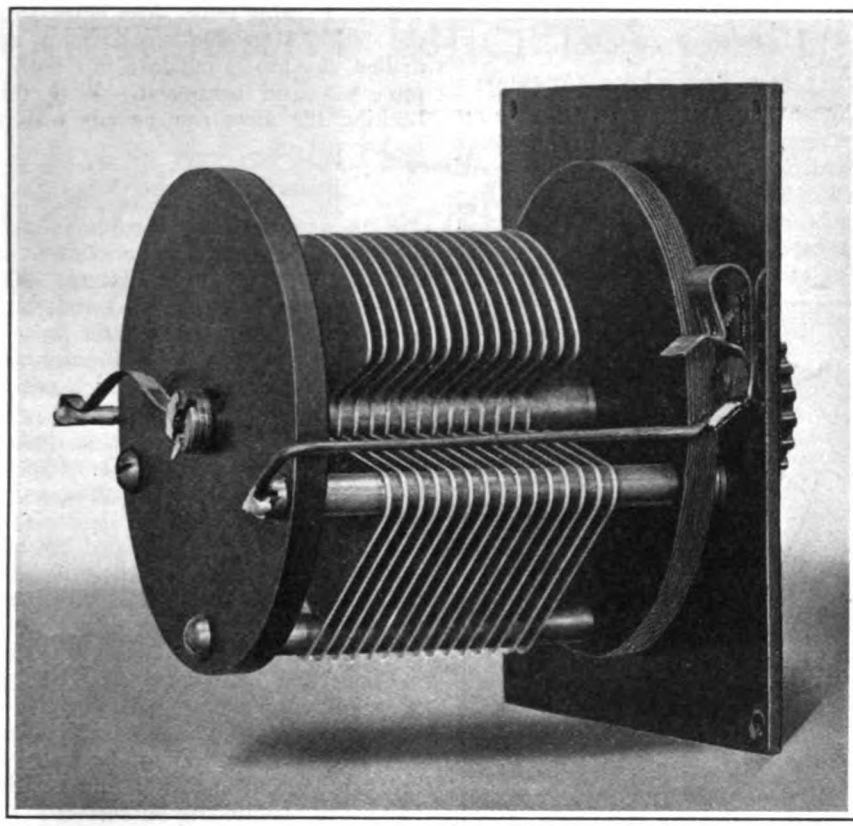


Fig. 3. A close view of the tuning condenser. The method of connecting is shown clearly

If a greater range of wavelength is required, a loading coil may be added to the set.

Loading Coil

To increase the wavelength range of this set or the one described in the March, 1920, issue, the panels must be changed around. The buzzer might be left out, or the key and telephone connection panel removed and replaced by a 5- by 5-in. panel to carry a loading coil. This is not shown, but the construction is simple.

The coil to be described will include the D range, giving a latitude of 200 to 6,000 meters. A tube 3½ ins. in diameter and 6 ins. long is needed. The winding is of three banks of 10 No. 38 high frequency cable, a size which is more economical of space than the heavy cable, and gives much better results than solid wire. Moreover, at the lower frequencies, the 10 No. 38 is practically as good as the other.

The winding is started ⅜ in. from one end of the tube, and is continued for 1.7 ins., in which space there should be 230 turns, allowing 45 turns per inch of this wire. The inductance at this point will be 5,200,000 cms. Then more wire is put on until the coil is 4.5 ins. long, giving a total of 607

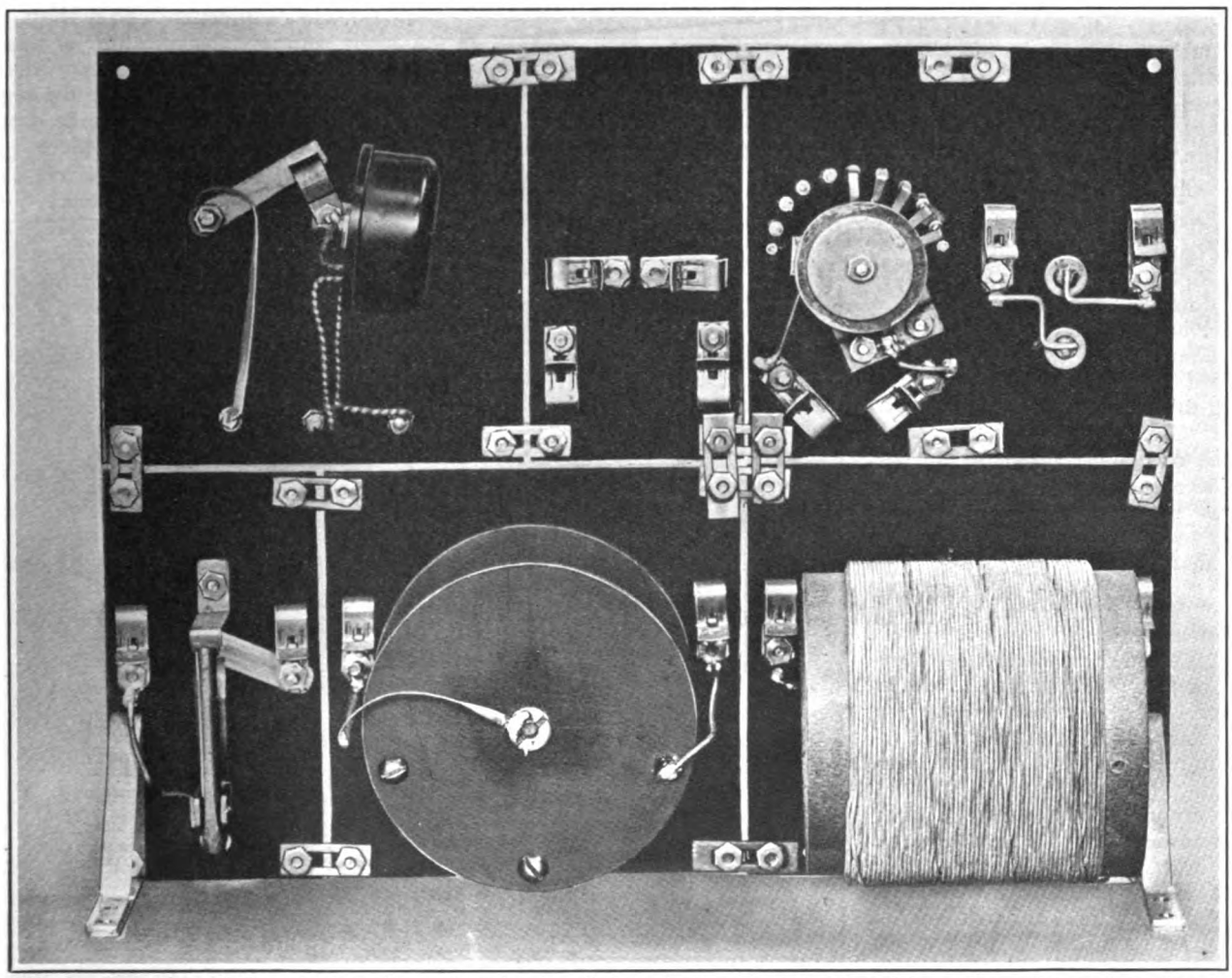


Fig. 2. Rear view of the crystal receiver. Attention is called to the buzzer, mounted at right angles to the panel, so that the vibrator contact screw can be adjusted from the front

Digitized by Google

turns. If these dimensions are adhered to closely, the inductance of the entire coil will be 18,200,000 cms.

Three points are needed on the switch that controls this coil. When connected in series with the other, the wavelength ranges are:

Tap 1, coil cut out.
Tap 2, 1,577 to 4,172 meters
Tap 3, 2,665 to 7,052 meters.

Sufficient space is allowed at the end of the tube that it can be mounted on legs, with the axis of the coil perpendicular to the panel. This makes the coils at right angles, so that there is no mutual inductance between them.

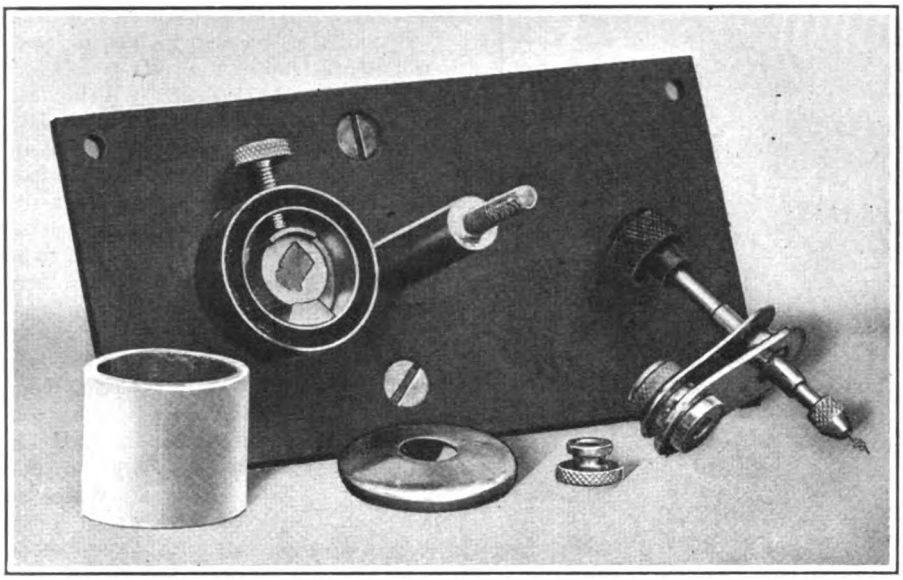


Fig. 4. A disassembled view of the crystal detector, showing the cup construction and universal joint

Tuning Condenser

This instrument was described in the last issue. It is made up of a G. A. Standardized condenser, 0.00001 to 0.0006 mfd. The condenser was mounted by removing the three screws which hold the upper bakelite plate to the fixed plates, and putting them through the front panel, as is shown in Fig. 3. Two washers on each screw hold the condenser end plate and the panel a slight distance apart. The previous issue explained the method used to secure the A. H. Corwin dial to the shaft.

Galena Detector

The detector, shown disassembled in Fig. 4, is from the Wireless Improvement Company. This type, so widely used on Government equipment, provides protection against dust, and allows a universal adjustment of the contact point.

The crystal cup carries a thumbscrew and clamping piece by means of which the crystal is held in place and contact is established. Around the edge of the cup, there is a felt ring, on which the glass tube fits tightly. When the thumbscrew is turned down on the upright post, the arm which carries the contact presses down on the cover at the top of the glass tube.

Adjustable Telephone Condenser

Fig. 5 shows the telephone shunt condenser. This is of the Dubilier mica construction, supplied by the Pacent Electric Company. It is made in five steps, each of 0.0001 mfd., giving a total capacity of 0.0005 mfd.

The condenser comes all mounted on a brass piece which is secured to the panel by a 6-32 machine screw. Although nine switch points are on the panel, only five are connected with the condenser. The other four are put in to carry over the fan switch.

No. 24 spring brass sheet is used for the fan. After the small holes are drilled, the fan is put in a vise with a piece of wood behind it. With this backing the slots can be cut with a backscrew.

Buzzer Practice Key

Rather unusual construction is used for the key, although its simplicity should appeal to experimenters. The key lever is of ¼ in. brass rod, bent as shown in Fig. 6. At the rear a U-shaped piece of ⅜ by 1/16 in. brass strip carries a ⅛ in. rod which passes through the lever.

Underneath the U piece is put a No. 24 sheet brass spring, bent so as to come over a tension adjusting screw threaded into the panel.

The movement is regulated by another screw against which the lever strikes when the key knob is pressed. Movement in the other direction is stopped by a brass strip bent at the end.

Connections are taken from the U piece and from a brass strip into which the upper adjusting screw is threaded.

While this key cannot be used to break heavy currents, it is quite satisfactory to operate the buzzer test.

Buzzer Test

This panel has been illustrated before, in conjunction with a short wave set. An excellent feature of the instrument is that the shaft of the left hand knob is threaded into the regular contact adjusting screw. A drop of solder holds the rod in place. The

(*Concluded on page* 67)

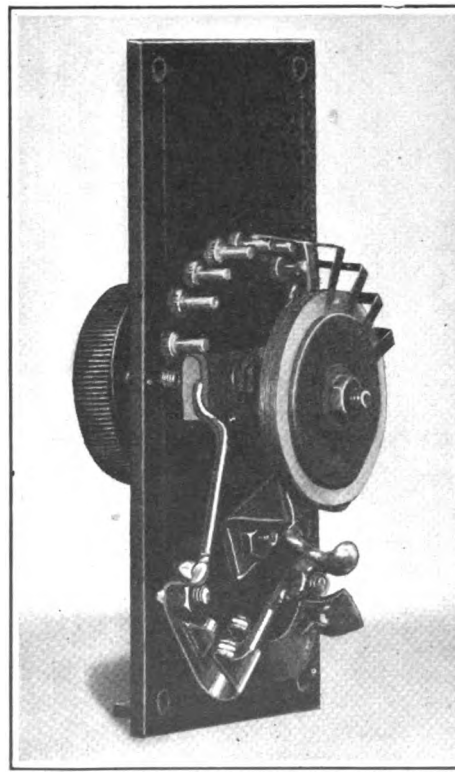


Fig. 5. The condenser is made of discs of mica and copper foil

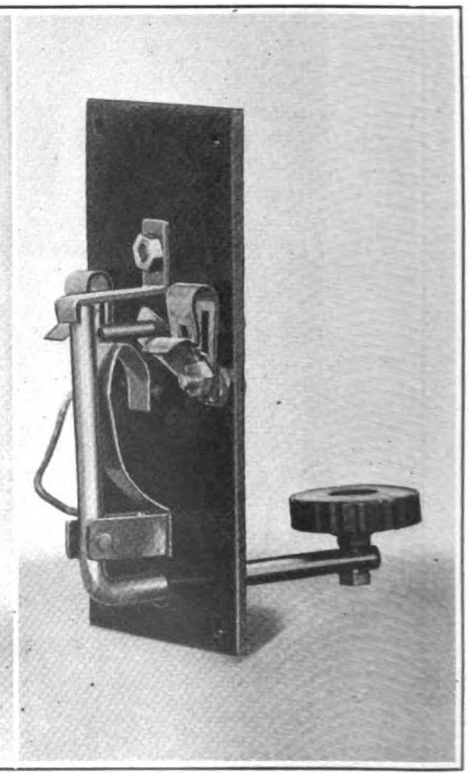


Fig. 6. Both the tension and stopping screws can be seen in this view

Digitized by Google

Comparative Efficiency of High and Low Spark Frequencies

Actual data obtained on tests, and an explanation of the results

IN the March issue of EVERYDAY ENGINEERING, mention was made of the current discussion of high and low spark frequencies, and their relation to transmitting ranges.

Very interesting light has been thrown upon the subject by Mr. C. F. Cairns, Chief Engineer of the Acme Apparatus Company, who supplied that data presented in this article.

Many of the "long distance" experimenters have discovered that, by lowering their spark frequencies, that is, slowing down their rotary gaps, their signals were heard over greater distances. The natural conclusion was that, with greater energy per wave train, longer distances could be covered.

As is shown in the following paragraphs, however, there are a number of effects to consider.

The usual, and one might say old fashioned, type of amateur radio transformer is known as the loose coupled resonant type which, when used with a particular condenser value and at a given frequency, produces a secondary voltage on open circuit greater than given by multiplying the primary voltage by the ratio of transformation. This phenomenon is known as resonance rise, and is due to a considerable leakage inductance, in the transformer, being balanced by a small condenser across the secondary terminals, and is specifically the production of a large series of forces by the application of a small series of forces at the correct time intervals.

A mechanical analogy of this phenomenon is the well known stunt that many of us have tried, namely, standing on the back platform of the street car whose wheels are in the middle, and by bringing our weight to bear at the proper time intervals get the car oscillating with the hopes of removing it from its beaten path. We found that the forces which we applied in this way were cumulative and that after a time the oscillations of the car were of such magnitude as to attract the attention of the conductor and give the motorman a ride in a different plane than was his custom.

Nevertheless, it took time to bring about the large forces which had to be built up to make the car oscillate at such amplitude. Just so in an electrical circuit, such as a radio transformer with a suitable condenser for resonance, the voltage on the condenser does not reach its final large value on immediate closure of the primary switch, but takes a definite time, and may under certain conditions take more than 1/120th of a second or the time of ½ cycle of the usual 60 cycle source of current. This phase of resonance phenomenon is known as transient effect and has been dealth with, for all circuits, by Steinmetz.

When operating a resonance type of radio transformer with a rotary spark gap, the condenser is periodically charged and discharged and the amount of energy drawn from the line is

$0.5\ CV^2N$, plus the losses in the transformer,

where C=capacity in mfds.
V=voltage in kilovolts.
N=frequency in cycles.

With high spark frequencies and the resonance type of transformer, the transient effect is of such magnitude that the voltage on the condenser does not have a chance to rise before the spark gap discharges the condenser and although the value of N is large, the voltage is consequently small. Therefore, with the resonance type of transformer, a *slower* gap speed produces better results as *more time is allowed for the condenser voltage to rise* before the rotary gap discharges the condenser, and more power is drawn from the line.

The reason, therefore, that the above mentioned amateurs got their signals further was not due to the low spark frequencies, but *because they were putting more power into the transformer and antenna.* If low spark frequencies were more efficient, 500 cycle sets would not be used so widely.

As further evidence of the efficiency of the higher gap speeds, it is a well known fact that the human ear is most sensitive to frequencies in the neighborhood of 1000 cycles per second and also that audio tuning is sharper at this frequency than at lower ones.

Recognizing these facts, the Acme Apparatus Company has designed their radio transformers to draw their rated power when used with a rotary gap operating at from 700 to 800 sparks per second. These transformers are reasonably close coupled and do not depend for their secondary voltage on the phenomenon of resonance. The transient effect is small and the condenser can therefore become sufficiently charged during the interval between gap discharges, although they occur at the rapid rate of 700 to 800 times per second.

As evidence of this fact the 1 k.w. Acme transformer has a rating of 15,000 R.M.S. over 20,000 peak voltage, and, when used with condensers of 20,000 volt rating, breaks them down, showing that even with high gap speeds the voltage gets on the condenser. With an Acme transformer, the power input is reduced with a reduction in gap speed as one would expect from the formula $0.5\ CV^2N$, when C and V remain the same and N is decreased.

It now rests with some interested amateur to get voltmeter, ammeter and wattmeter in the primary circuit of a resonance type of transformer, and then a non resonance type, and measure the radiation in amperes in the antenna at different gas speeds. At the same time an observer should be at a receiving station with an audibility meter or shunt box to measure the strength of the received signals under the different conditions.

Such tests would undoubtedly show that with the same watts input, the higher spark frequencies will carry much further than the low, not because of the medium or the amplifier, but because the human ear is affected more by the given amount of energy at 700 to 800 cycles than at 200 to 300 cycles.

Some recent experiments on ¼ KW Acme close coupled transformer and a ¼ KVA resonance type of transformer, of a well known make, showed the following results at 110 volts, 60 cycles, with a condenser of .007 mfd. and a rotary gap running at 800 sparks per second, on the usual operating conditions of an amateur station:

	Primary Current	*Watts Input*	*Secondary Current*	*Secondary R.M.S. Voltage*	*Power Factor*	*Efficiency*	*Watts Delivered*
Open Circuit							
ACME (close coupled)	1.00	50	.020	5875			
——— (resonance) ...	.52	60	.032	8860	(gap removed)		
Operating Condition							
ACME (close coupled)	2.55	275	.047	4830	.930	82%	226
——— (resonance) ...	3.45	215	.040	3450	.537	64.2%	138

The above figures bear out the facts given in this article. It will be noted that the amount of energy delivered by each transformer is:

ACME (close coupled) .047x4830=227 watts
——— (resonance) .040x3450=138 watts

If we take $0.5\ CV^2N$ for each transformer, it is not proper to use the secondary voltage as given either R.M.S. or peak, as the voltmeter integrates

Digitized by Google

the various values over a given time. During spark discharges the voltmeter is partially short circuited and between spark discharges its voltage should rise to that given on condenser load. Therefore, it can be seen that as the duration of partial short circuit is practically the same in both cases, the integrated value of the voltage in the case of the Acme shows that between gap discharges the voltage on the condenser is high and in the case of the resonance transformer is held down by the transient effect.

Using Concentrated Inductances

Methods for Mounting and Special Applications of the Coils

THERE are two types of concentrated inductances in use, one the De Forest plug-mounted type, and the other, unmounted. Both offer disadvantages to the man who makes his own instruments because the former must be used in a plug receptacle, while the other is not provided with any sort of mounting facilities.

A very efficient and good looking mounting for the plain coils is shown here. The three coils constitute the primary, secondary, and tickler, looking from right to left. A small wooden core is fitted in each coil, and drilled to take two 3/16-in. brass rods. The wires from the coils are connected to screws in the cores, from which flexible leads run to binding posts on the base.

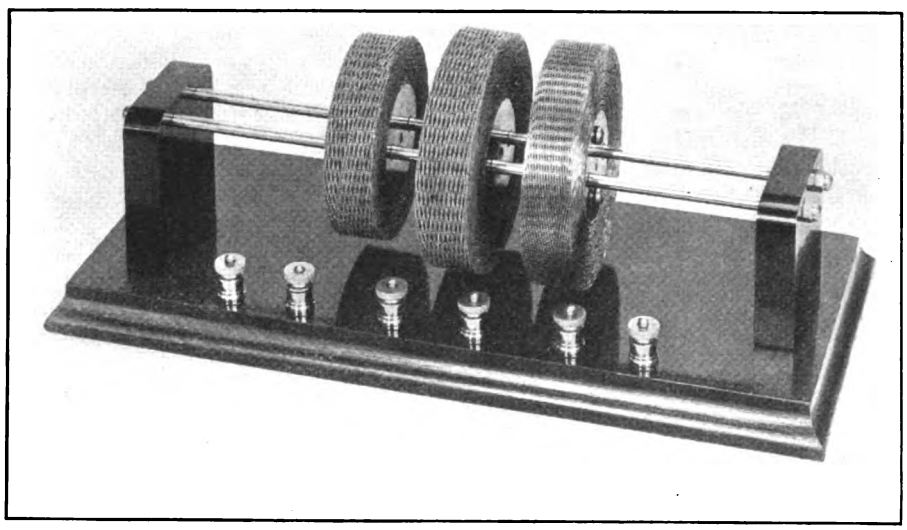
One of the best methods is to have a three-coil mounting to furnish primary-secondary and tickler coupling, and additional loading coils mounted as shown below:

SEC., 100 mh. PRI., 11 mh. PRI., 20 mh. PRI., 40 mh. PRI., 100 mh.

The coupling coils should be arranged like this:

PRI., 4.5 mh. SEC., 11 mh. TIC., 4.5 mh.

With 0.001 mfd. maximum condensers in both primary and secondary



A Radisco mounting for concentrated inductances

In operation, the secondary coil is left at the center, and the tickler coupling and primary-secondary coupling are varied by moving the outer coils.

For a long wave tuner, using a set of coils such as is supplied by the Atlantic Radio Company, this type of instrument is very good. The disadvantage is that the coils cannot be changed for tuning to short waves.

The A. T. Hovey Company gets around this by having a rod supported at only one end, so that coils can be slipped on or off quickly. Even these, however, it is necessary to change connections.

Of course, with the De Forest three-coil mounting, coils can be plugged in very quickly, but that is not as good as a simple switch.

circuits, in shunt, the wavelength range, using a Long Range Antenna of 0.0004 mfd., will be:

PRIMARY

L	λ
4.5 mh.	2,850 to 4,750 meters
11.0 mh.	4,400 to 7,450 meters
20.0 mh.	6,000 to 10,000 meters
40.0 mh.	8,400 to 14,200 meters
100.0 mh.	13,400 to 22,400 meters

SECONDARY

L	λ
11.0 mh.	2,000 to 6,300 meters
100.0 mh.	6,000 to 19,000 meters

These values were obtained by considering the condenser capacity as 0.0001 to 0.001 mfd. As a matter of fact, most condensers go both lower and higher than these values, giving an overlap of wavelengths sufficient to compensate for small variations in antenna capacity above or below 0.0004 mfd., the figure used to obtain the ranges given in the table.

An oscillating circuit is often useful, particularly for an undamped wave receiver. The simplest type is that using a coil tapped at the center. In the case of the concentrated inductances, where no taps are provided, it is best to mount two coils so that one can be moved toward or away from the other. The windings must be in the same direction, as if they were a single coil.

Then one end of one coil goes to the grid, the point at which the coils are connected together runs to the filament, and the other end of the second coil to the B battery and on to the plate. A 0.001 mfd. variable condenser is put across the grid and plate leads from the coils. To facilitate coupling, a small coil should be connected in series with the others, and mounted in place of the tickler coil.

Then an ordinary damped wave circuit is employed at the receiver. The oscillations in the coupled coil produce beats with the undamped waves.

For this purpose, an 11 mh. coil should be used for coupling, and two 40 mh. coils for the main inductance. They give a wavelength range of 6,000 to 20,000 meters.

A complete circuit for this type of oscillator was given on page 104 of the November-December, 1919, issue.

INDUCTANCE STANDARDS

MANY times the experimenter needs coils of given inductances Here is a table showing the length and turns for different coils, all wound with No. 28 single silk covered wire. If made carefully, the inductance values will be accurate within 5 per cent.

Coils 3 ins. in Diameter

L cms.	*Total No. of turns*	*Length of Coil in ins.*
50,000	18	0.28
100,000	27	0.42
200,000	42	0.64
300,000	53	0.82
400,000	64	0.98
500,000	73	1.13
600,000	83	1.27
700,000	92	1.42
800,000	101	1.55
900,000	110	1.70
1,000,000	119	1.83

Coils 5 ins. in Diameter

500,000	47	0.73
1,000,000	72	1.10
1,500,000	94	1.44
2,000,000	113	1.74
2,500,000	130	2.00
3,000,000	147	2.26
3,500,000	164	2.52
4,000,000	180	2.76
4,500,000	195	3.00
5,000,000	210	3.24

Remember that 1,000,000 cms. equals one 1 millihenry.

Digitized by Google

A Long Wave Receiver

The Grebe Regenerative Set for 500 to 20,000 Meters

THE CR-7 set from the A. H. Grebe Company is one of a very few long wave receivers which have been offered to radio experimenters. In fact, long wave sets have not been prominent in the great number of new radio catalogs, principally because, with the long single-layer inductances tabooed, the problems of large inductance in small space have not been solved satisfactorily by many companies.

Electrical circuits and mechanical design have been carried out on the CR-7 set in a way which will meet the unqualified approval of the most exacting experimenter. The design of the primary and secondary inductances, described farther on, is an unusually clever piece of work, representing an amount of thought seldom shown by other apparatus.

Fig. 1 illustrates the bakelite panel, 12 by 21¼ ins., with the various controls. An oak cabinet carries the panel on which all the instruments are mounted. A hinged cover permits the examination of the set.

Across the top, from left to right, are the primary-secondary coupling, primary inductance switch, opening for the insertion of the audion bulb, secondary inductance switch, and tickler coupling, while at the bottom are the primary condenser, antenna compensating inductance switch, rheostat, bridging condenser, secondary condenser, and telephone jack.

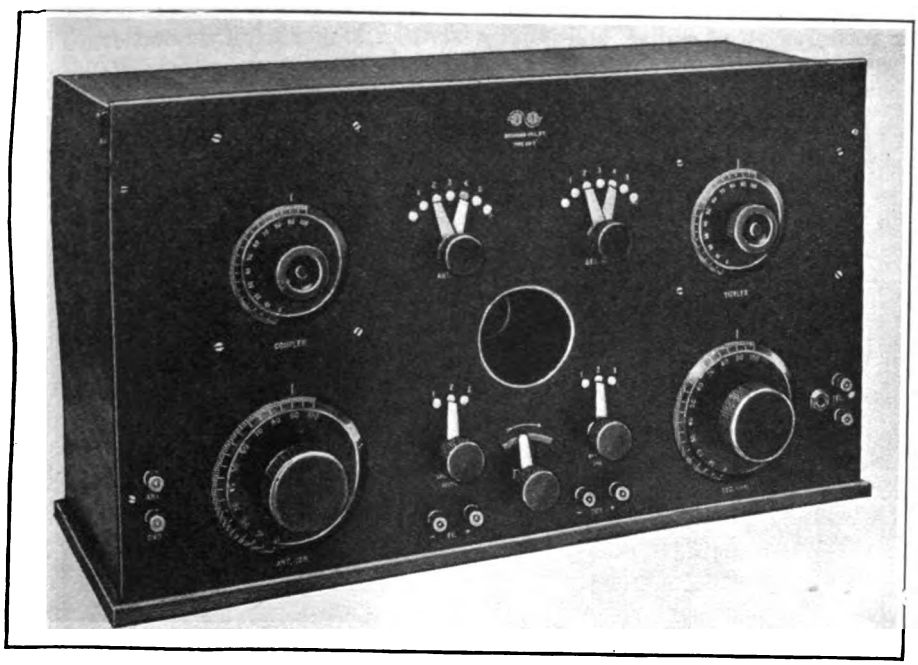


Fig. 1. The arrangement of the controls makes possible very rapid adjustment

In the rear view, Fig. 2, the primary condenser and inductance are at the right hand end of the panel. The tube at the center carries the audion socket. Dust is, in this way, kept out of the set.

Three small bridging condensers are located at the left of the socket tube, any one of which can be cut in by the three-point switch.

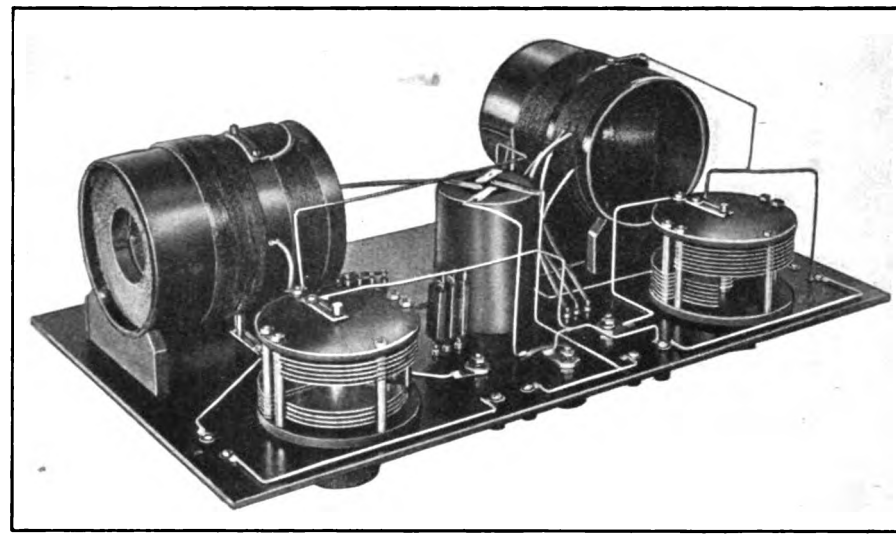


Fig. 2. The wiring of this set is a prominent feature

Primary Inductances

Fig. 3 shows, in the primary circuit, four concentrated inductances and a divided tubular coil wound with two banks of high frequency cable. The appearance of the assembled coils can be seen in Fig. 2.

The concentrated coils, instead of having the same inside diameters, have the same outside diameters, so that they fit snugly inside a tube on the end of which are the divided coils. The purpose of dividing the coils is to allow for the shaft of the secondary coupling coil.

The end section of the banked coil is tapped at three points, and is used to compensate for variations in the capacities of different antennas. By setting this switch at the proper point, determined experimentally, corresponding adjustments of the primary and secondary condensers and inductances give very nearly the same wavelengths in both circuits.

Two contacts, are employed on the inductance switch to short circuit the two sections ahead of the last one in use, a method of cutting down dead-end losses which is quite effective.

Primary Condenser

A 26-plate balanced condenser, having a maximum capacity of 0.0008 mfd., is connected in series with the ground. The method of establishing connection to the rotating plates is interesting. A short strip of brass, drilled and slotted at one end, clamps the end of the shaft tightly enough to give a low resistance contact.

Secondary Inductances

Fig. 2 shows clearly the coil assembly, similar to that of the primary. It is mounted at right angles to the other, to prevent any coupling effect. Here the tickler coil is mounted at the end of the tube. One part of the tickler is wound on the tube, and the other on the variometer ball. The coupling from the straight part of the tickler is

Digitized by Google

not great enough, however, to cause any noticeable feed-back effect when the adjustable section is at 0.

Secondary Coupling Coil

In Fig. 3 this coil is marked COUP. It can be seen at the end of the primary coils. The ends of the coil are soldered to the shaft, which is made in two pieces. Slotted brass strips are fastened to the tube and one to the panel, clamp on the shafts and make connections. These can be seen more readily on the tickler coil.

Secondary Condenser.

An 18-plate balanced condenser is provided for tuning the secondary circuit. At maximum, the capacity is 0.0004 mfd. Tuning is made sharper when a small condenser is employed in the secondary circuit.

Fig. 4 shows the wavelength of the secondary circuit at various settings. These curves are approximately correct for the primary circuit when the compensating coil is adjusted according to the antenna capacity.

Dial Setting	*Reception*
0	Damped waves (not amplified).
0–40	Damped waves (amplified by regeneration).
40–100	Undamped waves (set oscillating locally).

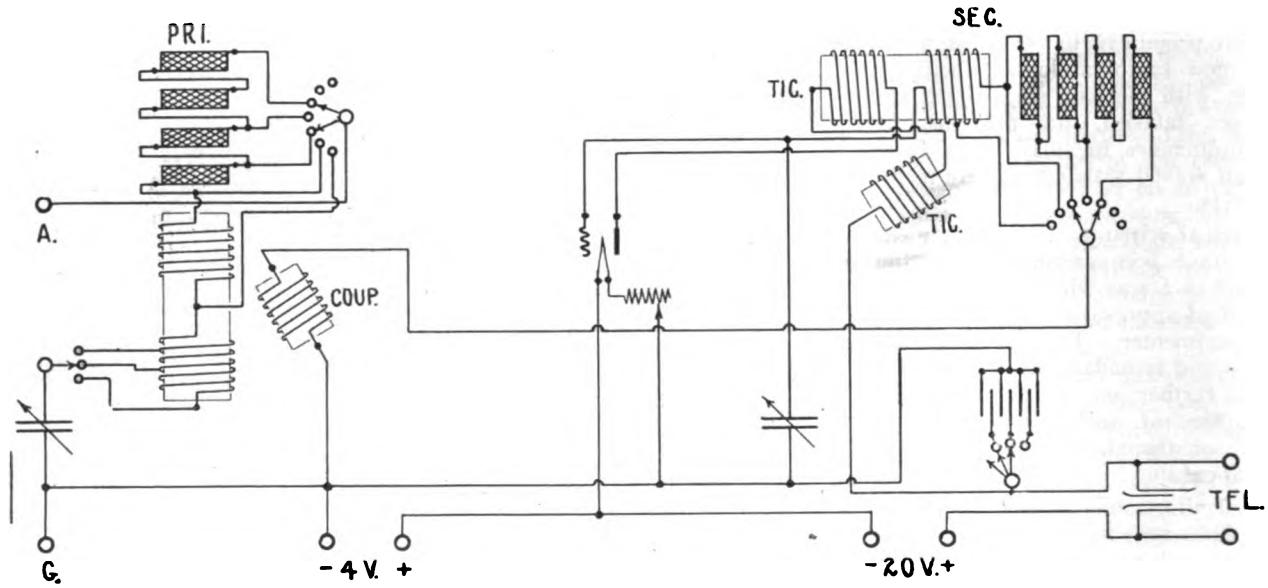


Fig. 3. Circuit for the Grebe CR-7 receiver

Tickler Coil

Energy from the plate circuit is fed back to the grid by means of a tickler coil. This method gives the best control, particularly on a long wave set.

At 0 coupling, spark stations come in the usual manner. As the coupling is increased, regenerative and finally oscillating effects occur. The table above shows the dial settings.

Audion Circuits

No grid leak or condenser is used with this set, as provision is made for a constant negative grid potential. Particularly on undamped waves, this is an advantage, as reception is better without a grid condenser.

Fig. 3 shows the connections of the by-pass condenser which shunts the telephones and batteries. The adjust-

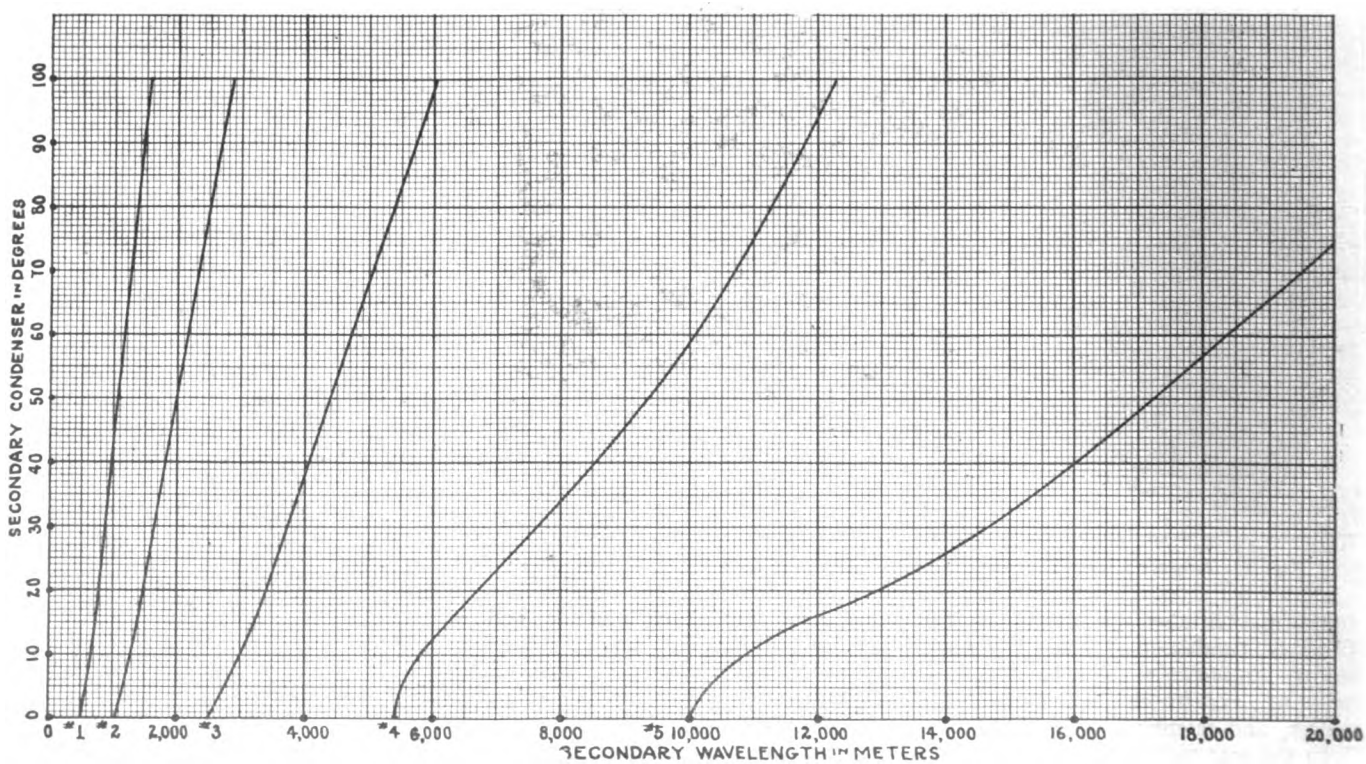


Fig. 4. Wavelength calibration for the secondary circuit. The numbers refer to the points on the secondary inductance switch

Digitized by Google

ment of this condenser has quite an appreciable effect on long wave signals.

A 4-volt battery is required for the audion filament, and a 20- or 22.5-volt battery for the plate.

Operation

The CR-7 is extremely simple to operate and, as the elements are all connected with heavy bus wire, the circuits are easy to follow.

To tune to a given wavelength, consult the wavelength curve and set the secondary condenser and switch to the positions corresponding to the desired wavelength. Next adjust the primary circuit to the same settings, making final adjustment for maximum signal strength when the signals are received.

For regeneration or amplification of spark signals, the tickler dial is turned towards the 100 mark until the signals have increased to the maximum, just below the point where a mushy and distorted note is obtained; for continuous wave reception, the tickler is increased to the oscillating point, and the proper beat obtained by adjustment of either the primary or secondary condensers.

RAVENSWOOD RADIO ASSOCIATION

THE Ravenswood Radio Association which, up to the present time, has restricted its membership to commercial licensed men only, has now formed a Junior Division which makes no restrictions on the applicants other than that they be sufficiently interested in radio and be of such character as to meet with the approval of the Board of Directors.

The Senior Division of this association, consisting of twenty-two commercial licensed operators, will without a doubt prove a great benefit to the junior members, and the valuable discussions and talks given at the weekly meetings will go a long way toward raising the standard of the radio amateurs and the elimination of local interference. It will also mean the promotion of good fellowship among the amateurs, an issue of vital importance to the systematic handling of amateur radio traffic.

A very reasonable fee is assessed the Junior Members and a membership certificate has been issued of which any radio men may be proud.

Further information may be obtained by either calling or writing the Secretary, Mr. N. E. Wunderlich, 4533 No. Sawyer Avenue, Chicago, Ill.

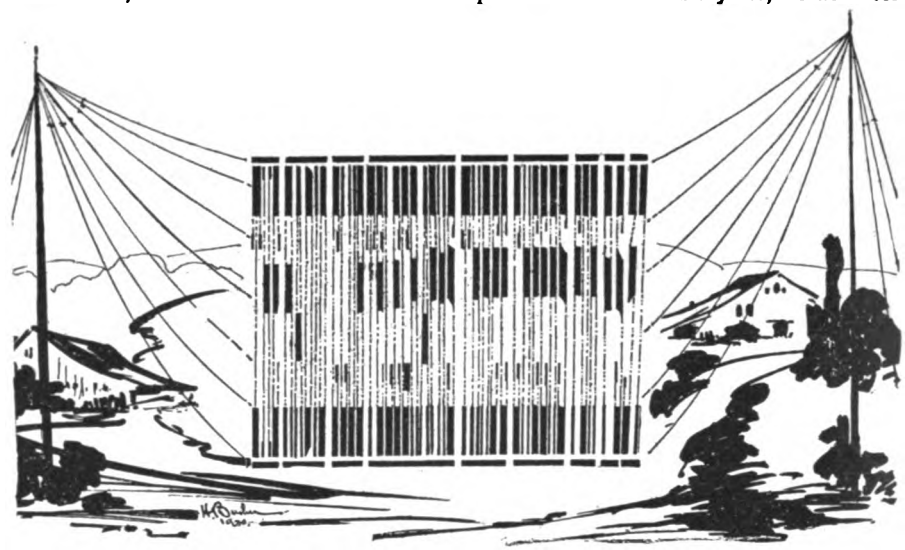
THE ARMOUR VILLA RADIO ASSOCIATION

THE Armour Villa Radio Association now has a code practice table and code practice is held every Friday evening. At every other meeting we are reading one part of an elementary course in radio telegraphy.

Last December we received a charter from the American Radio Relay League, and are now an affiliated association. We are trying out a new idea for QRM control. We offered to tune every amateur's transmitter, whether a member or not, free of charge. This is done by a Technical Committee member, and when he goes to the station he gives the owner a few points about unnecessary sending and proper operation of a transmitter, that is, on the communication part.

If an amateur persists in using a directly connected transmitter we shall notify the Radio Inspector. Clubs should not feel that they are unsportsmanlike when they do this. If a station after repeated warnings still continues to use a directly connected transmitter it is for the good of amateur radio that this station be shut down.

All communications should be addressed to Walter Remy, Secretary, Bronxville, N. Y.



Can you read this message from P. S. 37?

AN IDEA FOR RADIO CLUBS

THE members of the Radio Club of Public School 37 Bronx, N. Y., are selling post cards, bearing the design reproduced here, to raise money for apparatus.

By holding the magazine in the correct position, the reader will find a message, clearly readable, from P. S. 37. This message may be hard to find, but, looking at it from the correct angle, it is perfectly plain.

The postal was sent in by Dr. Herman V. Bucher, formerly Commissioner of Education in Argentina, and one of the most enthusiastic promoters of experimental radio work in the country.

LOST

INFORMATION is wanted concerning the whereabouts of Harold C. Sever, 9DN, of Valpariso, Ind., who left home for Chicago, Ill., Feb. 17, 1920, to test out some wireless apparatus, intending to return on a midnight train, and has not been heard from since.

He is 5 feet 6 inches tall, brown hair, blue eyes, weight 130 pounds, thumbs slightly crooked. Left in civilian clothes; mixed grey suit; dark gray overcoat; American Legion pin in coat lapel; green felt hat; navy shoes; name on all his clothes. Carried brown suitcase containing receiving set and a black bag with tools and working clothes.

His wife and mother will appreciate any word concerning him. For this purpose address Mrs. H. C. Sever, Box 226, Pleasant Plains, Ill.

THE PHILADELPHIA RADIO AMATEUR ASSOCIATION

PHILADELPHIA amateurs are invited to the meetings of the Philadelphia Radio Amateur Association which are held the second and fourth Mondays of each month at 1611 Columbia Ave. Live talks are given on practical amateur subjects, ideas interchanged, papers read and discussed, etc. Like other A. R. R. L. clubs, the P. R. A. A. is enjoying a healthy growth, but has room for every amateur in Philadelphia and vicinity.

THE ELECTRIC CITY RADIO CLUB

A NEW club has been organized at Scranton, Pa., The Electric City Radio Club. The officers are: President, R. C. Ehrhardt; Vice-President, Frank Tarbox; Secretary, P. D. McFarland, 802 Woodlawn St., and Treasurer, D. G. Shotton. Meetings are held every Tuesday evening at the Erie Railroad Apprentice School, and amateurs in the vicinity are cordially invited to visit and join. The present membership is about thirty. The club has a wave meter and will tune membership stations.

Digitized by Google

The Problems of Vacuum Tube Circuits

An Introduction to the Problems Encountered in the Design of Detectors, Amplifiers, and Undamped and Modulated Telephone and Telegraph Transmitters, Part VIII.

By L. M. Clement

DETECTION WITH A GRID CONDENSER

IF a condenser is connected in series with the grid of the tube the action of the tube as a detector is somewhat different from the case just discussed.

Detection results not only from the non-linear characteristic of the tube but from other effects also. The action is quite complex and involves not only the detector effect (due to the curved E_c 1_b curve), but the blocking action due to the grid condenser as well. No attempt will be made to explain the action in detail.

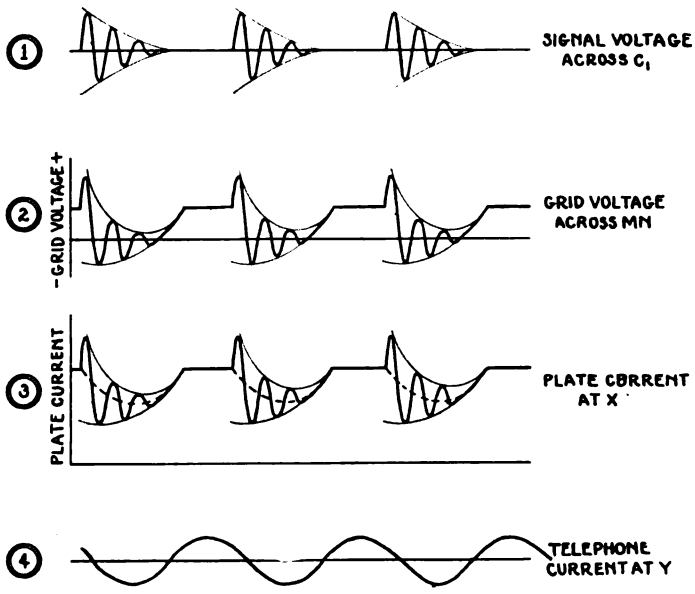


Fig. 42. Action in the audion circuits in the grid condenser

Let us consider the case of a tube of the high vacuum type similar to those made by the General Electric or Western Electric Companies. The grid-filament circuit has an almost infinite resistance when the grid is negative with respect to the filament due to the lack of carriers of electricity. In a gas tube this resistance may be relatively small due to the presence of positive ions of the gas molecules.

If the condenser has no leakage across its terminals the grid will be isolated from the rest of the circuit and will assume some charge with respect to the filament and plate. Upon the application of an alternating voltage to the circuit, current will flow during the positive half cycle only, from the grid to the filament and no current will flow during the negative half cycle. This is another way of saying that during the positive half cycle electrons are attached to the grid and during the negative half cycle this supply of electrons cannot leak off and in this way the grid receives negative charge each oscillation. This change of charge or voltage on the grid changes the plate current as it should, and for an impressed signal voltage has the effect of sliding the point of operation down the E_c 1_b curve, as shown at 2 in Fig. 42.

In most detector circuits there are small leakages in the condenser and other portions of the circuit which allow the charge to dissipate off slowly.

For good operation an artificial leak resistance is shunted between grid and filament to allow the accumulated charge to leak off rapidly enough so that blocking of the tube will not result.

The gas tube, due to the conduction between the grid and the filament, in general does not need an external resistance leak for proper operation.

Let us consider just what happens when an alternating current signal is applied to the grid circuit of a tube through a grid condenser. Fig. 43 illustrates a typical detector circuit with a grid condenser.

Suppose this signal is in the form of a series of damped oscillations as at 1 in Fig. 42. As we have already seen, when this voltage is applied to the grid circuit, the voltage between the grid and the filament falls due to the unilateral conductivity of the grid. The effect is equivalent to the superimposition of the radio frequency signal on a continuously changing point on the grid potential-plate current curve of the tube, and appears as shown on 2 of Fig. 42.

The plate circuit is very similar to the grid voltage except where detection due to the curve portion of the E_c 1_b curve distorts the signal current. The shape of the plate current is illustrated in 3 of Fig. 42.

If the leakage path were of high enough resistance, and the impressed voltage were large enough, the negative charge on the grid would finally become of such a value that the plate current would be reduced to zero. When this occurs, the tube would momentarily cease to operate. It is for the purpose of preventing this effect that an artificial external leak resistance R is employed. It has been found that for weak signals maximum detection is obtained for very high values of this leak resistance. The resistance should be such that the grid voltage is restored to its original value before the beginning of the second wave train in the group. This is illustrated at 2 of Fig. 42.

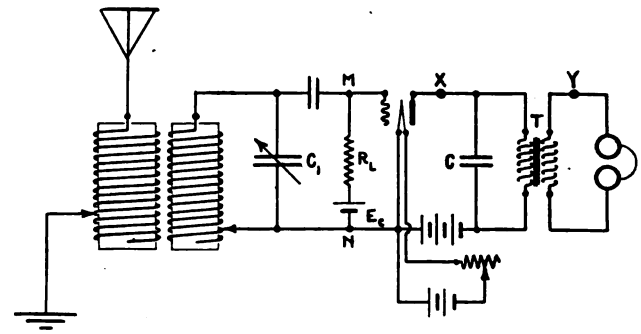


Fig. 43. The circuit on which the curves in Fig. 42 were obtained

By the application of the proper grid voltage, it is possible to start this action at any point of the grid voltage grid current curve.

For best detection, the point of maximum curvature should be selected. The location of this point differs for different tubes and should be determined experimentally if maximum detection is desired.

By observation of Fig. 42 it is seen that the grid leak resistance is of such a value that the accumulated charge is allowed to leak off before the arrival of the next wave train.

The telephone current is similar to the dotted line curve of 3 in Fig. 42, which follows the center point of each individual oscillation.

The wave form in the output circuit of the vacuum tube among other things can be resolved into a series of high

Digitized by Google

frequencies, a direct current and an audio frequency or signal current.

The condenser C, Fig. 43, bypasses these high frequency terms which prevents them from being amplified and causing disturbances or blocking of the ensuing stages of amplification.

The direct current passes through the primary winding of the transformer T while the audio frequency is transformed by it and delivered to the telephones.

If this output impedance of the tube is Ro and the impedance receivers at the signal frequency, usually between 800 and 1,000 cycles per second, is Z then in order to obtain maximum power in the telephones the transformer should have an impedance ratio of $\frac{Ro}{Z}$. This is equivalent to a turn ratio of $\sqrt{\frac{Ro}{Z}}$

The detection of a tube with a grid condenser, if the condenser and resistance are properly proportioned, is, in general, slightly better than the detection due to the detector effect described in the last installment of these articles for damped wave signals. This type of circuit, due to the grid leak resistance and grid currents which flow, produce some losses in the receiving circuit which manifest themselves by an increase of the decrement of the circuits.

For heterodyn reception it has been found that the ordinary detector circuit without a grid condenser gives best operation.

SOME IDEAS FOR A CRYSTAL RECEIVER

(*Continued from page* 60)

cover is slotted at the side allowing it to be slipped on over the rod.

When the tone of the buzzer becomes irregular, it can be quickly adjusted from the panel, without the necessity of removing the cover.

Assembly

The extreme simplicity of these instruments coupled with their excellent appearance, should appeal to the experimenters. All that is needed in the way of tools to build this apparatus are a set of drills, taps, files, a hacksaw, and a soldering iron.

Several methods can be employed to mount the panels. If another set of brackets is put on to support the top corners, the panels are sufficiently rigid for all purposes. Another way is to fit the set into a cabinet. This can be accomplished by putting small brass angles inside the cabinet, to which the corner screws can be secured.

Where connections are made at the front of the panels, wires can be run from the rear through the separations between the panels.

The Radio Department

WHAT'S the trouble with experimental radio work? The answer will depend upon the individual. Offhand, you may say that there doesn't seem to be anything wrong; in fact, you believe things are quite all right, at least considering some of the past trials of the experimenters.

If you are an A. R. R. L. man, you will probably complain of the Q R M. According to reports which are heard from the mid-west as well as from both coasts, the complaint would be justified. Some men tell of broad tuning, and others of non-regulation wavelengths.

It is to be hoped that the amount of trouble from indifference and wilfullness is small. The balance must be charged to the account of ignorance.

A great number of radio men are not interested in communication as much as in laboratory experimenting. Their cry is, "Give us data!"

THE article in this number, on high and low spark frequencies, is the first of a series which will give accurate data on transmitting equipment, with the idea of presenting information of value to the long distance operators.

Next month there will be some interesting facts about the Amrad quenched gap and spark coil. Mr. F. F. Pickslay, Sandusky, Ohio, is working on a radio telephone set, the details of which will be given to the readers of Everyday. This is a high powered equipment, employing a new type of circuit. An interesting feature is that no variable condensers will be used.

Mr. Clement is going to postpone the audion article which should be in the next issue, and is preparing, in its place some exceptionally valuable data on high frequency resistance measurements, accompanied by curves showing the resistance of different types of coils, at varying frequencies.

As a companion article, there will be complete details of a non-inductive resistance box, used with the circuits described by Mr. Clement. Various methods for measuring high frequency resistance have been used, but they had the disadvantage of requiring exceedingly careful shielding and special resistance bridges.

The system to be presented in the May issue does away with shielding troubles, and only calls for a resistance box and milliammeter.

UNDAMPED waves offer a broad field for experimental work, and a practical 200-meter outfit would be welcomed by the operators. The difficulty is in tuning undamped waves of such high frequency. There are ways to get around this trouble, one of which will be described shortly in Everyday.

One of the best methods of communicating on undamped waves is to use a buzzer or other type of modulator to call; then change over to the pure undamped waves. This gives a rather broad wave for calling, and a very sharp one for sending the messages.

HAVE you ever used a heterodyne wavemeter? This instrument, although not new, is not well known or understood by experimenters. It is nothing more than a calibrated audion oscillator, with a pair of telephones in the plate circuit. No buzzer exciter or detector is needed.

Wavelength, inductance or capacity can be measured, by means of the heterodyne wavemeter, with an accuracy which cannot be approached by the older type of instrument.

One of these meters is under construction in the Everyday laboratory, and will be described in detail as soon as it is ready, possibly in the May number.

ANOTHER matter of importance, on which experiments are being made, is the wave filter. It is easy to show on paper that series or shunt circuits can be employed to by-pass all but a given frequency, or to admit only a certain band of frequencies, but it is entirely different to operate such circuits advantageously under operating conditions.

Results obtained so far indicate that those circuits applied to radio receivers, are of little value except as paper inventions. Of course, they are used on wire telephone systems, but that is a different matter. We hope to have some data very soon which will show whether or not filter circuits really aid in the reduction of interference.

IT is gratifying to find that so many new radio clubs are being formed. The idea of giving code practice and tuning transmitters is particularly commendable. Moreover, the co-operation established in this way between experimenters allows an exchange of ideas which is not possible in casual conversations.

Quite a number of the local clubs have joined the A. R. R. L. thus building up the chain of relay stations which is already doing such good work.

Everyday is glad to publish announcements from all clubs, and also reports of conditions in different cities. If your club has succeeded in reducing the local Q R M, send in an account of the means which were used. This will give other clubs helpful suggestions for their own difficulties.

Digitized by Google

Design Features of the S. C. R. 112

Notes on the Loop Transmitter and Receiver from the Simon Company

IT is unfortunate that, with the end of the past emergency, the intensive development of radio equipment for the Army and Navy practically ceased. So many things which promised great successes never had the chance to prove themselves.

This is particularly true of the S. C. R. 112 set, which was to have been built in great quantities for communication between battalion and regiment posts of command or, in special cases, between battalions and companies. Operating on the ground or in dugouts, the range of this set is over four miles, using a loop of 3 turns, 1 meter square. The weight of this set, a matter of very great importance, is only 28 pounds.

Electrical details will not be discussed in this article, other than to say that the transmitter is of the buzzer type with an input of 60 to 85 watts at 10 volts, while the receiver is of the audion type, employing a condenser in shunt with the inductance of the loop for tuning. Adjustments are provided for transmitting wavelengths of 110, 123, and 140 meters. Some of the various instruments will be taken up in a subsequent article. We are concerned here with the exceptionally clever mechanical features.

Hidden away in the specifications for this set are the statements: "The box shall be capable of being dropped, with the instruments assembled within, five times the distance of 30 ins. on the earth without damage. It shall be sufficiently waterproof to operate when set upon the ground in a driving rain."

It took some time for the Signal Corps and the manufacturers to realize that apparatus in the field was subjected to such use. Possibly the thoughts of the beautiful skies and the smooth roads of France were too firmly implanted in the minds of the designers.

The influence of European methods can be seen in the canvas-covered carrying case a practical solution for waterproofness which, although it is not as handsome as bakelite or finished wood, gives a rugged appearance. This canvas covering also protects the wooden case from mechanical injury. Canvas flaps are also provided to guard the controls.

Figs. 2 and 4 show the flush construction of the switch handles and telegraph key. Instead of outstanding knobs to be knocked off and to strike against the legs of the man carrying the set, straight handles, easy to grip, turn in recesses. The top of the handle, flush with the side of the case, is marked with a line to read against the scale.

Indications for transmitting are filled with red pigment and for receiving, with white.

The spare parts are fitted in a section below the part of the case which carries the radio instruments. Thus, while no appreciable weight or size is added to the set, the disadvantage of a separate spare part box is overcome.

A very human consideration is introduced in the design of the filament switch, shown in Fig. 2, just beside the folding key lever. The switch mechanism is mounted on an asbestos panel, while the front plate is of aluminum. Between the asbestos sheet and the front plate are two Ward-Leonard resistances.

At the 4-volt position of the switch, the smaller resistance of 1.15 ohms is cut in, or at the 10-volt position, the 6.2 ohm resistance permitting the use of a 4- or 10-volt battery on the filament of the audion. The heat from these resistances is radiated by the aluminum front plate, giving the operator a chance to warm his fingers when the weather is cold. The flap at the end of the case can be let down to enhance this effect. Very little heat is conducted into the set because of the asbestos plate at the rear of the resistances.

The telegraph key is unusual in that

(*Continued on page* 86)

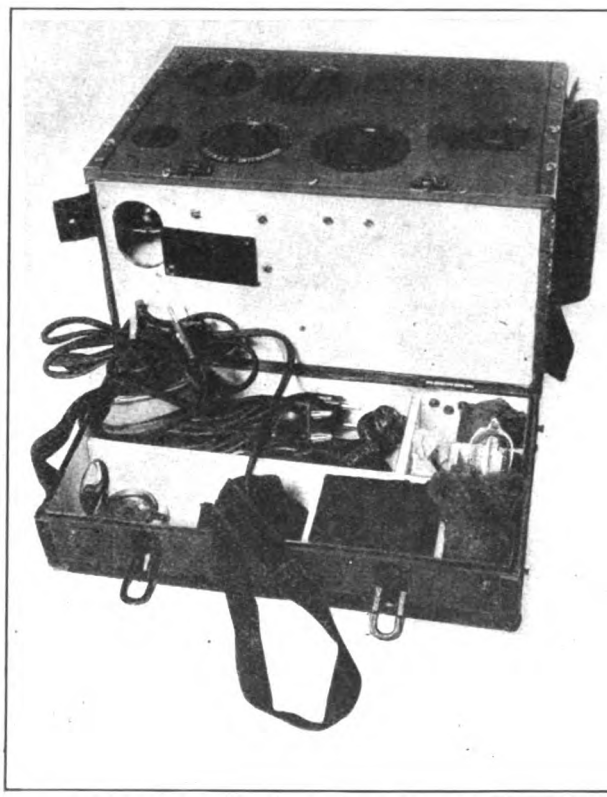


Fig. 1. The top section turned back to show the spare part box

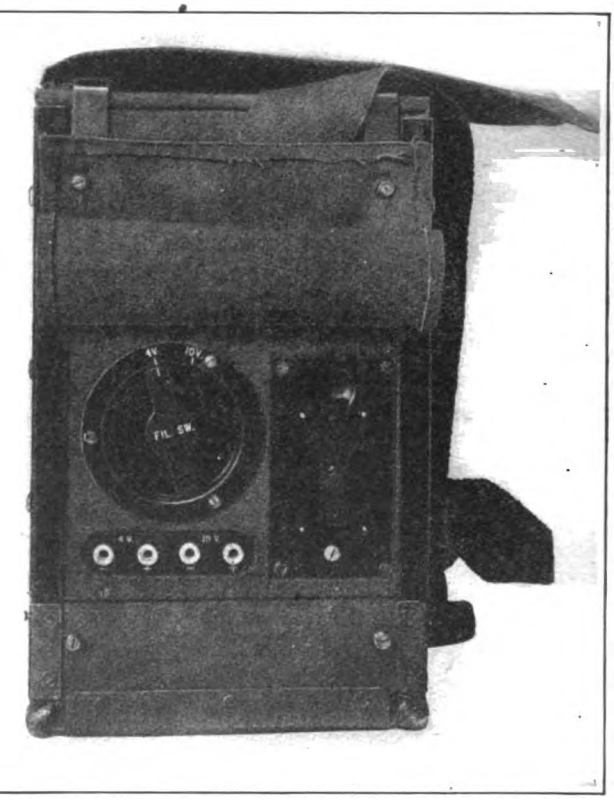


Fig. 2. Illustrating the key, in closed position, and the filament switch

Digitized by Google

The Man Who *Wouldn't* Stay Down



He was putting in long hours at monotonous unskilled work. His small pay scarcely lasted from one week to the next. Pleasures were few and far between and he couldn't save a cent.

He was down—but he *wouldn't stay there!* He saw other men promoted, and he made up his mind that what they could do *he* could do. Then he found the *reason* they were promoted was because they had special training—an expert knowledge of some one line. So he made up his mind that *he* would get that kind of training.

He marked and mailed to Scranton a coupon like the one below. That was his first step upward. It brought him just the information he was looking for. He found he could get the training he needed right at home in the hours after supper. From that time on he spent part of his spare time studying.

The first reward was not long in coming—an increase in salary. Then came another. Then he was made Foreman. Now he is Superintendent with an income that means independence and all the comforts and pleasures that make life worth living.

It just shows what a man with ambition can do. And this man is only one out of hundreds of thousands who have climbed the same steps to success with the help of the International Correspondence Schools.

What about *you?*

Are you satisfied merely to hang on where you are or would you, too, like to have a real job and real money? It's entirely up to you. You don't *have* to stay down. You *can* climb to the position you want in the work you like best. Yes, you can! The I. C. S. is ready and anxious to come to you, wherever you are, with the very help you need.

Surely when you have an opportunity that means so much, you can't afford to let another priceless hour pass without at least finding out about it. And the way to do that is easy—without cost, without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box EC7EB, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-20-19

Street and No._____

City_____ State_____

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Q. S. T.

Radio experimenters buying through this association are purchasing the goods of every advertiser in this magazine at considerable savings. We fill orders the day they arrive. After deducting their membership discounts they obtain the following prices:

Audiotron Tubes	$5.00
22 V "B" Batteries	1.10
001 Mfd Assembled Variable Condensers	3.50
De Forest Honey Comb Coils 10% off list price.	
130-230 Wavemeters	5.90
High Frequency Buzzers	2.00
Filament Back Panel Rheostats	1.55
Tubular Bulb Adaptors	1.05
Marconi VT Tubes	6.50
Marco Storage Batteries	7.00

We guarantee you some saving on anything advertised in this magazine if purchased through this association.
Send for detailed information

MUTUAL PURCHASERS ASSOCIATION

2 and 4 Stone Street Dept. EV-1 New York City

EXPERIMENTAL SCIENCE

· CHEMISTRY · · PHYSICS ·

A New Magazine of Science for the Experimenter and Practical non-Technical Man.

RADIO

First Issue out May 5th. $1.50 per year; Canada $1.75, 'New and Original.'

WRITTEN BY AUTHORITIES

Literature Sent on Request

Send In Your Subscription NOW!

Experimental Science Publishing Company

710 Fourteenth Street Washington, D. C.

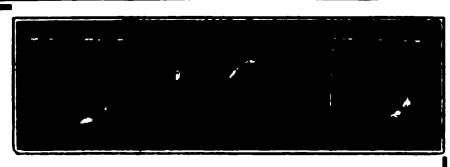
LCOX PANEL SWITCHES

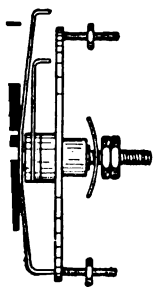
TYPE 101

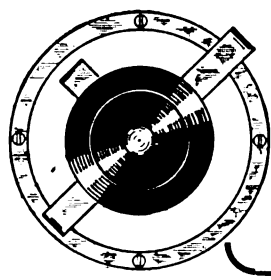
utiful and efficient standardized switch for gen- se. Furnished in two sizes.
Radius, Brass finish....40c Nickel finish....50c
Radius, Brass finish....50c Nickel finish....60c

TYPE 102 (Illustrated)

pound switch especially suitable for the primary e couplers. 1½" outside radius.
finish.....$1.10 Nickel finish.....$1.25







VARIOMETER PARTS

Turned from hardwood. Set as shown consisting of stator (two parts), rotor and form for winding coils.....Postpaid $2.50

Size of stator 5½" sq.
Other sizes made to order

SET NO. TWO contains all parts for the variometer including the above and knob, scale, pointer, shaft, binding posts, wire and instructions for assembly.....Postpaid $5.00

BUILD YOUR OWN APPARATUS

Our standardized parts and materials make it easy to build efficient apparatus that is beautiful and uniform in appearance.

NEW LOOSE LEAF CATALOG READY
Sent for five cents in stamps.

The Wilcox Laboratories

Lansing Dept. D Michigan

MEASUREMENT OF HIGH TEMPERATURES IN THE LABORATORY

(*Continued from page 37*)

nary work. All readings were checked with an Englehardt millivoltmeter and a platinum rhodium thermocouple which the writer has recently added to his laboratory equipment.

For obtaining approximate results in calibrating, Seger cones can be purchased from chemical supply houses and can be used in an electric furnace having an arrangement for viewing the melting of the cones. The cones and couple to be calibrated are arranged in the furnace and the temperature gradually raised. As the cones fuse the reading in millivolts should be taken. With the fusing point of the Seger cones known a curve can be plotted showing temperature and millivoltmeter readings. The cones can be purchased in assorted lots and should be ordered by number. Following is a list of cones with numbers and fusing points:

Number	*Fusing Point—Degrees C.*
.022	590
.021	629
.020	650
.019	680
.018	710
.017	740
.016	770
.015	800
.014	830
.013	860
.012	890
.011	920
.010	950
.09	970
.08	990
.07	1010
.06	1030
.05	1050
.04	1070

The electromotive force developed by a thermocouple depends upon the difference between the hot and cold junctions and for precise work one junction of the couple should be kept at constant temperature. A convenient arrangement is to have the ends of the couple pass through a cork into a thermo bottle, which has previously been filled with cracked ice. However, as the couple was primarily designed and made for the heat treatment of tool steel no cold junction need be made for these determinations.

The apparatus described herewith should appeal strongly to the amateur mechanic and model maker. Various tool steels fail to give the length of service expected due to insufficient hardness or lack of uniformity of hardness and a calibrated couple with a millivoltmeter offer a simple method for determining the proper temperature to which high carbon tool steel should be heated before quenching.

When iron and steel pass through certain of its transformation points the hardness and coarseness of the grain are considerably altered. These properties may be made permanent by sudden quenching.

(*Continued on page 72*)

Digitized by Google



LEARN WIRELESS
TELEGRAPHY AND TELEPHONY
AT HOME IN TEN WEEKS

Calls Coming in Steadily for National Radio Institute Graduates from All Parts of the Country. Four Concerns Guarantee to Take All Operators We Can Furnish.

Commercial Radio has arrived and many attractive positions are now open in Commercial Land Radio Service, Merchant Marine, Railroads, Radio Supply Factories, Lake and Ocean Steamship Lines, Telegraph Companies and Aerial Mail service. We are now receiving requests for more National Radio Institute Graduates than we can furnish and with the arrival of spring more opportunities than ever present themselves.

Salaries Up to $15,000 a Year

With our help you can quickly qualify for a first grade government license and a good position paying you approximately $225 a month to start as an operator. There are splendid opportunities for promotion to Radio Mechanic, Electrician, Government Inspector, Radio Aid, and Radio Engineer, some positions paying as high as $15,000 a year. Many of our students secure positions as operators before completing our course, because it is based on actual practice and teaches quickly what is needed to make a big success of Wireless work. No previous training or experience is necessary to study wireless. With the help of our wonderful Natrometer you can learn wireless, the National Radio Institute way, in approximately ten weeks by mail, right in your own home.

Get Your Instructions from Washington — Center of All National Wireless Activities

The National Radio Institute, established in 1914, was the first in America to successfully teach wireless by mail. Washington is the home of the United States Shipping Board—center of all official wireless activities—and the home of the United States Department of Commerce (Radio Dept.) which passes upon every first grade government license granted in America and also issues all permits to erect and operate radio stations. We now have hundreds of students throughout the world. Our location in the nation's capital, together with the standing of our officers and our wide acquaintance with government officials connected with wireless activities places us in position to give our students the best instructions obtainable and to be of the utmost help in assisting them to secure good paying positions.

Travel if You Want To

If you want to travel and see the world, go to foreign countries and increase your knowledge of world affairs, wireless offers you the chance of a lifetime. However, if you prefer to locate near your home you may secure a permanent position at one of the many land radio offices, railroads, telegraph and steamship companies.

Special Privileges to National Radio Institute Students

Students of the National Radio Institute receive the following:
Complete combination course in Wireless Telegraphy and Telephony—
Special post-graduate course at our large Washington school, if desired—
Five text books, one hand book, forty-six special lessons and eighteen personal examinations—
Membership in the N. R. I. Radio Relay league and handsome blue and gold membership pin presented immediately upon enrollment—
Large handsome diploma suitable for framing—
Complete automatic Natrometer outfit and carrying case—
Personal help in securing wireless position and endorsement of Institute officials.

This Fine Natrometer Given to You

This wonderful Natrometer automatically sends you wireless messages as though coming from a radio station thousands of miles away. It is a complete improved sending and receiving set, embodying the same type of instruments as used by the United States Bureau of Navigation in testing applicants for official license. Made especially and exclusively for National Radio Institute students.

Send for Free Booklet

We have prepared a book telling all you want to know about wireless and the future it offers you. Startling facts you are interested in are freely discussed. It tells how, during the past six years, we have helped hundreds of ambitious men and women and how we will help you. Send the coupon today or write to the

NATIONAL RADIO INSTITUTE
America's First and Foremost
Est. 1914—Dept. 187
14th & U Streets, Washington, D. C.



NATIONAL RADIO INSTITUTE,
Dept. 187, 14th & U Streets,
Washington, D. C.

Write Plainly

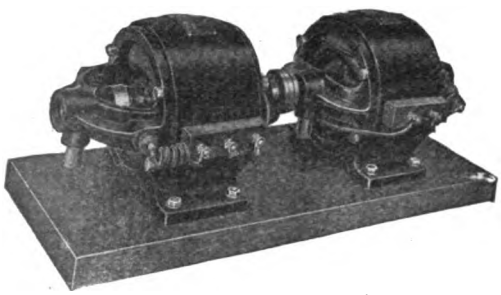
Send me your free book, "Wireless the Opportunity of Today," telling me about the opportunities in Wireless, your Famous Home Study course in Wireless Telegraphy and Telephony, your post-graduate course, the N. R. I. Radio Relay League and your special wireless instrument offer.

Name .....

Address .....

City ..... State .....

Digitized by Google



INTERNATIONAL RADIO

HIGH VOLTAGE—
DIRECT CURRENT

Motor Generators

Price, 110-Volt A.C. Driving Motor, $99.00; 110-Volt D.C. Driving Motor, $110.00, F.O.B. Factory

This unit has a normal output of 100 watts (200 milliamperes at 500 volts) with a voltage range of 200 to 500 volts. The generator is compounded to insure constant voltage under variable load. It is furnished to operate on either D.C. or A.C.; a shunt motor being supplied for D.C. and an induction motor for A.C. The generator is equipped with a commutator of 48 segments reducing the commutator hum to a minimum.

Unit is complete with insulating coupling and mounted as illustrated on a finished base 8" x 20". Shipment can be made immediately.

The motor generator illustrated above is only ONE of the many newly designed radio specialties which we have ready for you. Write us for descriptive bulletins which are being issued covering all International Radio products. Address Dept. No. 21.

INTERNATIONAL RADIO TELEGRAPH CO.

326 Broadway **New York City**

A MARK of QUALITY

THE WAY TO SATISFACTION

Lies thru a careful purchase of trustworthy equipment.

Let your first cost be your only cost by "Buying Right" at the very start.

Inferior apparatus can but produce inferior results.

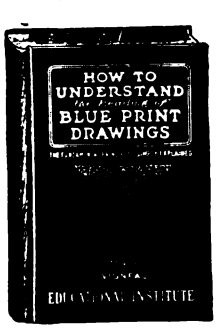
ALL RADIO EQUIPMENT

carried by us is selected stock—selected with a view toward dependability, service and reasonable cost.

Bulletin 14 will be sent upon receipt of 10 cents —applicable on first dollar order.

ATLANTIC RADIO CO., Inc.

88 Broad Street **Boston 9, Mass.**



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr.,
U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE, YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $3.25.
169 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 135 Rowland Bldg., Detroit, Michigan

(*Continued from page* 70)

The sample to be tested is prepared by counterboring a hole in the piece of steel and the bare end of the thermocouple inserted. Another method is to clamp over the bare end of the couple two pieces of the steel to be tested. These pieces should be at least one inch long and not less than three-quarters of an inch wide. The sample is now placed in a furnace and the furnace gradually heated. Fig. — shows the arrangement as used by the writer. A rheostat should be used to control the temperature. Allow the furnace to reach 600° C. At a certain point variable with the carbon content of steel the indicator on the millivoltmeter will be motionless for several seconds due to the readjustment of the steel structure and the changing conditions caused by the application of heat. This point is known as the decalescent point. The temperature of the millivoltmeter reading at this pause indicates the proper quenching temperature. The tool or sample to be tested is generally heated slightly higher than necessary to allow for the loss of heat from the furnace to the quenching bath.

The serious investigator, with the apparatus described in this paper, should have no difficulty to acquire the principles of thermoelectric pyrometry and particularly the pyrometric phenomena attending the critical quenching temperature of steel.

CHEMISTRY OF THE COMMON METALS

(*Continued from page* 36)

does not have a very great commercial value.

Potassium perchlorate is formed when the chlorate is heated very gently. This substance is a white crystalline one which is not very soluble in water. It can also be formed when perchloric acid is added to a solution of a potassium salt. At higher temperatures the perchlorate decomposes into the chloride and oxygen.

Potassium nitrate (KNO_3) is a very important compound. It is commonly known as saltpeter and is found in great quantities in nature. The present method of making the salt is by bringing together equivalent quantities of sodium nitrate, potassium chloride and water. When this mixture is heated to a fairly high temperature a large amount of the sodium chloride separates. The solution is filtered while hot and allowed to cool when potassium nitrate and a little sodium chloride crystallizes out.

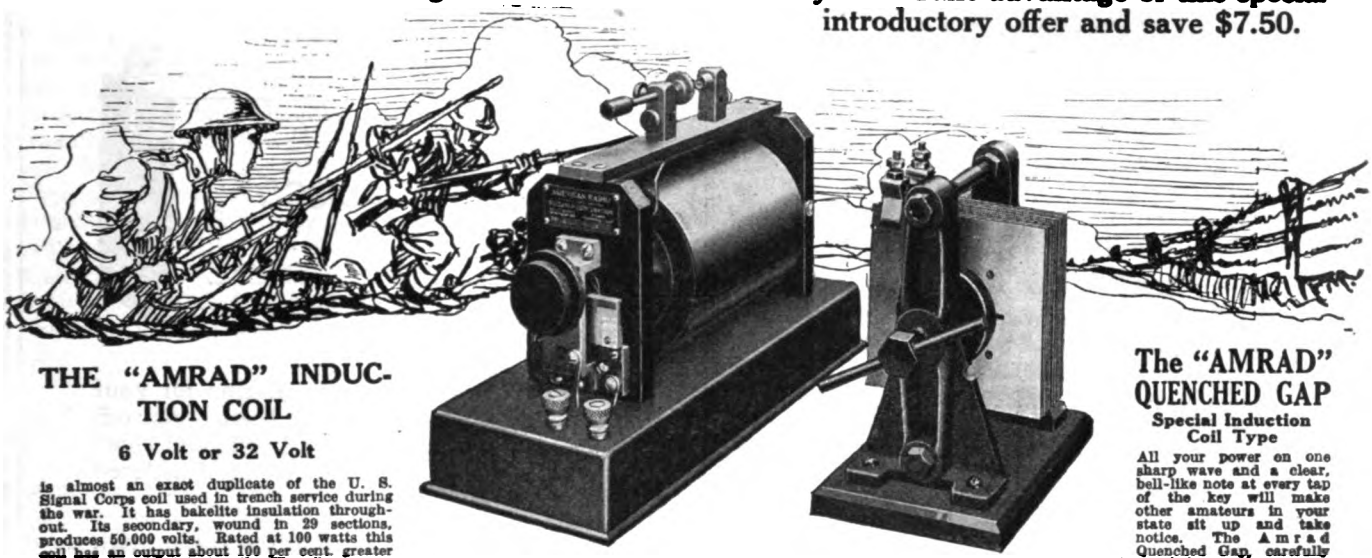
Potassium nitrate (KNO_2) is made in the same manner as the corresponding sodium salt. As it is much more difficult to purify and as it can be replaced in every case by the salt of sodium, it is not largely used.

(*Continued on page* 75)

Digitized by Google

AMATEURS ATTENTION!
Send over 25 Miles on D.C.

Here at last is real "commercial type" radio apparatus designed for low power direct current. New transmitting records are in store for you. Take advantage of this special introductory offer and save $7.50.



THE "AMRAD" INDUCTION COIL

6 Volt or 32 Volt

is almost an exact duplicate of the U. S. Signal Corps coil used in trench service during the war. It has bakelite insulation throughout. Its secondary, wound in 29 sections, produces 50,000 volts. Rated at 100 watts this coil has an output about 100 per cent. greater than the average 2 inch coil. The vibrator is rugged, steady and non-sticking and designed to give a spark frequency equivalent to 100 cycles which means maximum transmitting range on short wave lengths. The 32 volt coil is intended especially for use on farm lighting circuits. When ordered separately this type is $1 extra. To get maximum results with the 6 volt coil a heavy 6 volt storage battery is the best and most economical source of current.

Price, 6-volt type $28.50

The "AMRAD" QUENCHED GAP

Special Induction Coil Type

All your power on one sharp wave and a clear, bell-like note at every tap of the key will make other amateurs in your state sit up and take notice. The Amrad Quenched Gap, carefully operated, yields the secret of long-range transmitting on low power. This special gap is identical in design to the heavy 1¼ k.w. and 1 k.w. Amrad Quenched Gaps now being installed in long distance amateur stations. Not only will this special quenched gap make your transmitter as efficient, for its power, as the more costly equipment but you will be able to send more messages without interfering with other stations. For the first time in the history of amateur radio every induction coil transmitter can now be tuned to comply with Government decrement regulations. The Amrad Quenched Gap is the secret.

Price, Induction Coil Type . . . $12.50

Special Introductory Offer

If you have had limited power at your disposal and inefficient apparatus or if you are waiting to be introduced to the fascination of sending radio messages over into the next county or state here is your chance to get the two most important pieces of transmitting apparatus at an actual saving of $7.50.

"Amrad" Induction Coil, regular price . . . $28.50
"Amrad" Quenched Gap, " " . . . 12.50
$41.00

Special Price for the Double Buy, $33.50

Either 32-volt or 6-volt coil may be chosen

How to Order Show this advertisement to your dealer and ask him to order one of these combinations for you. If you have no radio dealer in your vicinity send us check or money order for $5 and we will ship direct to you by parcel post C. O. D., the balance plus postage. Act promptly, as the standard Signal Corps parts which we secured from the Government were only sufficient to make up a limited number of sets. If you are not ready to buy and want further information send for free Bulletin P which contains complete description and operating directions.

Dealers' Opportunity Write at once for short-term trade discount on this combination. No better opportunity to introduce apparatus of such high quality at such low prices will ever be had again. The offer is made especially to introduce our rapidly growing line of "commercial type" radio apparatus.

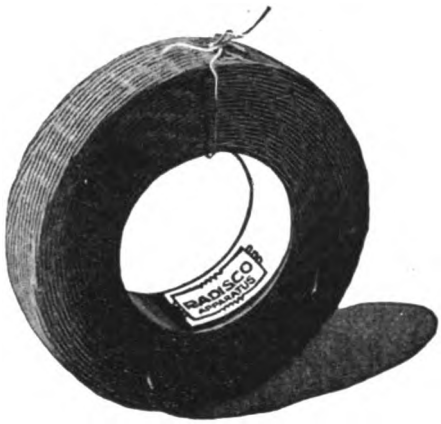
Address all communications to New York office

AMERICAN RADIO AND RESEARCH CORPORATION

15 Park Row — Factory at Medford Hillside, Mass. — New York

Please mention EVERYDAY ENGINEERING MAGAZINE

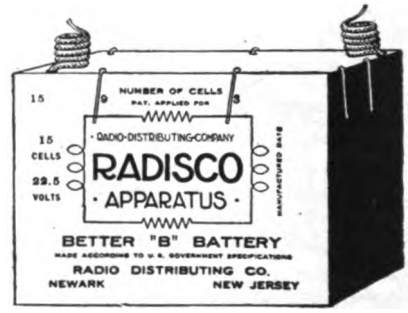
Digitized by Google



Two Famous
RADISCO SPECIALTIES

RADISCO COILS

conceded by several well-known Radio Men to be far superior to any similar type of Inductances. Made in seventeen sizes, tapped and plain. Wave length range from 200 to 20,000 meters. Priced from 70c to $4.85. Plentiful supply in stock at all Radisco Agencies.



RADISCO BETTER "B" BATTERY

is made according to Government specifications in two (2) sizes: 3¼ x 2 x 2½" and 6½ x 4 x 3". A first class 15 cell; 5 group battery; VARIABLE VOLTAGE (Pat. App. for) is a special feature of this battery which enables you to provide critical voltage regulation for your vacuum tube by means of a switch connection with cells, taps of which have been taken off. Very economical and convenient. If one cell goes bad just test each group of 3 cells and short circuit the bad one. Price: Small size $1.40. Large size $2.40. At any agency—or if ordered by mail include postage for 2 pounds on small size and 5 pounds on large size.

RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the RADISCO COILS, Better "B" Batteries, and are our Agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace.

ATLANTIC CITY, N. J.
Independent Radio Supply Co.,
118 So. New Jersey Ave.

BALTIMORE, MD.
Radio Engineering Co.,
827 Madison Ave.

BEINVILLE, QUEBEC, CANADA
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street.

BROOKLYN, N. Y.
Kelly & Phillips Electric Co.
312 Flatbush Avenue.

BRONX, NEW YORK.
Amateur Wireless Equipment Co.,
1390 Prospect Ave.

CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.

ILLINOIS.
EUREKA, PEORIA
Klaus Radio Co.

HAMPTON, N. H.
DeLancey Felch & Co.

LOS ANGELES, CALIF.
The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.
K. & L. Electric Co.
427 Olive Street.

NEW ORLEANS, LA.
L. A. Rose,
121 Camp Street.

NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street.

NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave.
"8HA"

PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets.

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington Street.

PITTSBURG, PA.
Radio Electric Co.,
4521 Forbes Street.

SCRANTON, PA.
Shotton Radio Mfg. Co.
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street.

TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street.

WASHINGTON, D. C.
National Radio Supply Co.,
1405 U Street, N. W.

WICHITA, KANSAS.
The Cosradio Co.,
1725 Fairmount Ave.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY : Newark, New Jersey

Digitized by Google

(*Continued from page 72*)

Potassium carbonate (K_2CO_3) is now obtained from potassium sulfate by a modification of the Le Blonc process for the preparation of soda. It is also obtained by the use of potassium chloride by taking advantage of the fact that when carbon dioxide under pressure is forced into a potassium chloride solution, containing magnesium carbonate in suspension, a double salt having the formula $KHCO_3$ $M_2CO_2 4H_2O$ is deposited. This salt is readily decomposed by hot water, producing M_2CO_3 which is preciptated. Carbon dioxide passes out of the solution and a solution of potassium carbonate remains from which the salt is obtained.

Potassium bicarbonate ($KHCO_3$) or potassium acid carbonate may be prepared by passing carbon dioxide through a very strong solution of the carbonate. The solution of this substance is slightly alkaline. It can be partially decomposed into CO_2 and the carbonate by boiling. At a temperature of 190° the salt is entirely decomposed into the carbonate, carbon dioxide and water.

Potassium sulfate (K_2SO_4) occurs largely in nature. It is present in schoenite and it is obtained from this substance by adding potassium chloride and a little water. When heated potassium sulfate crystallizes out, leaving magnesium chloride in the solution.

Potassium cyanide (KCN) is manufactured by heating potassium ferrocyanide with potassium carbonate. The following reaction then occurs:

$$K_4Fe(CN)_6 + K_2CO_3 = 5KCN + KCNO + CO_2 + Fe$$

Potassium cyanide is used in large quantities in gold mining and the processes of silver and electroplating.

A PRACTICAL SAFETY DEVICE

Emery wheels, rotary cutting machines, etc., are a constant source of danger to the workman's eyes. With "safety first" being preached by trained organizations of safety men in all big industrial estabishments, any device designed to protect the worker's eyes from injury is of general interest.

Goggles and glass shields have proven fairly satisfactory, but not entirely so, because of the liability of the glass to become broken.

Recently safety glass and transparent sheeting (the same material used for lights in auto curtains) have been tried with great success.

The safety glass is made either by laying in it a coarse mesh of fine wire or by employing hydraulic pressure to weld a piece of the transparent sheeting between two sheets of glass.

However, for goggles or shields over emery wheels, the transparent sheeting alone is very effective. It is cheaper and lighter than any form of glass.

"MODERN" AMPLIFIERS

bring in the telegraph and voice signals with amazing intensity. Operating on one dry cell, their ruggedness and simplicity makes them particularly well adapted for demonstrations.



Two-Step Amplifier and Horn

In the experimental station, a "Modern" Amplifier offers unlimited possibilities for new investigation.

Relay Stations depend upon the "Modern" Amplifier to strengthen their weak links in the trunk lines.



One-Step Amplifier

Ten years of development have gone into this outcome of the Multi-Audi-Fone. The perfect design, evident in the moulded Bakelite case and highly finished metal parts has been carried out consistently in the interior construction.

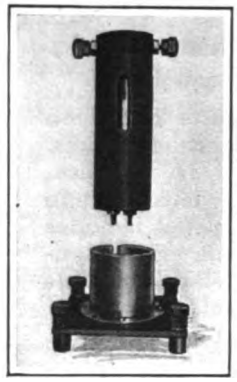
Only one dry cell is needed to operate the One-Step Amplifier, or three cells for the Two-Step Type. So little current is drawn that the batteries last from seven to twelve months. No high voltage or storage batteries to worry about.

Modern Amplifiers can be used with any detector
One-Step Amplifier (less headset) $18.00
Loud Speaking Horn for One-step 12.50
Two-Step Amplifier with Loud Speaking Horn . 75.00

BULLETIN A1 DESCRIBES THE AMPLIFIERS AND OTHER APPARATUS

MODERN RADIO EQUIPMENT COMPANY
29 South Broad Street **Elizabeth, N. J.**

YOU CAN USE AUDIOTRONS IN YOUR RADIO SET, WITHOUT CHANGING THE SOCKETS, IF YOU HAVE A



Radio Electric Audiotron Adapters are the logical means for using tubular audions in standard apparatus equipped with four-point sockets. The superiority of this adapter is evident in the simplicity of construction and protection afforded the vacuum tube.

AUDIOTRON ADAPTER, $1.50, Shipping weight 1 lb.

The Radio Electric Company carries a complete line of Bunnell, Radisco, Murdock, Clapp-Eastham Radio Apparatus, Federal and De Forest Instruments. Special equipment made to order. Pittsburgh experimenters are invited to visit our retail store. A 10c stamp will bring our catalog.

RADIO ELECTRIC COMPANY 4614 HENRY ST., E. E. PITTSBURGH, PA.

PITTSCO

MORE THAN A STORE !!

Distributors of reliable experimental and Laboratory Radio apparatus for High Schools, Colleges and Individuals. At F. D. Pitts Co., Inc., you will find an exposition of reliable radio apparatus and supplies from the foremost manufacturers of the country. No other store has such a complete line of equipment, nowhere else is there such an opportunity to choose from the products of so many radio manufacturers. A feature which must appeal to experimenters is that we keep things in stock! Immediate delivery!! Give our service a trial! Send 6 cents for new catalog. Every experimenter should have it!

F. D. PITTS CO., Inc.
12 PARK SQUARE Dept. F BOSTON 11, MASS.

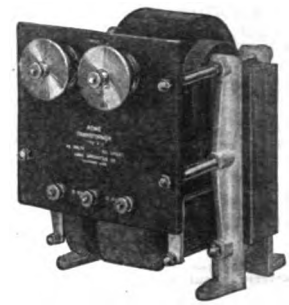
Digitized by Google

To Transmit Through Static Requires an Efficient Transformer and a High Spark Frequency

ACME TRANSFORMERS

ARE THE MOST EFFICIENT AT HIGH SPARK FREQUENCIES.
HIGH SPARK FREQUENCIES ARE THE MOST EFFICIENT.
VOLTS TO PRODUCE AUDIBLE SOUND IN 800 OHM RECEIVERS.
(By L. W. Austin, Bureau of Standards Bulletin, Vol. 5, No. 1)

Frequency	Volts
60	6,200 x 10^{-7}
120	2,900 "
180	1,700 "
300	600 "
420	170 "
540	80 "
660	30 "
780	11 "
900	6 "



Therefore the receivers are 100 times as sensitive at 900 sparks per second as at 300 sparks per second

High spark frequencies—for same power from transformers — means less voltage, less condenser losses, and larger antenna current

The Acme Transformer is the Only Amateur Radio Transformer Which Efficiently Supplies Energy to an Antenna at 800 Sparks Per Second from a 60 Cycle Source.

DESIGNED BY GOOD ENGINEERS
SOLD BY LEADING DEALERS
Write for Bulletin.
BUILT BY GOOD MECHANICS
USED BY LONG RANGE AMATEURS

ACME APPARATUS COMPANY

24 Windsor Street, Cambridge 39, Mass.

Radio and Transformer Engineers and Manufacturers

ACE

What Are the Wild Waves Saying?

You can find out with "Ace" equipment

We can furnish parts for audion control panels and amplifiers. The panels are 3/16" formica, grained finish, lettering in white. Control panel includes socket, grid leak, grid condenser, rheostat, binding posts and formica panel.

Amplifiers include the above and transformer, etc., all ready to wire.

Audion Control Panel	$7.50
One Step Amplifier	10.00
Audion Control Panel and One Step Amplifier on Large Panel	17.50
Two Step Amplifier on Large Panel	20.00

YOU MAY PAY MORE, BUT YOU CAN'T BUY BETTER

THE PRECISION EQUIPMENT CO., 2437 Gilbert Ave., Dept. B, CINCINNATI, OHIO

FOUR NEW BOOKS

WIRELESS EXPERIMENTERS will be interested in this NEW BOOK

SELENIUM CELLS. Design, construction and use of the various makes, by T. W. Benson. Illustrated with drawings and half-tones. 80 pages. 7½ x 5 in., cloth $1.50.

AUTOMOTIVE MAGNETO IGNITION, Its principles and applications, by MICH. E. TOEPEL. Second Edition, revised and enlarged. Illustrated. Cloth, $2.00.

AERONAUTICAL ENGINES, by F. J. KEAN, Second Edition, revised and enlarged, 96 pages, 48 diagrams, 29 page plates and 5 folding plates. Cloth, $2.60.

LATEST MAGIC, The New Book, by PROF. HOFFMANN (Angelo Lewis), Second Edition revised, fully illustrated, handsomely bound in cloth—gilt. $2.00.

Spon & Chamberlain

122 E. Liberty St. New York City

athematics Made Easy

Arcascope—the Combination Triangle a Brain—will multiply, divide, figure ntage and proportion, solve all problems igonometry and geometry, draw symmetrigures, plot arcs, etc. Superior to any slide Simple to operate. Also includes A TRANSENT TRIANGLE. PROTRACTOR and EE RULES. Used at Columbia University, Point, U. S. Aeronautic Schools, etc. Only postpaid. Order today before you forget. t. U, L. J. LEISHMAN CO., Ogden, Utah

A NEW DETECTOR

That can either be used as a Panel Unit, as advocated by this magazine or "on the table," and only one knob is used for Position and Pressure. Instantly adjustable to any spot on the crystal. Price includes tested galena. Base 5 ins. by 2½ ins. $2.50. Base 5 ins. by 5 ins. 3 cups $5.00.

Just write for information and list

THE BARWICK RADIO SUPPLY CO.
89 Britannia Ave. Hamilton, Ont., Can.

Arnold

Loose Couplers

Combination Loose Couplers or Parts and accessories.

Send 4c stamp for literature which is sure to interest you.

J. F. ARNOLD
2082 Lexington Av., N.Y.
Established 1910

Digitized by Google



Head Telephone. U. S. Navy Type CW 834, Army Type P-11

COMMERCIAL EXPERIMENTAL wicony RADIO PRODUCTS EDUCATIONAL LABORATORY

"The Quality Mark"

THE Standard Head Phone of both the U. S. Navy and U. S. Army is illustrated in the cut. More of these phones were purchased than all other types put together. No more sensitive or easy-wearing phone is made. They are manufactured for us by the Western Electric Company and are known as Navy type CW 834 and Signal Corps type P-11.

The regular price is $14.50, but for the next thirty days orders will be accepted at the regular price less 15% or $12.30 net, Parcel Post paid. This is the opportunity of a lifetime to get at a bargain what is undoubtedly the best phone made for long distance reception. Payment should accompany order.

Our complete line of other high grade radio products is now available to the experimenter.

WIRELESS IMPROVEMENT COMPANY

Radio Engineers, Manufacturers and Distributors

47 West Street **New York, U. S. A.**

WIRELESS MANUAL

We make a charge of 25c for it Issuing a coupon receipt redeemable on a purchase of $5 or more.

No. K-12
Ready May 25

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble.

Our 180 page combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments.

MANHATTAN ELECTRICAL SUPPLY CO., INC.

New York—17 Park Place
Chicago—114 So. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.

MERACO
EQUIPMENT

"MERACO" PERFECT B BATTERIES
Are made in three sizes and are fully guaranteed. Our circular will interest you. Send for it.

Buy WHILE YOU CAN at This Price

Here Are a Few Other Meraco Offers:

Hard rubber, ⅛, 3/16, ¼, ⅜, ½, in., $1.40 per lb.

Bakelite grade xx, natural, $2.90 per lb.; black, $3.00 per lb.

Flexible rubber tubing to slip over leads, 4c per foot; $3.50 per 100 ft.

Note: Postage must be included, as extremely low prices prohibit shipment otherwise.

MERCURY RADIO APPLIANCE CO.
672-A Broadway, Brooklyn, N. Y.



Silicon detector, $1.50 Galena detector, $1.50

GOING AWAY THIS SUMMER?

You may not be near a news stand while you are away this summer, but you must not miss the radio articles, for you will want the information when you start up in the fall. Don't take chances SUBSCRIBE BEFORE YOU GO!
EVERYDAY ENGINEERING

High Frequency Cable—(Litz)
10-38, 20-38, 2-16-38, 3-16-38 individual wires enameled, D.S. over all. Grey Cardboard Tubes, Bakelite, and Rubber Panels. Radio Call IJF. Write for circular on Honeycomb Coil Mounting. Wholesale and retail.
A. T. HOVEY
61 Belvidere St., near Mechanics Bldg. Boston, 17, Mass. Open Evenings

DISCOVER YOUR TALENTS

What are you best fitted for? Why drift from job to job? Why experiment with your future? Let an expert psychologist tell you the right vocation in life for YOU. Personal analysis by Dr. S. S. George, former U. S. Army psychologist, will help you to know your mind and what career you are most suited for in life. Send for Booklet "B." Phone Schuyler 5969
THE VOCATIONAL GUIDANCE INSTITUTE
Room 27, 2255 B'way. (81st St.), New York, N. Y.

EVERYDAY SCIENCE NOTES

The banana has been recommended as a source of alcohol; the Germans left vast plantations in Africa. Referred to the area cultivated it gives double the yield of sugar beets. An acre gives from its quota of 800 trees some 100,000 lbs. of fruit and the yield of alcohol is from 1,000 to 1,200 gallons per acre. In the Philippines, the Nipa palm is a possible source of alcohol; it is tapped like the sugar maple. A liquor for use by the natives is now made from it.

A bottle with a message from the aviator Hawker, who came down in the ocean last May in his attempt to cross to England, has been picked up off the southwest coast of Norway. It was found on November 20th. It was thrown out by Hawker on May 17th or 18th, so that it had been afloat some six months.

The following welding compositions are from a French contemporary.

A

Iron filings	6	parts by weight
Ammonium chloride	14	" "
Potassium ferrocyanide	14	" "
Borax	100	" "

B

Rosin	30	parts by weight
Salt	10	" "
Borax	300	" "
Alum	30	" "
Ammonium chloride	150	" "
Zinc sulphate	20	" "

A wooden boiler has been recently described. It was in use in the Philadelphia pumping station a century ago. It worked at a pressure of only 2½ lbs. to the square inch. It was made of 5-inch white pine braced with 10-inch oak beams; it was rectangular in shape, 9 by 14 feet area and 9 feet deep. It had an iron fire box and flue with a return flue above. The trouble on rceord is that it did not do well above the water line. The water seemed to keep the lower part in order, but the steam did not take care of the upper portions.

The Colonial Belgium Office is to try out motor tractors for use in Africa to burn palm oil and similar vegetable oils. They are to be used for ploughing and general hauling and traction.

A wood-screw is being placed on the market which has no slot, but in place of it has a square hole in its top, to receive a special square ended screw-driver. It is somewhat in the line of the safety set-screws for belt wheels on shafting.

It has been found that electric line poles give away and decay 20 inches below the surface and a little way above the surface of the ground. To save them they are dug around so as to expose a yard or less; if there is decay the rotten wood is scraped away, and a divided tank is put around the post and a preservative is put into it. Attempts to do this under pressure failed as the joints could not be adequately packed. After impregnation with the preservative eight vertical reinforcing pieces of steel are attached and concrete is applied to a thickness of three or four inches, extending a foot above the surface of the earth. When new poles are to be put into the places formerly occupied by old and decayed poles it is advantageous to use new and fresh earth as the old earth is filled with fungus germs and will quickly start decay.

Digitized by Google

VACUUM TUBES REPAIRED

We repair the filaments and other elements in all types of vacuum tubes and guarantee them to operate equally as well as a new tube. In most cases they operate better. We produce wonderful oscillators, detectors and amplifiers.

MARCONI VT
DE FOREST VT
MOORHEAD TUBES
WESTERN ELECTRIC

REPAIRED AT FOUR DOLLARS AND FIFTY CENTS EACH

ELECTRON RELAYS
OSCILLAUDIONS
and all tubular types.

REPAIRED AT FOUR DOLLARS EACH

All foreign-made receiving tubes repaired at SIX FIFTY and power tubes, depending upon size.
WE HAVE PURCHASED A LARGE QUANTITY OF BURNED OUT MARCONI VTs AND ELECTRON RELAYS, WHICH WE OFFER FOR SALE AT FIVE DOLLARS.
REMEMBER THESE TUBES ARE GUARANTEED GOOD AS NEW.

Dealers write us.

VACUUM TUBE REPAIR CO.
511 Perry Building OAKLAND, CAL.



BOYS Get the most attractive warning sign made. Your den is incomplete without it. Printed in bright red on white stiff cardboard. 7¼" x 11¼". Reduced to 10c each, in coin only. Send stamp for postage. Don't buy plain printed signs. Satisfaction guaranteed or money back. Sent unbent.
BECK NOVELTY HOUSE
Dept. D, 1298 Carroll Street, Brooklyn, N. Y.

Recognized as the largest and best
Service Radio School
INCORPORATED
Send ten cents for descriptive catalogue to
Dept. E, 900-902 Penna. Ave., N. W., Washington, D. C.

"POROX"
"Trade Mark"
High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.
Special Batteries made to order also duplicating of foreign batteries.
Prices on request.
ALBERT MULLER
8758 Queens Boulevard
Jamaica, Long Island, N. Y.

EVERYDAY ENGINEERING MAGAZINE
2 WEST 45th STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for.....years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the..... (Date of issue) issue. I enclose $....., and according to your special offer send me copy of book checked off.

Name .....
Street .....
City .....
State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS
Check off title desired here

1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



RADIO MEN

Make your apparatus up to date. **Indicating dials** now available at a reasonable price.

Made of fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. Bevelled edge.

We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted...$1.30 Postpaid

NEW CATALOG JUST OUT, ready for distribution at once. 24 pages of real, live, up to the minute illustrations, NEWS and descriptions of all standard Radio parts, including the above Indicating Dial.

Sent anywhere upon receipt of 10c.

For sale at all Radisco Agencies and by

A. H. Corwin & Co.

4 West Park Street Newark, N. J.

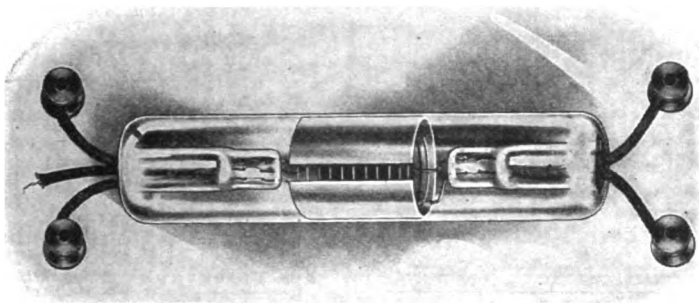
Licensed by De Forest

AUDIOTRON

The Original Tubular Vacuum Amplifier

The AudioTron vacuum tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos 841387 and 879532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.



PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

Laminated closed core, two coil type

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO., Lick Bldg., San Francisco, Calif.

"ASK ANYONE WHO HAS USED IT."

WHAT OUR PATRONS SAY

"Out of six different makes of receivers I find yours are the best. They do all and more than you claim for them." (Name on request.)

BRANDES WIRELESS HEADSET



Superior, 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. 32 Union Square, Room 822 New York

WIRELESS RECEIVER SPECIALISTS

Federal Radio Accessories

Are the Recognized STANDARDS for Their Respective Uses.

BULLETIN 102 W.A.

Gives full description. Besides it contains valuable information on

AMPLIFICATION of Radio Signals

Send 6c in Stamps today and receive this Bulletin.

FEDERAL TELEPHONE AND TELEGRAPH CO.
1756 Elmwood Avenue
BUFFALO, N. Y.

Digitized by Google

Useful Books

Complete Practical Machinist

by Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations

Price $3.00

Metal Worker's Handy-Book of Recipes and Processes

By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations

Price $3.00

Techno-Chemical Receipt Book

Edited with Additions by Wm. T. Brannt and Wm. H. Wahl

This well-known Receipt Book is a mine of accurate information that everyone may work to great advantage. It is encyclopedic in range, yet gives only the best formulas for each preparation or operation, and thorough tests by competent men guarantee their intrinsic merit.

A compact and reliable collection of approved receipts and processes, containing thousands of receipts covering the latest, most important and most useful discoveries in chemical technology and their application in the useful arts and industries. It is indispensable to every practical man and contains 500 pages, closely printed, giving an immense amount of matter on a great variety of subjects. Every care has been taken to select the very best receipts of each kind and there are few persons, no matter in what business or trade they may be engaged, who will not find in this volume something of use and benefit to them. The library of the laboratory, factory or home is not complete without a copy of this handy and useful book of reference.

516 Pages. 78 Illustrations

Price $2.50

Friction, Lubrication, Fats and Oils

By Emil F. Dieterichs

When we realize that it is no figure of speech, but a bald statement of fact, to say that lubrication alone keeps the wheels of industry turning, then we must look respectively upon this as a question of vital importance in this mechanical age. The author, himself a chemist and an inventor and manufacturer of lubricants, wrote this manual for the mechanic and manufacturer of ordinary education, that the busiest man might learn the main facts of friction, the origin and charteristics of fats and oils, their uses, their adulterations, their practical testing and the best ways to make them serve his own particular ends.

Price $1.50

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.
Publishers of Mechanical and Industrial Books
2 West 45th Street, New York, N. Y.

OF SPECIAL INTEREST TO AMATEURS!



We have a number of GENERAL RADIO CO. HOT WIRE AMMETERS range 0-2.5 amperes which were left on our hands at the termination of the war. These instruments are of the flush type, calibrated, and in good condition, exactly like a large number supplied by us to the U. S. Army Air Service.

We also have a few ammeters of the same type, range 0-1 ampere, adapted to use in measuring the filament current of vacuum tubes or low power transmitting sets.

While they last, $5.00 will bring you either range, although our regular price is $10.00.

Dealers write for our proposition

GENERAL RADIO COMPANY CAMBRIDGE, MASS.

THE STANDARD— WHEREVER "B" BATTERIES ARE USED

STANDARD VT BATTERIES give you the service you expect, and the "VARIABLE STANDARD VT BATTERY" is unequalled in efficiency, convenience and fineness of variation.

Used by leading manufacturers. Sold by the best dealers.

Send for literature, and kindly mention your dealer's name.

RICHTER & BYRNE, New York, Mfgrs.

PACENT ELECTRIC CO., Inc.
Sole Eastern Agents
150 Nassau St. New York, N. Y.

BEST MADE

MAXIMUM OPERATING LIFE



BURGESS "B" BATTERIES

SEVERAL SIZES FOR SPECIAL WORK



SEND FOR CATALOGUE

BURGESS BATTERY COMPANY

HARRIS TRUST BLDG.-CHICAGO, ILL.



DUCK'S No. 13 264 Pages Electrical and Wireless Catalog

JUST OFF THE PRESS

175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

- 175 pp. Wireless Apparatus for Commercial and Experimental use;
- 10 pp. Raw Material;
- 2 pp. Transformers;
- 9 pp. Auto and Stg. Batteries;
- 8 pp. Telegraph Instruments;
- 42 pp. Motors and Dynamos;
- 8 pp. Flashlights;
- 2 pp. Medical Batteries;
- 3 pp. Ammeters and Voltmeters;
- 20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

Send for

HALCUN Radio Catalogue

Full Line of Amateur Requirements

Halcun Radio Co.
San Francisco, Calif.
Formerly Haller Cunningham Elec. Co.

RADIO APPARATUS on the INSTALLMENT PLAN

Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.

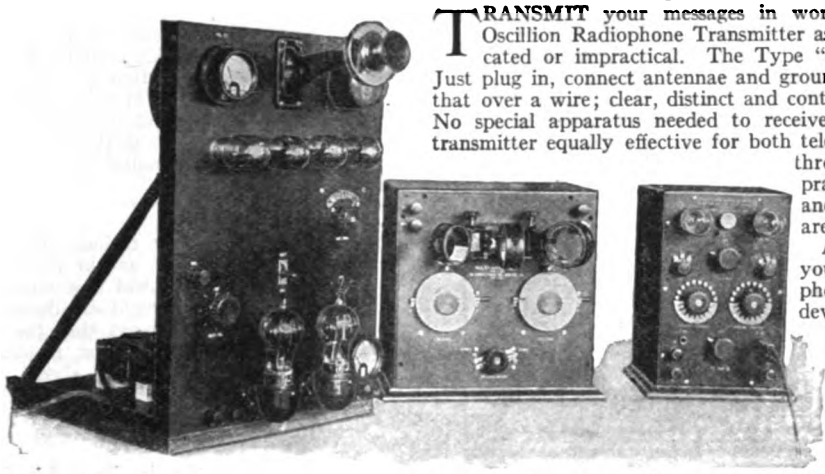
J. DONALD VANDERCOOK
LOMBARD Box 442 ILLINOIS

EVERYDAY ENGINEERING MAGAZINE
Is Now 20 Cents Per Copy
SUBSCRIBE AND SAVE MONEY

Digitized by Google

DE FOREST

A Wireless Telephone Now Possible for Every Radio Amateur!



TRANSMIT your messages in words instead of dots and dashes! Install a DeForest Oscillion Radiophone Transmitter as part of your set and you can do it. Nothing complicated or impractical. The Type "O" Transmitter shown below plugs into lamp socket. Just plug in, connect antennae and ground, push a button and talk! Voice quality superior to that over a wire; clear, distinct and continuous. Once adjusted it requires no further attention. No special apparatus needed to receive Radiophone messages over limited distances. Same transmitter equally effective for both telephone and telegraph. Throw a switch and telegraph; throw it back and talk! Not an experiment or an impractical instrument. Absolutely perfect in performance and guaranteed to operate as claimed when instructions are followed.

Add the DeForest Oscillion Radiophone Transmitter to your set and you can send messages by telegraph or telephone. Its cost is not prohibitive and it is the coming development in Radio Service. Find out all about it—

DeForest Complete Radiophone Transmitting and Receiving Station

Type "O," "A O," Oscillion Transmitter for Radio Telephone and Telegraph (left); Type T-200 Multiwave Tuner (center), and Type P-300 Combination Audion-Ultraudion Detector and One-Step Amplifier (right). This outfit comprises a complete Radio Telephone-Telegraph Station for both transmission and reception. The instruments may be purchased separately. Send for a catalogue and get complete details.

Send for the DeForest Catalogue

A 56-page book full of vital Radio information for the Amateur, including wiring diagrams and other data. Sent postpaid for 10 cents in stamps. Send for yours today.

DEFOREST RADIO TELEPHONE & TELEGRAPH COMPANY

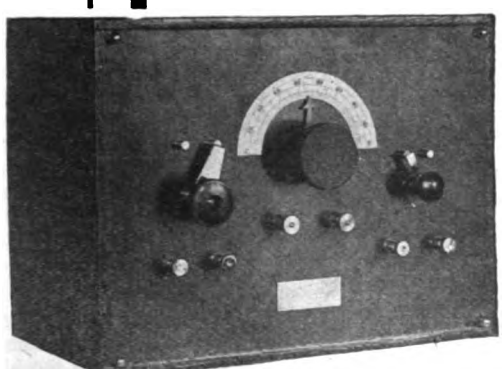
Inventors and Manufacturers of High Grade Radio Apparatus.

1399 Sedgwick Avenue New York City.

DE FOREST

RECORDING WIRELESS MESSAGES

A New Development in Radio that Makes it Possible to Record Wireless Messages on a Tape and to Give Visible or Audible Indication upon the Reception of Signals by Means of a Light or Bell.



PATENTED

PRICE $75.00

A Practical Device

This instrument is the only thoroughly reliable device that has been perfected for the recording of wireless messages. A new principle has been brought into use which makes possible great sensitivity without any sacrifice in ruggedness.

This instrument will function with entire satisfaction over long distances.

JEWELLERS ATTENTION!

By placing this device in your window Arlington Time Signals can be made visible to pedestrians. Be the first one in your town to introduce this novel feature.

Literature Gladly Furnished upon Receipt of Stamp

Price does not include tape register.

AMERICAN RADIO RECORDER & SIGNAL CO.

435 WILLIAM ST., BUFFALO, N.Y.

Radio Traffic Association

An organization devoted to the improvement of Amateur Radio Traffic conditions.

Brooklyn, New York

AFFILIATED WITH THE A. R. R. L.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 33rd St. Valparaiso, Indiana

High Frequency Resistance Measurements; Construction of a Heterodyne Wavemeter; Use of the Quenched Spark Gap; 200-Meter Undamped Wave Transmitter.

These are some of the articles which will appear in EVERYDAY, the magazine that gives accurate construction data on instruments which do the work. If you miss a single issue, you will lose information you cannot find elsewhere.

Digitized by Google

A GOOD WAVEMETER
AT A MODERATE PRICE



TYPE B. Q. WAVEMETER

is accurate, simple and rugged. Comprises a portable oak case 5¾" x 8¼" x 6½" with hinged cover, bakelite panel, balanced condenser, buzzer, detector, switch, binding posts, and two 2-unit inductance windings, range 200 to 2000 meters.

Price $27.50

These meters are in stock for immediate delivery, and are carried in stock by most good dealers.

Bulletins Z and F sent for 4c Stamps list our complete line of high grade, moderately priced apparatus for the radio laboratory. Bulletin R lists the Cambridge Rectifier for Storage Battery Charging.

CLAPP-EASTHAM CO., 131 Main Street, Cambridge, Mass.

The Wise Radioman

looks for service as well as quality and workmanship when he buys radio apparatus.

We are selling a high grade line of Amateur and Commercial radio apparatus and equipment which will assure you of maximum satisfaction.

Just received—a large stock of Storage and "B" Batteries particularly adapted for Audion and Amplifier work, made of the best materials and guaranteed to give good hard service which we are offering at prices it will pay you to investigate.

Our organization is always ready to render "personalized" service with every purchase making it a pleasure for you to do business with us.

Send 10 cents for our new catalog—just off the press—you will say it's "different."

"Quality Apparatus and Service"

The International Electric Co.

Eugene Dyner, President

226-A Fulton Street, New York, N. Y.

THE RADIO ENGINEERING CO.
(INCORPORATED)
BY POPULAR ACCLAMATION

"RECO" DETECTOR & 2-STEP AMP. $40.00

Manufacturers of RECO QUALITY "Radio Apparatus"

"RECO" KEY $6.50 10 AMP.

TO H. I. M. THE AMERICAN AMATEUR

Standard in Design, Workmanship and Service.

Apparatus made to order. Our low prices will surprise you. We are specialists in Short Wave Relay Station equipment. Our Monthly Bulletins, describing our new products, mailed you for six cents in stamps. Get on Our Mailing List—Get Ready for the Fall. Agents for all Standard Quality Radio Apparatus.

614 North Calvert Street, Baltimore, Maryland Branch at Richmond, Va., P. O. Box 859

THE OUTSTANDING FEATURE OF THE RADIO ARTICLES IN EVERYDAY is that you can believe what you read because the instruments described are actually built and tested and known to work. They are not ideas on paper. That is why EVERYDAY carries such a high reputation among experimenters.

EVERYDAY SCIENCE NOTES

The iron mines of Bill Island, Newfoundland, have been attracting some attention. There are two areas, one good for 700,000 tons per annum, the other for 600,000 tons. There is enough it is believed to keep the mines going for centuries. In Nova Scotia a 10,000,000-ton deposit is cited, lying near the coast.

From England comes the interesting intelligence that the manufacturers of automobiles are seriously turning their thoughts to the manufacture of air-cooled engines. Presumably it is the aeroplane that has awakened this interest, but to us in this country it is a very familiar subject, as we have several very successful cars of the type in question, and have been familiar with such for many years.

Exploration of the upper regions of the atmosphere by huge rockets, as our readers know, has been proposed. And now comes the suggestion that there might be danger in such attempts, the idea being that there may be hydrogen gas in the higher regions and that a rocket might bring about a catastrophy by igniting it. This is a very odd and fanciful idea.

It is calculated that on the Pennsylvania Railroad it takes 127 men to do the work formerly done by 100. This is supposed to have occurred in the last two years. In shop work the output per man has fallen to three-quarters on a ten-hour basis; if the eight-hour day be taken as the basis the decline is about 40 per cent., or it takes ten men to do the work formerly done by six men.

It was observed that piles in the Great Salt Lake lasted a long time. Now railroad sleepers are soaked in the water of the lake for a year before use; Oregon pine sleepers are greatly improved in durability by this system.

In Algeria truck drivers found that their trucks would give them electric shocks, during the siroccos or high winds of that region. They avoided them by attaching a dragging wire to the truck. This gave a ground and kept the chassis discharged. Otherwise the insulation afforded by the rubber tires kept them in a charged condition once the flying sand had so affected them.

Three of four instances of whales killed by the Allies' dirigibles in the war have been cited. They were mistaken for submarines and bombs were dropped with the idea of sinking the enemy craft, but it was the poor cetacean that suffered. The English submarines evolved a method of signaling by jets of water or sterm. This increased their resemblance to whales and it is said that one was mistaken for a whale by a friendly ship.

The porosity of porcelain telegraph and power line insulators has been lately carried out in New Zealand. They were subjected to a pressure of 2,000 lbs. to the square inch in a cavity in a steel block. The hole was 3 inches wide and 6½ inches deep and was closed with a plate an inch thick. A solution colored red was used to enable the penetration to be tested. Some showed no penetration and no relation between the specific gravity and porosity could be traced.

Digitized by Google

BOOK REVIEWS

COMPLETE PRACTICAL MACHINIST. By Joshua Rose, M.E. Published by the Henry Carey Baird Co., 2 West 45th Street, New York, N. Y. Size 5 x 7½, bound in cloth, contains 536 pages and 432 line drawings and halftones.

This book is a particularly complete treatment of general machine shop processes and machine operation. It seems to have been prepared with the aim to interest the student and workman rather than the advanced machine designer or engineer. The contents are written in a practical, straightforward manner easily digestible to the layman as well as to the experienced mechanic. All of the various machine shop subjects that it treats are well illustrated in a way that greatly facilitates proper understanding. As a home study book for the man desiring to advance himself where he is employed, few would be more useful.

The chapters cover the following subjects: Cutting Tools for Lathe and Planing Machines, Cutting Speed and Feed, Boring Tools for Lathe Work, Screw-cutting Tools, Lathe Dogs, Carriers or Drivers, Turning Eccentrics, Hand Turning, Drilling in the Lathe, Boring Brass, Slotting Machine Tools, Twist Drills, Tool Steel Taps and Dies, Vise Work—Tools, Fitting Connecting Rods, Milling Machine and Milling Tools, Grinding Stone and Tool Grinding, Lining or Marking Out Work, Machine Tools, Precision Lathe Attachments and Their Use, Fellows Gear Shaper and Its Operation, Miscellaneous Attachments and Machinery, To Calculate the Speed of Wheels, Pulleys, Etc., How to Set a Slide Valve and Pumps.

SELENIUM CELLS AND HOW THEY ARE MADE. By Samuel Wein. Published by Progress Publishing Co., 1812 Lexington Ave., New York City. Contains 30 pages, bound in paper and illustrated with halftones and line cuts.

This is one of the very few books that have been published on the interesting subject of selenium, its properties and use. Also includes a brief historical sketch of the element and the method of producing it on a commercial scale.

Probably the most interesting data in this booklet is the clear discourse given on each of the well known types of selenium cells. The Bell-Tainter, Fritts, Mercadier, Bidwell, Townsend, Gripenberg, Ruhmer, Hammer and other cells of note are treated in an understandable way. The latter part of the booklet is devoted to general constructional data. A very interesting table showing the sensitivity of Ruhmers cells at different distances and with different sources of light is given. Another very useful table is included which has to do with inertia.

To cut down the cost per cut

How Many S. P. M.?

"Haste makes waste" is just as true of hack saws as of anything else. Forcing a blade by increasing the strokes per minute means a quickly dulled blade. 50 to 60 strokes per minute is about as fast as it is economical to run when cutting dry. On soft steel, using compound, saws may be run to advantage at about 100 S. P. M., at from 65 to 80 on annealed steel, and on unannealed tool steel at about 60 to 80 strokes per minute.

Follow the Starrett Hack Saw Chart, put on the weight and watch the cutting cost decrease.

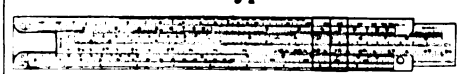
THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



Use Starr[illegible]lack Saw Blades

42-982

Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $2.00.

An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO., Niles, Mich.

STAUNCH

TOOL Chest economy means a Union Tool Chest—the chest of stauncher construction for stauncher service. Built of solid oak, top and bottom rabbeted in and frame joints lock-cornered, not dove-tailed. Union Tool Chests outlast the tools they contain. Bangs, knocks, jolts, falls, bad weather do not hurt your tools when you keep them safe and secure in a Union Tool Chest. 24 Styles and Sizes.



Write for Catalog, prices and name of nearest dealer and guarantee. If no dealer near you, write for special offer.

Union Tool Chest Co., Inc., 34 Mill Street, Rochester, N. Y.

UNION TOOL CHESTS

Speed Lathe $7 Complete Swing 7 ins. 24 in. metal bed

Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

REWINDING A. C. MOTORS

And all methods for connecting and reconnecting are clearly shown in the ELECTRICAL WORKERS FRIEND. 66 diagrams with detailed explanations solving every rewinding and reconnecting problem. Electricians and Experimenters will find this book exactly what the name implies "The Electrical Workers Friend." Price $4.00 Cash with order or (C.O.D.—U.S.A. only).

HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Penna.

SEE SPECIAL SUBSCRIPTION OFFER ON PAGES 84 and 85. VALUABLE BOOKS GIVEN AWAY FREE.

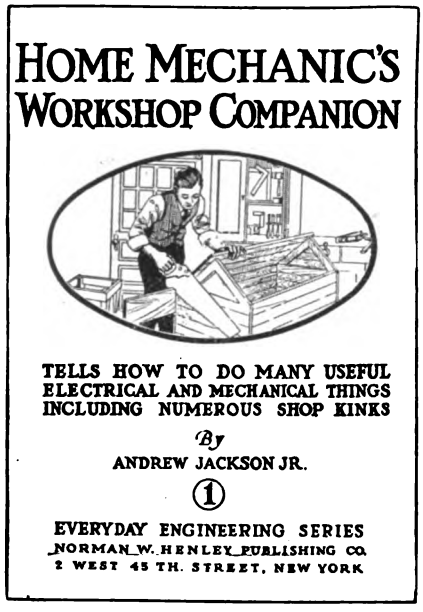
Digitized by Google

Just Published

The Everyday Engineering Handbooks

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man—the Mechanic and the Radio Experimenter

ILLUSTRATED BY SPECIAL DRAWINGS AND PHOTOGRAPHS



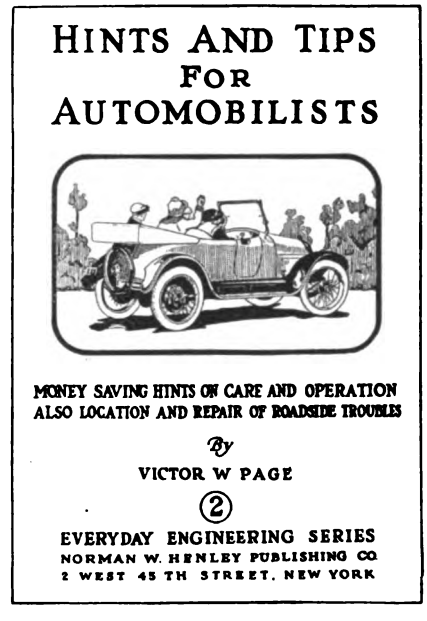
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.

This treatise includes a compilation of useful suggestions that cannot fail to interest the handy man, and while it is not intended for mechanical experts or scientists, it will prove to be a veritable store of information for any one who desires to rig up a small shop where odd jobs can be carried on.

The subject matter is divided in five parts as follows:

Chapter 1—The Home Workshop and Its Equipment. Chapter 2—Special Tools and Shop Expedients. Chapter 3—Useful Home Appliances. Chapter 4—How to Do Things Electrical. Chapter 5—Helpful Recipes and Formulae. The illustrations are especially clear and all suggestions are further amplified or made more easy of comprehension by hundreds of thumb nail sketches made by the author.

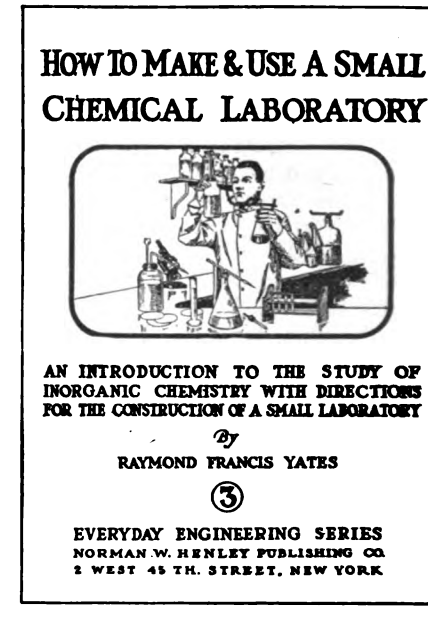


For the Automobile Owner or Driver

This volume is replete with interesting facts compiled by an expert from a mass of information furnished by the Service Departments of leading automobile makers on operation, upkeep, lubrication, location of troubles and simple repairs of automobile parts. The instructions given are concise and to the point and no information that will help in the everyday operation of automobiles is omitted.

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints and a brief simple exposition of location and remedy of roadside troubles apt to occur under ordinary operating conditions.

The permit of logical presentation, the subject matter is divided into four chapters. Chapter 1 deals with the Control and Operation; Chapter 2, Systematic Inspection and Lubrication; Chapter 3, Power Plant and Auxiliary Groups; Chapter 4, Automobile Care and Maintenance Suggestions.



For the Student Chemist and Experimenter

The treatise covers all of the essentials of elementary chemistry. The law of definite proportions, solutions, crystalloids, colloids, electrolysis, etc., are explained. The second part of the book is devoted to chemical and electro-chemical experiments. Only those experiments that will tend to broaden the readers' knowledge of chemistry in general have been chosen.

The third part of the book describes the construction and fitting out of the home chemical laboratory. Directions for the construction of the many simple pieces of chemical apparatus are given. A chemical balance, ring stand, electric furnace, etc., are described in detail, with working drawings. The manipulation of chemical glassware is also treated.

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.

A SPECIAL OFFER TO READERS OF

ANY ONE OF THE ABOVE VALUABLE BOOKS WILL BE

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YC

Fill Out the Special Blank on Page 78 of this Issue. Check Off the Title Desired and Mail with Your Remittance to

Please mention EVERYDAY ENGINEERING MAGAZINE

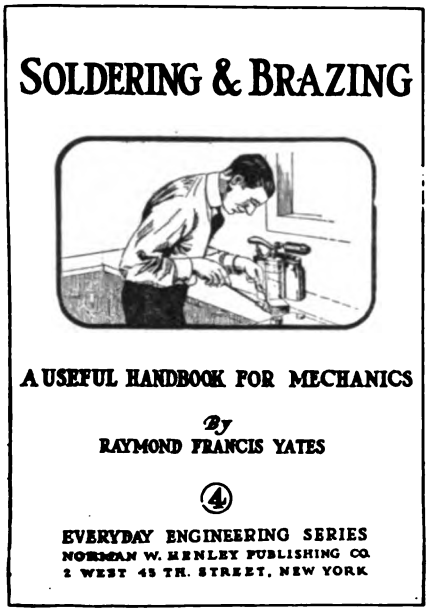
Digitized by Google

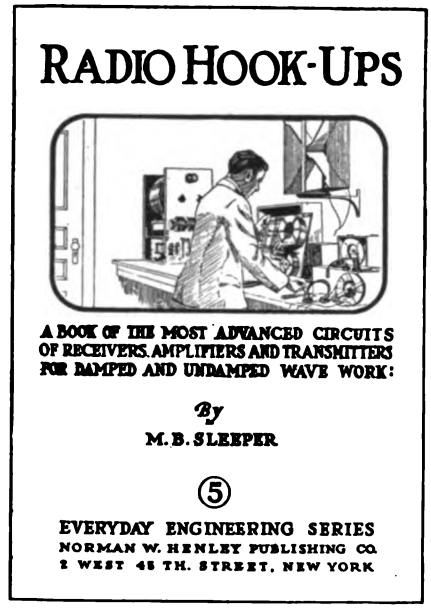
Just Published

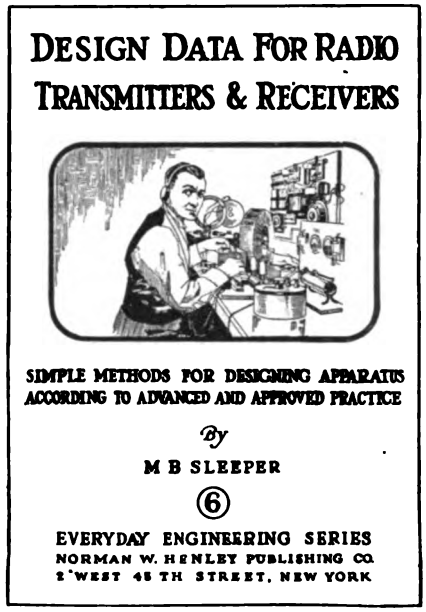
Should be in Every Practical Man's Library

All of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest

RADIO BOOKS CONTAIN MANY WIRING DIAGRAMS







For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work —something that he may heretofore have forgotten.

Hard soldering, for some reason, is not generally known. Hard soldering, however, is very important and must be used in all cases where soft solder does not possess sufficient strength. Hard soldering and solders are thoroughly covered in the book. Nothing has been omitted that will enable the mechanic to apply hard solder successfully.

Brazing and all of its important ramifications are treated in detail. Brazing, like hard soldering, is a process little understood by many mechanics. The book "Soldering and Brazing" is divided in five parts as follows: Part I—Soft Soldering; Part II—Hard Soldering; Part III—Brazing; Part IV—Heating Devices; Part V—Soldering Notes.

For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuits for tuning coils, loose couplers, capacity coupling, variometers and other equipment for receiving long and short damped and undamped waves, damped, undamped and modulated wave transmitters using buzzers, spark coils, transformers, arcs and vacuum tubes, telephone transmitters, laboratory oscillators, vacuum tube characteristic measuring circuits, wave-meters, and audibility meters—in short, diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving constructon or operating details. Spaces are also provided for notes on the results obtained with each diagram. This arrangement, coupled with the skillful selection of the circuits, makes Radio Hook-ups an essential to every radio experimenter or operator.

For the Radio Engineer and Student

Far from being a collection of formulas, Design Data takes up in proper sequence the problems encountered in planning all types of receiving sets for short, medium, and long wave work, and spark coil, transformer, and vacuum tube transmitters operating in 200 meters.

Where formulas are difficult, tables have been worked out so that values can be found without the use of mathematics. The few formulas given are so simple that any school boy can solve them. The subjects are so arranged that, having decided upon the type of receiver or transmitter to be built, the reader can locate immediately the problems and solutions required.

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

SENT **FREE** FOR EACH NEW OR RENEWAL SUBSCRIPTION

OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

EVERYDAY ENGINEERING MAGAZINE, 2 W. 45th ST., NEW YORK CITY

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

(*Continued from page* 68)
the lever folds up flush with the case when not in use. Inside is the breaking mechanism and a small resistance, shunted across the key to prevent sparking and also to keep the buzzer interrupter in vibration between the dots and dashes. This idea might be applied to spark coils as well.

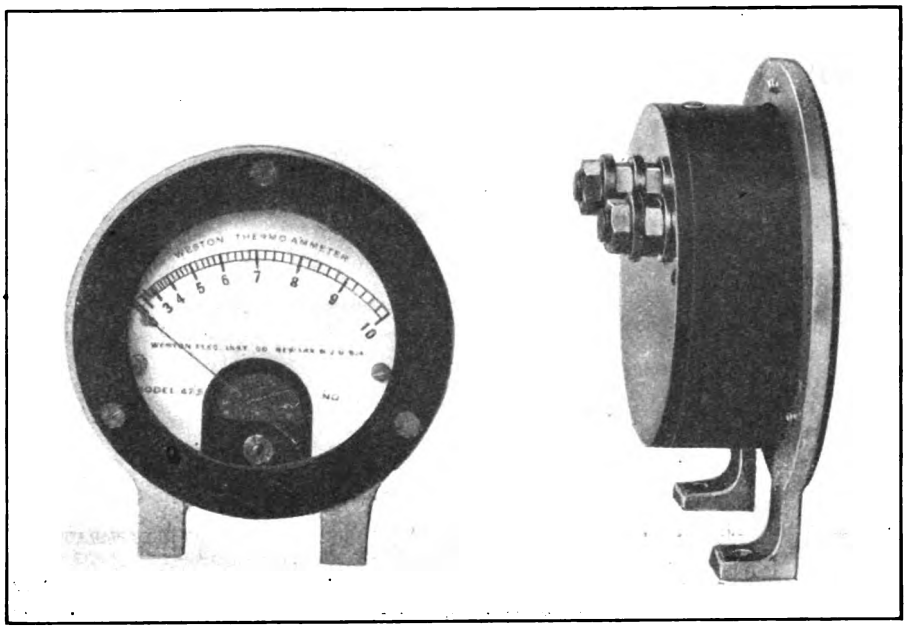


Fig. 3. *Details of the thermo ammeter mounting*

Fig. 3 illustrates the method employed for mounting the Weston thermo ammeter. As it is not practical to use the ordinary flush mounting, a yoke was made to fit around the case, fastened to the flange by machine screws.

In this way the flush mounting effect was secured without actually putting the ammeter on the front panel.

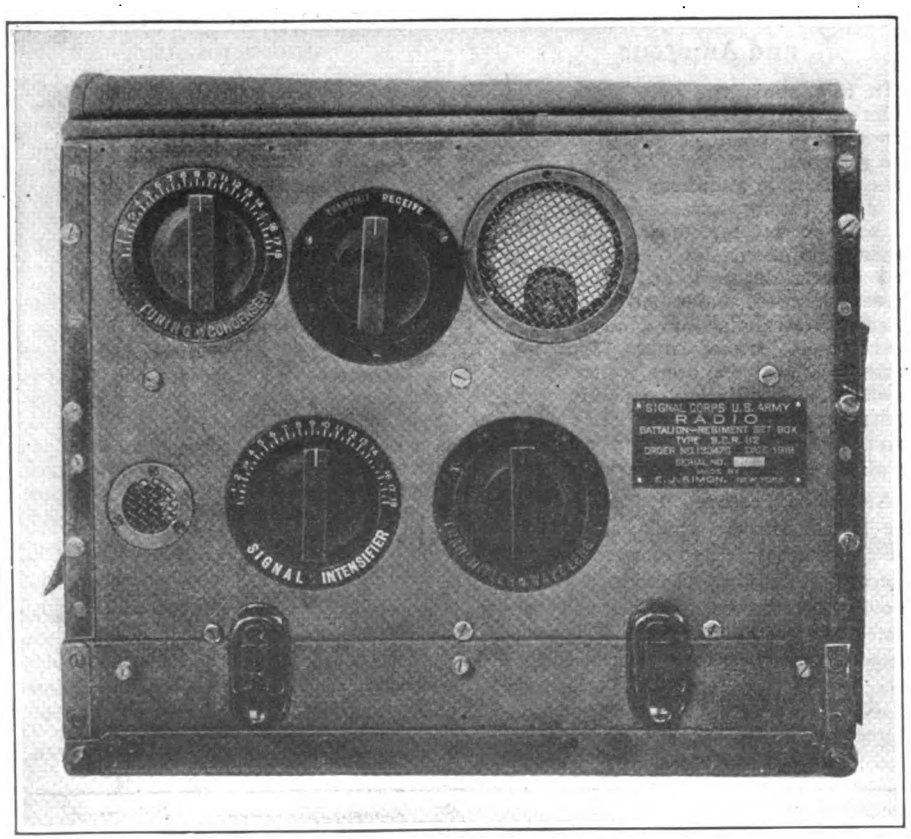


Fig. 4. *Front of the case, showing the controls and location of the spare part box*

Attention is also called to the protection provided for the ammeter and audion observation opening. To prevent the admission of dust, glass windows are provided behind the heavy wire mesh. Fig. 1 shows the opening through which the audion is removed.

THE RADIO INTELLIGENCE POST

The Radio Intelligence Post of the American Legion wishes to hear from former service men who were attached to the Radio Intelligence Section of the General Staff.

Membership in this Post should be interesting to these men for the opportunities it gives for exchange of experiences and social activity, as well as keeping abreast of radio developments.

The secretary is A. L. Bernhard, 1679 42nd Street, Brooklyn, N. Y.

ENGLISH RADIO ASSOCIATIONS

THE American radio clubs will undoubtedly find it of great interest to correspond with some of the newly established associations in England. An exchange of ideas and co-operation can be established in this way. Below are the names of some of the associations and their secretaries.

The Wireless Society of London. Hon. Secretary, Mr. H. L. McMichael, 32, Quex Road, West Hempstead, N.W. London, England.

The Manchester Wireless Club. Hon. Secretary, Mr. J. C. A. Reid, 16, Hawthorn Avenue, Monton, Eccles, Manchester, England.

The Derby Wireless Club. Hon. Secretary, Mr. S. G. Taylor, St. Mary's Gate, Derby, England.

North Middlesex Wireless Club. Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N. 21, North Middlesex, England.

There is a radio society in Belgium with which correspondence can be carried on in the English or French language.

Le Cercle Belge d'Etudes Radiotéléraphiques. The Secretary is M. Pierre Tollenaere, 209, Bd. Leopold 11, Brussels, Belgium.

SOUTH JERSEY RADIO ASSOCIATION

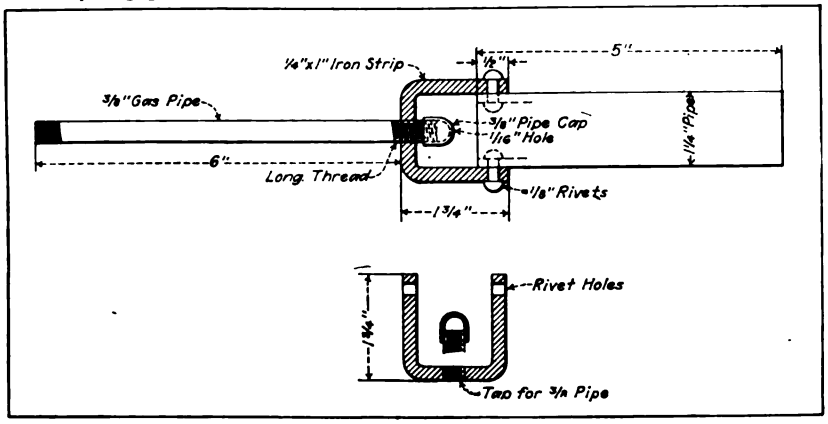
THE South Jersey Radio Association has just elected new officers for the ensuing year. This organization has been in existence for some time. During the war it conducted a radio school and graduated many men who went into the service. It is now looking forward to a bright future and hopes to secure members from all parts of South Jersey. If the experimenters from this part of the country will cooperate with the Association we can make it a live, wide-awake one which will benefit everyone.

The meetings are held every third Thursday of the month at Collingswood, N. J. Communications should be addressed to Edward B. Patterson, West Walnut Avenue, Merchantville, N. J.

Digitized by Google

NON-BACK-FIRING GAS BURNER

THE sketch shows a cheap and easily constructed gas burner that gives a hot flame. All that is needed is a piece of 1¼" pipe, 5" long, and a piece of ⅜" pipe with long thread on one end, a piece of ¼" x 1" iron strip, and one ⅜" pipe cap. Screw the long thread of ⅜" pipe through the ¼ x 1" iron strip and then screw on ⅜" cap to the end of the pipe that projects through with 1/16" hole drilled in the center. This burner can be turned down to mere pilot light when not in use, and will not go out.—*Harry F. Mack.*



Non-back-firing gas burner

SODIUM FLUORIDE AS A WOOD PRESERVATIVE

TESTS made years ago at the Forest Products Laboratory indicated that sodium fluoride might be successfully used as a wood preservative, because it had high toxicity, was not injurious to metal, and was convenient to handle. Laboratory tests alone, however, are never sufficient to establish the value of any material as a wood preservative; actual service tests, even though they require years to complete, are also needed.

In order to obtain comparative durability records, the laboratory in 1914 placed sap-pine ties treated with sodium fluoride, together with ties treated with zinc chloride and creosote, in one of the mines of the Tennessee Coal, Iron and Railway Company, at Birmingham, Alabama. Similar service tests were also started at this time on red oak ties placed in the tracks of the Baltimore and Ohio Railway Company.

After five years of service the mine ties which were treated with sodium fluoride have been found in as good condition as those treated with zinc chloride, both showing very little deterioration. The creosoted mine ties apparently were in still better condition, while the untreated ones were in various advanced stages of decay. The red oak railway ties treated with sodium fluoride were practically all sound, as were those treated with zinc chloride, whereas a large percentage of the untreated oak ties had been removed.

Both of these tests, as well as others started later, must continue for a number of years, yet before the relative value of the sodium-fluoride treatment for ties and timbers is definitely known.

NOTES ON BEARINGS

THE projected area of a bearing is equal to the diameter of the shaft multiplied by the length of the bearing. Pressure per inch, therefore, may be arrived at by dividing the total pressure by the projected areas of the bearing. Required bearing area is the total pressure divided by the allowable pressures per square inch, giving the required projected area in square inches. Required bearing length is the total pressure divided by the desired pressure per square inch, and this again divided by the diameter of the shaft; or the projected area divided by the shaft's diameter.

Allowable pressure per square inch ranges from 10 to 30 lbs. for high-speed shafts in babbitted bearings, to 100 lbs. for large slow-speed shafts. Engine crankpins often sustain 1,000 to 3,000 lbs. the sq. in.

Speed of minimum friction is the ratio of motion at which, if varied from, either faster or slower, the friction of a bearing increases. With perfect lubrication it is believed to be between 100 and 150 ft. per minute.

A curious and not particularly valuable presentation of a hypothetical trip to the moon is given by one of our contemporaries. As there is no atmosphere for an aeroplane propellor to work in, above a certain altitude, the logical deduction is that the propelling motor would have to be of the reaction or rocket type. Then as gravity ceased, if the speed was uniform water would not pour, the operator would float about in his compartment, and a fictitious gravity effect would have to be created by having a constantly accelerated speed. As the efficiency of the reaction engine is very low a vast amount of explosive to operate it would have to be carried—a consumption of some 500 lbs. to the mile might be looked for. The physiology of the operation is not treated of by our authority—life in a vacuum is presumably beyond his planning. Finally he takes the view that there is enough energy for the transit locked up in an ounce of radium, but over 1700 years would be required to get it out.



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6076P, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BUSINESS MANAGEMENT
☐ BRIDGE DRAFTING	☐ Private Secretary
☐ MACHINE DESIGN	☐ BOOKKEEPER
☐ ELECTRICAL ENGINEER	☐ Stenographer and Typist
☐ Electric Lighting and Railways	☐ Cert. Public Accountant
☐ Electric Wiring	☐ TRAFFIC MANAGER
☐ Telegraph Engineer	☐ Railway Accountant
☐ Telephone Work	☐ GOOD ENGLISH
☐ MECHANICAL ENGINEER	☐ Teacher
☐ Machine Shop Practice	☐ Common School Subjects
☐ Gas Engine Operating	☐ Mathematics
☐ CIVIL ENGINEER	☐ CIVIL SERVICE
☐ Surveying and Mapping	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Marine Engineer	☐ Auto Repairing
☐ ARCHITECT	☐ PLUMBING AND HEATING
☐ Contractor and Builder	☐ Textile Overseer or Supt.
☐ Concrete Builder	☐ Navigation ☐ Spanish
☐ Structural Engineer	☐ AGRICULTURE ☐ French
☐ CHEMIST	☐ Poultry Raising ☐ Italian

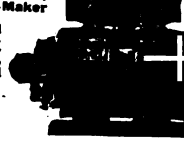
Name_____
Present Occupation_____ 7-26-19
Street and No._____
City_____ State_____

BIG PROFITS for YOU in HB BATTERY CHARGING

Start now to build big battery business. Opportunities best this season—more old cars driven—new Fords with storage batteries. HB users are easily clearing

$100 TO $200 EXTRA PROFIT EVERY MONTH

Some even more. Get in the game! This HB 8-Battery Charger recharges 1 to 8 auto batteries at once. Current costs 10c to 15c per battery—Motorist pays 75c to $1.50. Figure your profits. No Electrical or mechanical experience required to operate No expensive renewals or adjustments. **Small Cash Payment Puts this Money-Maker in Your Shop.** Balance on easy monthly terms. Profits will easily pay for outfit. No burn-outs, no expensive renewals—steady 24 hours a day service with BIG PROFITS. Absolute Money Back Guarantee. Tear out this ad and mail TODAY for information.



HOBART BROTHERS COMPANY
Box EE 41 Troy, Ohio
Successful Manufacturers Since 1893

Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF II SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

Send for This Book of Model Aeroplanes

Tells how you can build and fly accurate, reduced-scale Models of real Aeroplanes; DE HAVILLAND Battle Plane, NC-4 and others. You can build one easily. Send 10c in stamps NOW and get this 48-page book. Plans for Model Aeroplanes—NC-4, 50c; DE HAVILLAND Battle Plane, Curtiss Military Tractor, Bleriot Monoplane, Nieuport Monoplane, Taube Monoplane, 35c each; Cecil Peoli Champion Racer, 25c. Send for Plans or Book Today.



IDEAL AIRPLANE & SUPPLY COMPANY

Making Model Aeroplanes Since 1911

Cor. W. Houston & Wooster Sts. New York

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 7494 431 S. Dearborn St. CHICAGO

UmakeM Airplanes

Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.



Glide "O" Plane

Learn the principles of Aviation by flying our famous Glide "O" Plane, shipped complete ready to assemble and fly with illustrated flying instructions. PRICE 55 Cents POSTPAID IN U.S.A.

Illustrated instructions from which you may carve an accurate propeller complete with a sample propeller blank. 30 Cents POSTPAID IN U.S.A.

Both the above postpaid in U. S. A. 75 Cents. Send for our catalogue D4. It is free.

HEC Aeroplane Co.

345 East 49th St., New York City

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS

Official Organ: American Radio Relay League

Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work all A.R.R.L. News, Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER

Regular price $1.50 per year, 15 cents per copy. Introductory rate: 9 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

Enclosed find $1; please enter my trial subscription to QST for 9 months.

Name_____

Address_____

UmakeM Club

You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 19 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.

W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 5th Ave., N.Y.

MODEL CAR TRUCKS

(*Continued from page* 12)

truck on the roadbed. The sketch, Fig. 8, gives full particulars of the device natural size, and it will, as far as the writer is concerned, be considered as the American model railroad standard fixing for bogie trucks for all vehicles.

The beaming springs should be designed to take a load of about 16 oz. each with a deflection of about ⅛ in., the unloaded length being about ⅝ in. As already mentioned, the coefficients of scale tonnage are:

1 lb. of model = 5.41 tons.

1 ton of original = 0.184 lbs. in the model.

Taking the car at an average of 40 tons, the weight on each spring would possible.

be 40 × 0.184 ÷ 8 = .92 lbs. Tempered springs should be obtained if

The spliced ends of the crossbars and side frames of the truck may be bolted together with 3/32 in. bolts, and where additional realism is desired safety chains—often used in real practice to limit the movement of a truck—may be attached to these bolts.

The transom of the car body may vary in design, but it is suggested that the dimension of its underside (including the metal rubbing plate) being ratined for all types of vehicle at 1 9/16 in. approximately, above rail level. A difference of 1/32 in. either way is of no account.

In view of the fact that a British firm has adopted a similar design to the above, for their ½ in. scale Pullman coaches, and readers can obtain castings, the points of difference, which are solely due to the manufacturing considerations, may be mentioned. The axleboxes and equalizer are cast in one. but instead of the boxes working in a slot in the side frame casting, the latter is milled out as shown in the sketch and the journal rides in this slot. The axlebox therefore provides for the vertical movement and control of the journal, while any longitudinal position of the journal is restrained by the milled slob. The sketches should make this clear.

WHITE WRITING FLUID FOR BLUE-PRINTS

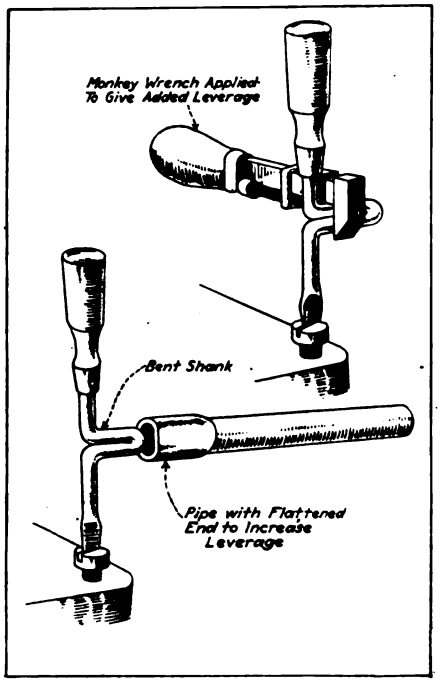
A FLUID which I find is as good as any I have ever used for writing white on blue-prints is made of equal parts of sal-soda and water. Another fluid, not as good, is made by mixing equal parts of borax and water. Both these fluids must be used with a fine-pointed pen; a pen with a blunt point will not work well.

It is proposed by French electricians to use what they term "denatured electricity" for heating purposes. This kind of electric power is supposed to be made unfit for anything but heating, and so is said to be "denatured". The current is periodically cut off or is purposely caused to fluctuate so as to be intolerable for lighting and to work badly for power. For heating such interruptions are of no account.

Digitized by Google

HEAVY DUTY SCREWDRIVER

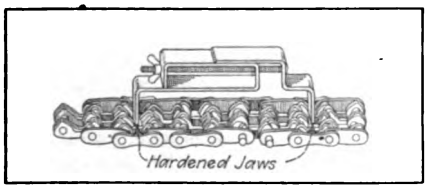
THE improved type of screwdriver shown in accompanying cut will be found useful for turning large or tight screws. Any long bladed driver may be altered by heating and bending it into the shape indicated. It can be



used with a piece of flattened pipe to provide increased leverage, or a monkey wrench can be applied. If the screwdriver is of good grade of steel, the most stubborn of screws ordinarily beyond its capacity if used in the regular way, can be easily turned.

SILENT CHAIN TOOL

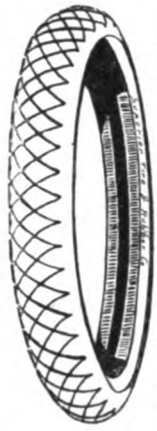
REMOVAL or replacement of the lock link of silent motor chains is made easier by the use of a tool that will draw the chain together while doing the work. Such a tool comprises



two steel hooks made of strip stock that may be caught into the links at each side of the master or lock link and contracted by a thumbscrew and bolt. The steel jaws may be case-hardened to insure durability but this is not absolutely necessary.

The Siemens house is putting an inert dry cell on the market. Its exciting components are absolutely dry, so that it suffers no deterioration from standing for however long a period. Before using it water is added, and it at once becomes active.

Triple the Mileage at ¼ the Cost



4000 Miles Guaranteed

Reconstructed for durability. Superior Super-Fabric Tires represent quality, value, service and satisfaction, and are guaranteed for 5,000 miles good wear. Tires have 12 plies of fabric of ordinary tires making them practically puncture and blow-out proof.

Look at these Low Prices

SIZE	TIRE	TUBE
30x3	$6.00	$2.50
30x3½	7.00	2.60
32x3½ s. s. only	8.00	2.70
31x4	9.00	2.90
32x4	9.25	2.95
33x4	9.50	3.00
34x4	9.75	3.10
34x4½	11.25	3.35
35x4½	11.50	3.40
36x4½	12.00	3.50
35x5	12.75	3.70
37x5	13.25	3.85

Reliner Free With Every Tire—State whether you want straight side or clincher, plain or non-skid. Send $2.00 deposit for each tire; $1.00 deposit on tubes; balance C. O. D. subject to examination, or 5% discount if full amount is sent with order.

SUPERIOR TIRE & RUBBER COMPANY
Dept. 100, 633 First Avenue, New York City

$1 Week pays for the **Black Beauty**



Nature's Lure

The freedom of riding anywhere is yours if you own a Black Beauty. The speediest, classiest bicycle you ever laid eyes on.

We want to send you this wonderful bicycle. Write for big, free catalog illustrating many styles. Pick out the one that appeals to you.

We ship at our risk. We pay freight. After examining it you pay a small deposit. Then, send a dollar a week. No waiting to save up.

18 Exclusive Features—Remember the Black Beauty is a **real** bike. Chockfull of "class." Graceful lines. Powerful steel construction. Fascinating color combinations.

Factory Wholesale Price
You save money by our "direct-to-you" plan.

Repair Kit, Tool Case and Stand Free! Don't wait. Write for Catalog **now!**

Sundries Get our factory prices first. Lowest anywhere. Tires, stands, horns, lamps, parts, etc. Sundries Catalog sent free.

Haverford Cycle Co.
Established 24 Years
Dept. 474 Philadelphia

FREE Puncture Proof TUBE
6000 Mile Guarantee



UNION TIRES represent the highest standard in reconstructed tires. Their reinforcement of 4 extra layers of fabric reduces greatly blowout and puncture possibilities. Over 200,000 in use. To further increase mileage, we include with every tire ordered **A PUNCTURE PROOF TUBE FREE** that under ordinary conditions will last ten to 20,000 miles. Our 5,000-mile tire guarantee certificate with every tire.

Prices Include Tire and Tube

30x3	$7.40	32x4½	$12.00
30x3½	8.90	33x4½	12.50
32x3½ S.S. only	9.10	34x4½	13.15
31x4	10.35	35x4½	13.40
32x4	10.70	36x4½	13.85
33x4	11.15	36x5	14.85
34x4	11.50	37x5	14.95

Reliner Free With Every Tire

State whether you want straight side or clincher, plain or non-skid. Send $2 deposit for each tire ordered, balance C.O.D., subject to examination, or 5 percent discount if full amount is sent with order.

UNION RUBBER COMPANY
Dept. 89, Racine Ave. & 15th St., Chicago

FREE Puncture Proof Tube
18,000 Miles Record of this Tube



A puncture proof tube FREE with every Public Tire ordered. Public Tires are reconstructed and guaranteed on 6,000 mile basis.

Price Includes Tubes and Tires

28x3	$ 6.80	34x4	$11.30
30x3	7.20	34x4½	12.95
30x3½	8.30	35x4½	13.20
32x3½	8.90	36x4½	13.70
31x4	10.15	35x5	14.35
32x4	10.50	36x5	14.70
33x4	10.95	37x5	14.95

In ordering state whether SS or CL is desired. Send $2.00 deposit for each tire. Bal. C. O. D. subject to examination. 5% special discount if full amount sent with order.

We send you our guarantee bond with order. This is your protection.

PUBLIC TIRE CORPORATION
Dept. 57, 3500 S. Michigan Ave., Chicago, Ill.

SHIP BY TRUCK

Motor Cartage.

One to Five-ton Trucks.

Hauls made to any point in United States and Canada.

Rates by hour, day or contract.

W. H. SQUIRES
1561 Woodward Avenue
Detroit, Mich.

NEW PLUGS FOR OLD

Your used Spark Plugs made new by our process.

We clean and repair any Spark Plug.

AGENTS wanted.

SPARK PLUG SERVICE CO.
6 Hendrie Ave.
Detroit, Mich.

You Can Save $50.00



By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

$8.46 and up Parcels Post Paid

LIBERTY TOP & TIRE CO., Dept. E3, Cincinnati, O.

BACK NUMBERS OF EVERYDAY ENGINEERING MAGAZINE

Cannot be supplied dating back of January, 1919. All back numbers are now 20 cents, and only a few are in stock. SUBSCRIBE NOW—YOU CANNOT AFFORD TO MISS A SINGLE ISSUE.

Digitized by Google



NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$28.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$52.50
1	H. P., 110-220 volts, repulsion, with sliding base	$76.50
2	H. P., 110-220 volts, repulsion, sliding base	$116.50
3	H. P., 110-220 volts, repulsion, sliding base	$142.50
5	H. P., 110-220 volts, repulsion, sliding base	$184.50

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

6 volts, 10 amp.	$19.50
15 volts, 10 amp.	$24.50
40 volts, 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 volts, 5 amp.	$46.50
40 volts, 30 amp.	$78.50
110 volts, 10 amp.	$106.50
110 volts, 26 amp.	$146.50
Moving Picture Arc Generator 60 v., 35 a.	$106.50

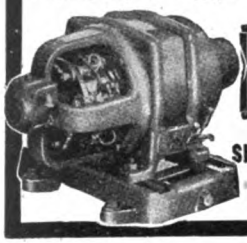
Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$64.00
2 H. P.	$81.00
3 H. P.	$96.00
5 H. P.	$112.00
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase. Voltage as specified.

110-220 v., A.C., 150 watts, 15 v., with switchboard	$68.50
110-220 v., A.C., 150 watts, 30 v., with switchboard	$68.50
110-220 v., A.C., 175 watts, 24 volts, with switchboard	$68.50
110-220 v., A.C., 250 watts, 36 volts, with switchboard	$88.50
220 volts, 2 phase, 600 watts, 24 v., without switchboard	$75.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

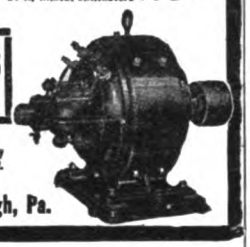


SPECIAL **1/4 H.P.** 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley



WASHING MACHINE MOTORS Suitable for operating ¼ Small Compressors, Coffee Grinders, Bottle Washers, Etc. **$22.75** Each Reg. Val. $32.50

MONEY BACK GUARANTEE



SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.



PREVENT WASTE
Put the Grease where it is Needed

THE BRIDGEPORT
Center Thread Grease Cup

This cup will squirt more grease than any cup of the same size made.
Equip your machine, auto or boat with this new type of grease cup, one that does not leak, that cannot be cross-threaded and that forces the grease to the bearing points.
The cleanest Grease Cup made.

Send for Circular and Price List

THE GARRISON COMPANY
348 George St. Bridgeport, Conn.

Genuine Armstrong Stocks and Dies



Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.

Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.

Send direct to us if your dealer cannot supply you.

Descriptive Catalog on Request

The Armstrong Manufacturing Co.
701 Knowlton Steet Bridgeport, Conn.

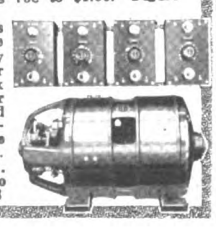
Big Profits in Battery Charging with the HB 32 Battery Charger

$150 TO $350 CLEAR PROFIT EVERY MONTH WITH THIS HB32 BATTERY CHARGER

You can recharge 32 6-volt auto batteries or equivalent in 12- or 24-volt batteries, at one time, for 10c to 15c each. Customer pays 75c to $1.50. Figure those profits!

Small Investment Puts This Money-Maker in Your Garage

Balance on easy monthly terms. Outfit easily pays for itself. Absolute Money-Back Guarantee. No burnouts or renewals. Easy to install and operate. Only attention needed is occasional oiling. Write TODAY for full information.



HOBART BROTHERS CO.
Box EE43 Troy, Ohio
Successful Mfrs. Since 1893



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.

MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.

MODEL ENGINE CASTINGS

For engines described in previous numbers of "Everyday Engineering." Castings made in Bronze or "Duralite." Model water pumps also supplied.

J. E. CARRINGTON
49 So. Clinton St. East Orange, N. J.

A SMALL HIGH FREQUENCY ALTERNATOR

(*Continued from page* 52)

point of maximum sensitiveness. A buzzer used for this purpose often produces too heavy a current and many times burns the point of a detector crystal and renders it insensitive. The little high-frequency alternator described can be used successfully as a substitute for the buzzer and will be found much more efficient for this purpose. By the use of a rheostat inserted in the input circuit or in the circuit of the first buzzer, the amount of current flowing through the detector crystal can be controlled. The frequency of the machine can also be controlled nicely by adjusting the speed of the motor. By the use of a higher frequency it is possible to bring the detector to a higher point of sensitivity as the human ear is more sensitive to the higher vibrations. A buzzer is continuously getting out of adjustment and it is almost impossible to keep one in perfect order. This disadvantage is entirely overcome by the use of the high-frequency alternator. Once the motor speed is set, the frequency of the machine will not vary in the least and the machine can be run indefinitely. When the device is used for wireless work it can be controlled by push buttons in the same way a buzzer is controlled.

PAINTING IRONWORK

THERE are many positions where girders and other iron members are used which are not prominently in view, and often because metal work is not in immediate view it gets neglected. In putting in out-of-sight work it should be all cleaned thoroughly and have one or two coats of red lead and raw linseed oil paint, usually about 4 lbs. red and 1 lb. old white lead thoroughly ground together, forming the pigment, no driers or turpentine being used. The paint is made fresh as required, and is well worked in with stiff paint brushes, each coat being allowed to dry before a succeeding one is applied. After the work of building is finished all dirt should be cleaned off the ironwork, and if the paint has been removed or broken another coat should be applied. In places where stream and moisture is prevalent all concealed ironwork should be examined and, where necessary repainted at least once a year, but where exposed to view there is less need to specially hunt after paint defects, as they soon make themselves apparent.

Terrestial heat is believed to be profoundly influenced by the presence of radium in the crust of the earth. And now comes the theory that the heat encountered in driving the Simplon tunnel was in part at least due to radium. It is very obvious, as is stated, that if there had been enough radium it would have been impossible to construct the tunnel.

Digitized by Google

TESTING GLOVES FOR USE OF LINEMEN

SOME day when you are walking along a "main-traveled" road where traffic is piled back as far as one can see and linemen are repairing a broken wire, stop and watch them work. They are interesting artisans; the most interesting phase of their operations you will not see. The gloves they wear tell a unique story. Probably the line they are handling is "alive", and carrying electric current enough to cause instant death, yet they pick it up, twist it, splice it as nonchalantly as though handling fishing tackle. They are able to pick up the live wire because of the rubber gloves they wear. Did you know that these gloves are today made according to rigid specifications completely standardized, and that no purchasing agent dare buy rubber gloves until he has thoroughly tested them?

No glove can be marked with the manufacturer's name or with the size in such a manner as to injure it in any way. Every glove must be more than 14 inches long and the average thickness not less than 60 mils. They must have a tensile strength of 1,200 pounds per square inch and bear having two inches of their surface stretched to twelve without a rupture. The gloves shall be capable of withstanding the application of 18,000 volts without puncturing. The dielectric test is made by immersing the glove in a pan of water with the glove nearly full of water. The water inside and outside of the glove forms the electrodes. These are conveniently connected to the testing transformer by means of a chain suspended within the glove and by direct connection to the retaining vessel.

After the gloves are purchased, rigid inspection is insisted upon; they are subjected to periodic high voltage tests weekly or monthly, cleaned with soap and water and stored in cold, dark places. They are marked by serial numbers and their history kept. You understand that should one of the linemen you have been watching puncture his gloves, death may result. The perfection of linemen's rubber gloves is one of the silent romances of the electrical industry. They are as important in the day's work as the steel helmet in battle. Today line work is a hundred times safer than formerly, for now when a line is deadened the switch is usually of the modern safety enclosed type and no other person but the man on the line holds the key that locks the disconnected switch.

Melted quartz, now coming into many uses will not crack as glass does under sudden changes of temperature. An immersion heater is produced in England, in which the core on which the wire is wound as well as the enclosing tube are made of quartz.



Sharp Turn!

It's easy for this fellow. Steering 'round corners and out of tight places is a feature of the Auto-Wheel Coaster and Auto-Wheel Convertible Roadster. These wagons develop the best motorists — with sharp eyes and keen nerves.

Roller-Bearings, cut-under wheels, wide-sweeping steering-tongue. Built durably to give years of service. The Auto-Wheel will carry a 1,000 lb. load.

Two types: Auto-Wheel Coaster — for all 'round coasting and hauling. Auto-Wheel Convertible Roadster — two wagons in one, changed from box wagon to speedster in half a minute.

Felt Pennant Free

Also descriptive booklet, and our new magazine for boys — for the names of three local coaster dealers. Mention which one handles the wagon with Auto-Wheel Coaster or Auto-Wheel Convertible Roadster on the sides

Organize an Auto-Wheel Coaster Club. Free caps to members. Special cap to Captain. Get busy.

The Buffalo Sled Company,
159 Schenck St., N. Tonawanda, N. Y.
In Canada: Preston, Ont.

LEARN WIRING!
EARN $75. A WEEK
This Year's Edition Will Make You an Expert Wireman

SEND FOR IT TO-DAY



440 Pages
Illustrated

The National Authority for 26 Years

All the latest underwriters' rules. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting or motor installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. How to install and operate generators, motors and every kind of wiring device with diagrams of connections.

Leather Cover. Pocket Size. Gilt Edges.
Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, JR.
6 W. 40th Street New York

Earn $35 to $100 a Week
BECOME A PROFESSIONAL PHOTOGRAPHER

Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:
MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free
Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.
N. Y. INSTITUTE of PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.



10 Cents a Day Pays
for This Symphonola

Plays all records, Victor, Columbia, Edison, Pathe, Little Wonder, Emerson. Take a year to pay, after 30 days' trial. Compare its tone for clearness, volume, with more costly instruments. Return at our expense if it fails to make good. Ask today for the
Beautifully Illustrated Symphonola Book FREE
Shows this and other Symphonola styles sold on easy payments.

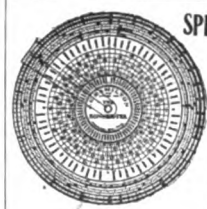
Symphonola Records Get our list of the latest song, dance, popular, clear sounding, full toned disc records. Playable on any Phonograph.

Larkin Co. Desk SEE 420, Buffalo, N. Y.

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46M, E. 12th St., N. Y., U.S.A.



SPECIAL KON-VER-TER SLIDE RULE

The original KON-VER-TER slide rule has over 8,000 graduations and over 1,800 letters and figures, will handle anything in Arithmetic, Algebra, Geometry or Trigonometry. Is 5.4 inches in diameter and in use all over the world, is much simpler to operate than others of similar construction. Eventually you will get the KON-VER-TER—get it now and save money. Plain Utility rules $1.00; Special De Luxe white ivory celluloid $2.50. Leatherette case 50c extra.
J. C. HAMILTON & CO.
Dept. F-7 Water St., Boston, U.S.A.



$110 A Month To Start As Railway Traffic Inspector

ONLY THREE MONTHS' spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad-minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today, and they're on the road to still further advancement, so write immediately for Booklet D 48 before you turn this page.

WE ARRANGE FOR A POSITION

Standard Business Training Institute, Buffalo N.Y.

STUDY HUMAN NATURE

MAKE PEOPLE LIKE YOU

Get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "PERSONAL POWER," a little book that points the way. Address
PROGRESS LEAGUE, 5831 Union Sq., N. Y.

Digitized by Google

Pattern Work in Wood and Metal

Prompt Service Guaranteed

Mail Order Work Solicited

Perfect wood or metal patterns made for any of the machines or model engines described in Everyday Engineering Magazine.

BRING YOUR PATTERN PROBLEMS TO US

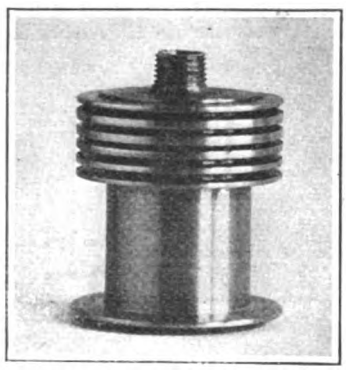
We solicit the work of experimenters, inventors and model makers. Quotations gladly made upon the receipt of drawings and specifications. Patterns both large and small made for any part no matter how intricate or complicated.

Have you had the sad experience of taking a set of home-made patterns to the foundry only to have the foreman laugh and tell you that they are made wrong? Let us save you this embarrassment.

Our charges are reasonable, our service prompt and courteous.

U. S. PATTERN AND MFG. CO.

64-66 High Street, West. Detroit, Mich.



MODEL COMPRESSED AIR MOTORS

We are the manufacturers of rotary compressed air motors suitable for the propulsion of model airplanes. Motors are made of the very best materials with cylinders turned from solid steel stock.

SPECIAL WORK

We also build motors to specification and will be glad to furnish quotations upon the receipt of drawings and details.

MODEL SUPPLIES

We manufacture a line of model supplies and will send complete list together with prices upon receipt of stamp.

MODEL MACHINE SHOP CO.

415 E. 71st St. New York, N. Y.

A Necessity for Every Shop

"The Samson No. 3 Bench Punch," with a powerful leverage of 24 to 1, is intended for work beyond the capacity of the "Samson Hand Punches," and will punch holes from ⅛ to ⅜ in. in soft metal up to 12 Gauge. Extra sets punches and dies size ⅛, 3/16, ¼, 5/16, and ⅜ in. easily inserted and removed, (maximum punching capacity 3/16 in. through 12 gauge soft metal.)



Equipped with 3-16-inch Punch and Die unless Otherwise Specified.

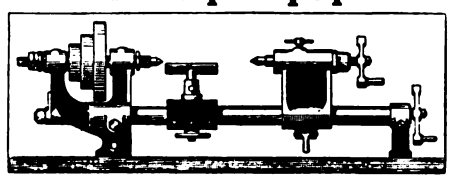
Price $12.50 F.O.B. Factory

Catalog of Complete Line Sent on Request.

The Machine Appliance Corporation

351 Jay Street, Dept. Eng. BROOKLYN, N. Y.

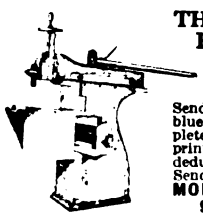
Model Shop Equipment



6 INCH BENCH LATHE

Castings or finished machine. Shop tools and supplies. Designs for Model Boats. Drawings of U. S. Destroyer. Stamp for catalog.

HUHN MFG. CO., 590 Elm St., Arlington, N. J.

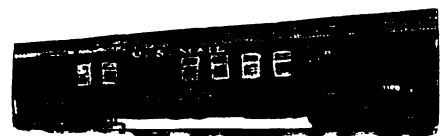


THE HURD 7 INCH HAND SHAPER

Rough Castings or Finished Machine

Send 25c for construction blue prints or $1.00 for complete set of detailed blue prints. This amount will be deducted from first order. Send stamp for circular.

MODEL TOOL WORKS,
908 West 3rd St., Plainfield, N. J.



WANTED—Railway Mail Clerks

Beginners Get $1300 a Year

Hundreds Men Boys over 17 Needed at Once

Sure Pay. Life Job. Full Unnecessary.

Coupon

Franklin Institute,
Dept. S-97, Rochester, N. Y.

Sirs: Send me, without charge, (1) sample Railway Mail Clerk Examination questions; (2) schedule showing places of all U. S. Government coming examinations; (3) list of other government jobs now open to men and women, and (4) free book describing them.

NAME.....

ADDRESS.....

ENGINE ROOM HINTS

LEAKY boiler settings may be made lastingly tight by soaking cheap waste or asbestos from old discarded pipe covering in thin fire clay and hammering the mixture into the cracks. Paint the brickwork with thin fire clay or cement.

In packing valve stems of piston rods, never use old packing that has been removed. It has lost its elasticity, and there is danger of its scoring the rods.

Frequently the sight feed glass of a lubricator fills with oil. If the oil is removed from the body of the cup and it is filled with water and started up in the usual way the water will float the oil out of the blast without further trouble.

DETECTING SULPHURIC ACID IN OIL

BROUGHT into contact with moisture, any acid present in the lubricant will cause corrosion. The presence of sulphuric acid may be detected by a solution of barium chloride in distilled water. Thin the oil by mixing it with an equal quantity of gasoline or benzine. Add a few drops of the barium chloride solution, and if the oil contains sulphuric acid, a whitish precipitate will be revealed. In the absence of moisture, sulphuric acid is not so active and may escape detection.

Dr. W. H. Eccles in a recent discussion before the British Association said that the three electrode vacuum tube was revolutionizing wireless telegraphy. One point made was that it can be used with small receptive antennae. By its use speech, he said, has been freely transmitted across the Atlantic. He thought it possible that it may yet be used in the field of electric power. In his laboratory he has detected currents due to 10-10 volts; at times a magnification of 20,000 was involved. He calculated that with a fifty-mile length of cable submerged on each side of the Atlantic with a 40-ampere current and a frequency of 20 to the second, telegraphic messages could be dispatched.

The production of tungsten has doubled during the war. Portugal, Spain, France and Great Britain are credited with 2,500 to 2,800 tons, North America with 6,000 tons. South America with 3,000 to 3,500 tons, India, Siam, Australia and the Malay States with 5,500 to 6,000 tons, and China, Japan and Indo-China with 800 to 1,200 tons. Although produced in such small tonnage, it is one of the most important metals in the world. In its use in incandescent electric lamps it has increased the efficiency of that type of lamp fourfold, and has brought about the manufacture of such high candle power lamps that they almost rival the arc lights in power.

From Canada comes the suggestion to use water transmission lines for the conveyance of voice messages by what is known as "wired wireless"; in this system a metallic line is used in connection with wireless transmission methods. to effect in some degree a limitation of transmission to one station.

Digitized by Google

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.

Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop then.

PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs.

Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School

YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

"Old Town Canoes"

An "Old Town Canoe" will jump at the thrust, or glide at the dip of a paddle. Floats light as a fleck of foam, but every "Old Town" has the built-in strength and sturdiness to withstand many years of rugged service. For the youngsters, buy the "Sponson Model" the canoe that's safer than a row boat. Write for catalog. 3000 canoes in stock. $67 up from dealer or factory.

OLD TOWN CANOE COMPANY
944 Fourth Street
Old Town, Maine, U. S. A.



You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 907 Bogue Bldg., Indianapolis

UmakeM Lathe

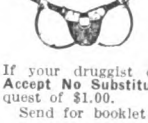
You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $25. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address **W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.**

PRINCE ALBERT

the national joy smoke

Our exclusive patented process cuts out bite and parch.

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit and low price. If your druggist does not carry Schnoter's, **Accept No Substitutes.** Sent direct upon request of $1.00.

Send for booklet of other styles and prices.

J. C. SCHNOTER CO.
628 SIXTH AVE. Dept. (E) N. Y. CITY

SAFETY RAZOR BLADES

Safety Razor Blades, all makes sharpened with the "Minit Sharpner." Can be carried in the vest pocket. 50c postpaid.

Send 60c and get a Sharpener with a "Sail me" Airplane; fun and instruction for the kiddies. Airplanes singly, 15c postpaid.

OLDWELL MANUFACTURING COMPANY
240 Broadway, Room 11, New York, N. Y.

Stop Forgetting — Memory the Basis of All Knowledge

The Key To Success

The secret of business and social success is the ability to remember. I can make your mind an infallible classified index from which you can **instantly** select thoughts, facts, figures, names, faces. Enables you to **concentrate, develop self-control, overcome bashfulness, think on your feet, address an audience.** Easy. Simple. The result of 20 years' experience developing memories of thousands.

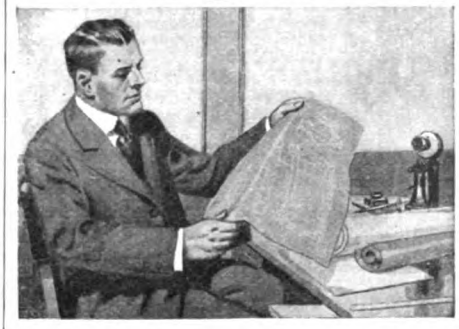


Prof. Henry Dickson, Principal

Write Today for free booklet "How to Remember" and **Copyrighted Memory Test,** also how to obtain my FREE book, "How To Speak In Public."

Dickson School of Memory, 1740 Hearst Bldg., Chicago, Ill.

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now.*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6077B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

Professional Assistance and Consultation

We solicit the patronage of inventors and will give prompt, confidential service in the perfection of ideas. Complete drawings and plans prepared. Specialists in steam and gas engine appliances.

Correspondence Invited.

Let Us Know Your Problem

Bell & Hoyt
1731 Broadway, New York, N. Y.

INVENTORS;
I MAKE WORKING MODELS
Send Sketch and Description for Free Estimate
BENNIE NORTWED, KELLERTON, BOX 101, IOWA.

MR. INVENTOR! Let us assist you with that idea that you can't just work out, or let us construct a model of your patent. We develop ideas, and are experts in MODEL and EXPERIMENTAL work. We specialize in designing and building special LABOR SAVING MACHINES. Or perhaps your device is ready for manufacturing. If so, get in touch with us. It would be to our mutual advantages.
ELK MFG. CO., INC.
1926A Broadway, New York

UmakeM **Outfit** No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys NOW.
W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

EVERYDAY SCIENCE NOTES

The preparation of tungsten filaments for incandescent lamps is carried out in the general way as described here. The crude oxide is dissolved and reprecipitated and heated to expel any ammonium salts it may have retained from the precipitation. Some thorium nitrate is mixed with it and it is compressed into a prismatic shaped bar, eight inches long and a quarter of an inch square by hydraulic pressure. It is heated in a gas furnace until it sinters. The heating is then completed in a reducing atmosphere by passing an electric current through it. It is then drawn down into wire, graphite being used as the lubricant. The thorium must be in just the right proportions.

In welding operations on the large scale as in ship-building, it is found that arc welding is slower and takes more labor charge, but requires less power and a less expensive apparatus. Butt and spot welding are done by incandescence and plates three inches thick can be successfully spot-welded. For seams between plates to be joined arc-welding is much employed. Metallic electrodes are favored for arc work, and the skill of the workman counts for a great deal in the work.

It is claimed that by the use of wire of streamline section, rafwire, ten miles an hour have been added to the speed of an aeroplane. The designation "raf" stands for Royal Aircraft Factory.

If a machine in a factory breaks down it may be an affair of days to replace it. If it is a workman that is injured he can be replaced without delay. In Germany it is said there is a special insurance to cover the contingency of the breaking down of machines; in case of a machine failing the insurance company is held obliged to immediately replace it. It is obvious that this might be an impossibility, however.

As it begins to appear that the resources of the world in tungsten are limited, molybdenum comes in as a substitute for tungsten in high speed steel. This has already been noted in these notes. The production of molybdenum in Canada in 1918 was ten times what it was in 1914. If tungsten is to be scarce it is well to keep it for incandescent lamp filaments and to use the commoner metal, molybdenum, for steel.

According to some calculations at the present rate the petroleum resources of the United States will be expended by 1927. Other countries are searching for oil, the Argentine Confederacy and England among the most prominent.

A good deal of work is being done in the development of the production of electrolytic iron. Electrolytic copper has long had a place in commerce, and now a very pure iron is being precipitated by the electric current from the solution of the metal. A rotating cathode receives the deposit, which is stripped from it as a sheet from time to time. Hydrogen gas accumulates on the cathode and interferes to some extent with the progress of the operation. The iron produced is very soft. After fusion it can be cut with a knife like copper, and is as malleable as that metal. It is of special value for tubes and sheets. Under the microscope it shows a lamellar structure.

Telegraph Pictures
BY ELECTRICITY
A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.
L. J. LEISHMAN CO. Dept. L, Ogden, Utah



SEND $1. TODAY
For One Hundred Successful Circular Letters. No two copies alike. Letters that pulled business in 100 different lines of business. This is not a book that tells "How to Write Letters," but gives the complete copies of each letter. Worth their weight in gold.
Special letters prepared on every subject, $5. each. Three follow-up letters, $15.00.
These letters are endorsed by advertising agencies and the press.
Established Reputation (25th Year)
ROSENBLUM ADVERTISING EXPERT
1482 Broadway, New York City



Small Investors Wanted
To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.
For full particulars address
Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

DRAFTING
Inventions and Ideas Developed!
Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE
A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

Don't Wear a Truss



Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.
Mr. C. E. BROOKS
Brooks' Rupture Appliance
Has automatic Air Cushions, Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.
Brooks Appliance Co., 284A State St., Marshall, Mich

Your Prospective Customers
are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.
Send Them Sales Letters
You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"
Ross-Gould Mailing Lists St. Louis

Digitized by Google

THE
Wireless World

The Official Organ of the Wireless Society of London

Commencing with April 3d, will be published fortnightly in order to adequately deal with the increasing amount of Wireless Experimental and Research Work.

Full of Practical hints and useful information for Wireless Amateurs.

Extensive reports of the Wireless Societies of Great Britain.

Annual Subscription 17s, Post Free

Single Copies 9d, Post Free

To be entirely up-to-date in your knowledge of Wireless you must be a subscriber to The Wireless World.

To the Publisher,
The Wireless World,
12-13 Henrietta St.,
London, WC2, England.

Please enter me as a subscriber to the Wireless World for the period ..... to .....
for which I enclose .....
Name .....
Address .....
Please write distinctly.

THE
RADIO REVIEW

A MONTHLY RECORD OF SCIENTIFIC PROGRESS IN RADIO TELEGRAPHY AND TELEPHONY

Monthly - Half-a-Crown

Single copies, post free 2s. 9d. Annual Subscription, post paid, 30/- post free.

THE RADIO REVIEW, a new monthly magazine, devoted entirely to the technical side of radio communication.

Edited by Professor G. W. O. HOWE, D.Sc., M.I.E.E., assisted by PHILIP R. COURSEY, B.Sc. A.M.I.E.E.

THE RADIO REVIEW is the Authoritative Journal of Wireless Research. Contributions from the pens of the World's leading Radio Scientists will be a special exclusive feature.

. . . . . .

Editorial and Publishing Offices
12-13, HENRIETTA STREET
LONDON, W.C. 2

FREE APPARATUS!!

You get a coupon valued at 50 cents for every subscription you receive for "Pacific Radio News." These coupons are as good as cash when presented at radio supply stores.

Your own subscription or extension of your present subscription will be credited with one coupon.

Send for a copy of "Pacific Radio News" today and learn about the FAIR PLAY contest.

15 cents per copy
$1.50 per year.

PACIFIC RADIO PUB. CO.
50 Main St., San Francisco, Cal.

USEFUL BOOKS

FOR THE PRACTICAL ELECTRICIAN

Wiring a House

By HERBERT PRATT. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules; in fact, just the information you need. Directions apply equally to a shop. Fourth edtion.

Electric Bells

By M. B. SLEEPER. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated.

Norman W. Henley Publishing Co.
Dept. EE, 2 West 45th Street, New York





Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

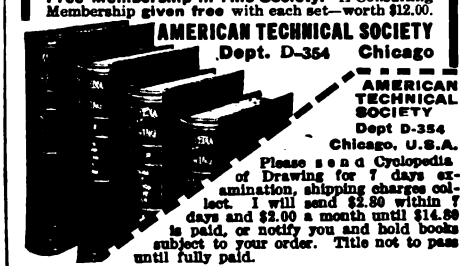
4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-354 Chicago



AMERICAN TECHNICAL SOCIETY
Dept D-354
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days examination, shipping charges collect. I will send $2.80 within 7 days and $2.00 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....
Address.....
Reference.....

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

AGENTS. Signs for store and offices. Entirely new. $50-week easily made. Chicago Sign System, I-326-River St., Chicago.

SCIENCE CREATES NEW AUTO WONDER; solves puzzling problem; no more rain or snow blurred windshields; mystic cloth works like magic, deposits invisible chemical film; one rub keeps glass clear 24 hours; one agent sold 5,000. Security Mfg. Co., Dept. 255, Toledo, Ohio.

MAKE $30.00 NEXT SATURDAY. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Mich.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

MORE POWER, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

TIRES—10,000 MILES GUARANTEED IN WRITING. (No seconds). At special Wholesale direct-to-you prices. Don't buy until you get our prices. Write Washington-McLean Tire Co., 2104 14th St., N. W., Washington, D. C.

Aviation

$175.00 BUYS motors, propeller, wing frames, tail frames and under-carriage for single seater tractor biplane. Brubaker, 522 East 78th Street, New York.

MIX your own airplane dope. Perfect results easy. Small cost. Guaranteed formula $1.00. Send stamp for sample. Pianoloid, Box 309, Old Town, Me.

BUILD YOUR OWN AEROPLANE, on installments, materials cut to fit or in the rough. J. Angeles, Centralia, Wash.

Books

BOOKS DELIVERED FREE. Write today for Illustrated Guide to the Latest Books. Wesley Mills Co., Dept. A, 500 Fifth Avenue, New York, N. Y.

FORD CAR REPAIR BOOK sent free. This complete, well illustrated, valuable book explains in a simple way the Causes and Cures of Overheating; Repairing Ford Timer; Curing Piston Ring Troubles; Carburetor Adjustments and Repairs; Connecting Rods; Transmission Troubles; Care and Repair of Rear Axle; Stopping Axle Grease Leaks; also covers practically every other phase of Ford Car repairing. Another feature is a chart showing exactly how much to pay for work done by repair men. Send 25c coin for three months' trial subscription and get the valuable repair book free. Ford Owners' Magazine, 499 Montgomery Bldg., Milwaukee, Wisconsin.

MARRIED AND ENGAGED people should read "Science of a New Life," nature explained. 400 pages illustrated, $2.00. Central Company, 601 Ninth Ave., New York.

"LOVERS' PACKAGE" containing instructive and pleasing books for lovers, 75c. Central Company, 601 Ninth Ave., New York.

"DON'T MARRY," read this book first, 25c. Central Company, 601 Ninth Ave., New York.

Business Opportunities

AMBITIOUS MEN—Grasp this opportunity to make money. You can make $5.00 to $10.00 every day in your spare time at home. Not a cheap scheme, agency or soliciting proposition, but substantial business plans. Investigate this today. Address, Business, Box 175, Fredonia, N. Y.

$1 DOES IT. Texas oil land making holders big money everyday. Bank references furnished. Investigate us thoroughly, that's all we ask. Results count. Our plan, $1 down, balance monthly, few months gives you Warranty Deed to land. May pay profits $200 or more monthly. Maps, reports, established facts FREE. Address Sourlake Texas Oil Co., —— DeMenil, St. Louis, Mo.

USED CORRESPONDENCE COURSES Bought and Sold. E. Moffett, Ruston, Louisiana.

THE BUILDERS SUPPLY and EQUIPMENT business requires no capital and commissions can be earned while business is being learned by mail. Particulars free. Construction Bureau, 338 Shepard Bldg., Grand Rapids, Michigan.

FREE information regarding large earnings, Raising Canaries for pastime. Birdland, Lynnhaven, Virginia.

Chemicals

EXPERIMENTAL LABORATORIES, fully equipped—$11.00 to $100.00. Payment Plan or Cash. Descriptions and actual photographs free. Write Dept. E-27. Lions Scientific Institute, "Laboratory Outfitters," Mt. Oliver, Pittsburgh, Pa.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

MILLION TESTED FORMULAS, Trade Secrets, Processes. Everything! Thousand pages. Cost? Only $2.00 Postpaid. Can I find it? Yes; and 999,999 others. Write us. J. Goodnow, Highland Ave., South Sudbury, Mass.

For Sale

UNUSED RADIO APPARATUS; send stamp for particulars. Roy Anderson, Ketchikan, Alaska.

MODEL BOAT PROPELLERS, also marine boiler in working order. Adams, 163 De L'Epee Ave., Montreal.

FINISHED LOCOMOTIVE CHASSIS ready to run. Full Walscherts Gear ¾ inch scale 3½ inch gauge 4-4-0 Cab Finished. Needs Boiler to complete. First $30.00 takes it. Thirteen Bound Vols. Model Engineer and Electrician. $2.00 per Vol. or first $25.00 takes all. Vol. 3 and 4 Models Railways and Locomotives. $4.00 each. ½ inch scale Locomotive parts. Cylinder Wheels, etc. F. R. Russell, 563 Palisade Ave., Yonkers, N. Y.

Help Wanted

RAILWAY MAIL CLERKS. City Mail Carriers, wanted by government. Commence $100 month. Men, 18-45. List positions free. Write immediately. Franklin Institute, Dept. S-99, Rochester, N. Y.

Instructions

CRYSTAL GAZING—The craze. Send self-addressed stamped envelope right now for free instructions. Zancig's, Box 556, Asbury Park, N. J.

Inventors

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

INVENTORS—I make Electrical and Mechanical Models. Estimate free. Geo. E. Chambers, 326 Camp Street, Meriden, Conn.

Kodak Finishing

ONE 6 EX. ROLL developed and finished, 20c. C. Frain, Eureka, Ill.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM 36. Standard Business Training Institute, Buffalo, N. Y.

FIREMEN, Brakemen, Baggagemen, $140-$200. Colored Porters by Railroads everywhere. Experience unnecessary. 898 Ry. Bureau, East St. Louis, Ills.

Miscellaneous

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

SHAWNEE, OKLAHOMA, a growing city, a good place to live. Write for information. Board of Commerce, Shawnee, Oklahoma.

DETECTIVES EARN BIG MONEY. Travel. Experience Unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

COMPLETE SET OF DRAWINGS of the Liberty 12 engine. A United States Standardized Aircraft Engine. Giving all views with number of parts, names of parts and weights of parts. Mail $1.00. Dept. A., Ocean Publishing Co., 25 W. 42nd St., New York City.

TRAPPERS—Eleven good box traps. Complete blue prints 20c. R. E. Grant, Dept. 92. 215 12th St., Detroit, Mich.

EXCEPTIONAL OPPORTUNITIES ARE OFFERED to men, with or without experience, to act as subscription agents for Everyday Engineering Magazine.

This Magazine is very readily sold in all kinds of machine shops, electrical plants, and vocational schools. Everyday sells itself because it sells on its own merits. It contains the kind of articles which appeal to all classes of mechanics as well as students, teachers, and professional men.

The terms to solicitors are so liberal, and the Magazine so easily sold that many of Everyday's subscription solicitors own automobiles in which they travel from town to town.

If there is a large manufacturing plant, college or garage in your city, you can start, without any expense to you, in your own locality.

Remember that the summer is the ideal season. If you want big money and pleasant work, write immediately for Subscription Solicitor's proposition.

Subscription Dept. Everyday Engineering Magazine.

Motion Picture Plays & Supplies

$25-$300 PAID ANYONE for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

Patents

DON'T LOSE YOUR RIGHTS to patent protection. Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster and Allwine, 237 Ouray Bldg., Washington, D. C. "Originators of the form "Evidence of Conception."

PATENTS—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years actual experience; full information upon request. B. P. Fishburne, 322 McGill Bldg., Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers, Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS — Herbert Jenner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York 625 F Street, Washington; Tower Building, Chicago; Hobart Bldg., 582 Market Street, San Francisco, Calif.

GET YOUR OWN PATENTS: Save attorney's fees; instructions and advice free. Carl Larsen Co., Park Row Bldg., New York.

PATENTS. In all matters pertaining to invention consult National Institute of Inventors, 118 Fulton St., New York City, having three thousand members. Booklet free.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1883. "Inventor's Guide" FREE. Franklin H. Hough, 510 Loan & Trust Bldg., Washington, D. C.

Phonographs

BUILD YOUR OWN PHONOGRAPH—Big saving. We furnish parts and cabinets. Write today for free instructions. Associated Phonograph Supply Co., Dept. V, Cincinnati, Ohio.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

STAMPS — 50 VARIETIES — Transvaal, Brazil, Peru, Cuba, Mexico, etc., and Album, 10c: 60 different U. S., 25c; 1,000 hinges, 10c; 1,000 mixed, 40c. List Free. I buy stamps. C. Stegmann, 5975 Cote Brilliante, St. Louis, Mo.

PACKET "X" 100 varieties foreign stamps, 20c. Dayton Stamp Co., East Foxboro, Mass.

APPROVALS 40-50% disc.; Packets, 10 U. S. Precancels 12c, 50 Assorted 25c; 2c Postage. Stanley Albert, Box 498, Waterbury, Ct.

Want to Buy

CASH FOR OLD FALSE TEETH—We pay up to $35.00 per set (broken or not). Also buy discarded gold jewelry, gold crowns, bridges platinum, diamonds, watches and silver. Send now. Cash by return mail. Packages held 5 to 10 days for sender's approval of our offer. U. S. Smelting Works, Dept. 61, Chicago, Ills.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¼" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotoy Electric, Charlotte, N. C.

TO YOU WHO ARE USING OUR CLASSIFIED COLUMNS:

Do you realize that you are placing whatever products you have for sale or exchange before an ever growing audience? An audience whose Purchasing Power is among the greatest? Do you realize you are paying an exceedingly low rate for this opportunity? Here is an audience which has increased by considerably over 9,000 in three months!

Now, you know you have to pay more for materials, cost of production—so do we. Heretofore we have not advanced our price, which has remained at the same old standard. **Now,** it is absolutely imperative. Consequently we are making the small and exceedingly justifiable increase of two-cents a word, thus, the rate for these columns AFTER JUNE 1st, 1920, WILL BE SEVEN CENTS A WORD.

Do you see the significance of this advance information?

EVERYDAY ENGINEERING MAGAZINE.

Digitized by Google

CONTENTS

VOL. 9 MAY, 1920 NO. 2

ISOLATED LIGHTING PLANTS 105
By Jerry Dare

ELECTRIC MOTORS FOR MODEL LOCOMOTIVES ... 107
By R. D. McMurry

HEAT TREATING ALLOY STEELS 108
By Victor W. Pagé, M.S.A.E.

PUTTING A BOAT HULL IN CONDITION 111
By Andrew Jackson, Jr.

BUILDING A TWO-PASSENGER SEAPLANE 113
By Charles E. Muller, M.S.A.E.

THE KNACK OF CARBURETOR ADJUSTMENT 116
By Victor W. Pagé, M.S.A.E.

A NEW X-RAY OUTFIT 119

A MODEL ENGINEER ABOARD A DESTROYER 120
By Harvey Dale

TURNING WHEELS AND PULLEYS 123

THE EVERYDAY MOTORIST 125

A UNIVERSAL LATHE ATTACHMENT 127
By H. H. Parker

THE LANGMUIR CONDENSATION PUMP 130

SURFACE COMBUSTION 131
By Prof. T. O'Connor Sloane

MANUAL ARTS AND CRAFTS 133

AVIATION BRIEFS 136

EVERYDAY SCIENCE NOTES 138

EXPERIMENTAL CHEMISTRY 140
By Henry L. Havens

EXPERIMENTAL PHYSICS 141
By James L. Clifford

A NEW MODEL RECORD BREAKER 142

A LONG DISTANCE INDICATOR 143

COMPRESSED AIR DRIVEN MONOPLANE 144
By H. C. Ellis

THE AMERICAN SOCIETY OF EXPERIMENTAL ENGINEERS 146

THE ELECTRICAL PROGRESS DIGEST 147

DETECTING FLAWS IN CONDENSERS 149

IDEAS FOR THE RADIO LABORATORY 150
By M. B. Sleeper

A TWO-STAGE AMPLIFIER 153

QUENCHED GAP OPERATION 154

MEASUREMENT OF HIGH FREQUENCY RESISTANCE 156
By L. M. Clements

DETERMINATION OF THE CAPACITY AND INDUCTANCE OF A COIL 158

THE RADIO DEPARTMENT 159

RADIO TUNING CIRCUITS 160

HIGH INDUCTANCE VARIOMETERS 162

A MODEL AUTOMOBILE 163

A HOME-MADE HYGROSCOPE 164
By L. B. Robbins

THE THOMAS-MORSE MAIL PLANE 182

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

Edited by RAYMOND F. YATES

Managing Editor
VICTOR W. PAGÉ

Radio Editor
M. B. SLEEPER

Contributing Editor
PROF. T. O'CONOR SLOANE

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Office
SEARS & IRVINE, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, INC.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechanics Co., Inc.

SPACE AND TIME

DID you ever stand and gaze into the illimitable depths of a starry night? You were awe-inspired? Why? Because space seems so vast, so unending or because you are so small? Is man's respect for the boundless space beyond us, due to the smallness of man or the greatness of space?

IF an ant approached a mountain, the ant would think that the mountain was infinite in size because he would compare the size of the mountain with his own tiny self. To an elephant, or a dinosaur, were such a creature in existence today, the mountain would not seem so large.

MAN is continually comparing things with himself. He calls a locomotive heavy because it weighs a great deal more than he is capable of lifting. He thinks that the earth is large because it is spread out under him in all directions as far as his eye can see.

WHEN man compares things by his own standards he is apt to be confused by the smallness of small things and the greatness of great things. The atom is thought to be extremely small not only because it lies just beyond the borderline of the visible, but because man attempts to determine its size by his own units of measure.

OUR minds are undeveloped and easily confused. The day will come when these things will be more understandable.

MAN measures time in much the same manner as he measures space—by units hopelessly small. A man's life to a man covers a considerable period. Compared to the age of the earth, for instance, man's existence is only a flicker of life, created and extinguished at almost the same instant. Yet as individuals time appears to drag on.

BEHIND space and time there is a great unanswerable "Why?". There is a "Why" to everything, no matter how small, trivial or insignificant it may appear to be. To the average man time is just time and space—well space is just plain space. Simple, is it not?

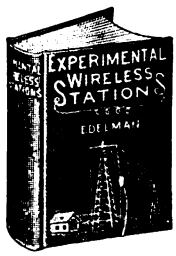
RAYMOND FRANCIS YATES, Editor.

Digitized by Google

JUST PUBLISHED—PRACTICAL NEW BOOKS

ALL MECHANICAL MEN AND EXPERIMENTERS WILL BE INTERESTED IN THESE NEW VOLUMES ON RADIO, BOATS, PLATING AND SHOP WORK

Experimental Wireless Stations



Their Theory, Design, Construction and Operation

By P. E. EDELMAN, E. E.

12 Mo. 390 Pages

167 Specially Made Engravings

Price, $2.50

This book tells how to make apparatus to not only hear telephoned and telegraphed radio messages, but also how to make simple equipment that works for transmission over reasonably long distances. Then there is a host of new information included. The first and only book to give you all the recent important radio improvements, some of which have never been published. This volume anticipates every need of the reader who wants the gist of the art, its principles, simplified calculations, apparatus dimensions, and understandable directions for efficient operation.

Complete Understandable Modern Radio Information

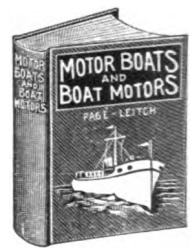
Answers Every Question—Clears Up Mysteries of Things Radio You Have Often Wondered About.

Endorsed by foremost instructors, preferred by amateurs, and recommended by Government Radio Inspectors, because of its accurate descriptions of all modern apparatus without limitation to any company types as in non-independent publications. Straight from the shoulder and without abtruse mathematics, you are told not only how and why the circuits work, but also the size of the parts; how to make and operate same in accordance with the radio law.

1920 REVISED AND ENLARGED EDITION

Motor Boats and Boat Motors

DESIGN OPERATION
CONSTRUCTION REPAIR



Written by a corps of experts, edited by

VICTOR W. PAGÉ, M.E.

524 Pages (6x9) 372 specially made engravings and Complete Working Drawing for Boat Builders — includes

Full Instructions for Building Five Boats Ranging from a General Utility 16-Foot Model to a 25-Foot Raised Cabin Cruiser from Tested Designs by

A. CLARK LEITCH, N. A.

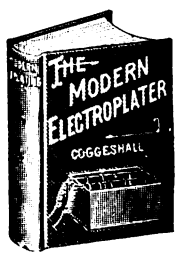
Price, $4.00

This is an indispensable book for every present or perspective owner, user, repairman or operator of motor boats and marine engines. A non-technical treatise for practical men.

This is a complete handbook for all interested in any phase of motor boating, as it considers all details of modern hulls and marine motors, deals exhaustively with boat design and construction, design and installation of all types of marine engines and gives expert advice on boat and engine maintenance and repair. Not only is boat construction fully treated but every needed dimension is given for building from complete, yet simple plans and construction is considered step by step.

CONTAINS A SPECIAL CHAPTER ON SEAPLANES AND FLYING BOATS

The Modern Electroplater



A Complete Treatise on the Electro-Deposition of All Metals

By KENNETH M. COGGESHALL
Practical Electroplater

12 Mo. 350 Pages. 142 Illustrations.

Price, $3.00

This book details in simple language all of the elementary principles pertaining to electro-plating and allied processes, their practical application and industrial use. It includes a discussion of the essential fundamentals of chemistry, magnetism and electricity, written with special reference to the needs of the practical man. It considers all equipment and supplies required for a successful plating plant and outlines all the latest methods of cleaning, plating and finishing metals on a commercial scale. The student, as well as the practical man will find valuable tables, tested formulae for solutions of all kinds, also easily understood instructions for setting up and using apparatus and mechinery designed for plating establishments.

UP-TO-DATE, PRACTICAL INFORMATION ON PLATING

Shop Practice for Home Mechanics

USE OF TOOLS
SHOP PROCESSES
SHOP PROJECTS



By RAYMOND FRANCIS YATES
Author of "Model Making."

324 Octavo Pages
309 Illustrations

Price, $3.00

The author of this volume has made special effort to present things in a clear and simple manner and everything from the very simplest shop matters to the more involved processes is covered. If a man wishes to learn how to run a lathe, he will find the information in this book. If he wishes to know something about pattern making, use of measuring tools, filing, grinding or the heat treatment of steel, the information given in a straight-forward manner, will be found in the book. Nothing that would be of value to men seeking enlightenment along the line of small shop work has been overlooked.

This is the only book now available that sets forth the principles of shop work from the standpoint of the amateur. It treats every important shop process and operation in such a way that one possessing little or no mechanical education can grasp the essentials. Every detail that would be of interest to the man who uses small tools is treated.

An Indispensable Book for All Interested in Mechanical Work—the Mechanic as Well as the Amateur Can Read With Profit.

Any of these books sent prepaid on receipt of price. FREE—Our new 1920 Catalog of Practical Books sent free on request

THE NORMAN HENLEY PUBLISHING COMPANY

Dept. E. E. **2 West 45th Street, New York**

Digitized by Google



Five Days to Prove I Can Raise Your Pay

I've done it for thousands of others. I can doubtless do it for you. If I can't, then it won't cost you a cent.

I MEAN just what I say. There's no trick or catch about it. Give me five days and I'll prove that I can get your pay raised for you. I'll do it on a "show you" basis. You get the proof before you pay me a cent.

You've probably heard of me. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches. There's no sound reason why I cannot do it for you. So let's try.

Now, follow me carefully. I'm going to tell you exactly how to do it. I'm the possessor of a "secret" for which men have been searching since Time began.

There's no need to discuss the whys and the wherefores of this "secret." Suffice it to say that *It Works*. That's all we care about—*It Works*. Over 400,000 men and women the world over have proved it for themselves.

Among them are such men as Judge Ben B. Lindsay; Supreme Court Justice Parker; Governor McKelvie, of Nebraska; Wu Ting Fang, ex-U. S. Chinese Ambassador; Governor Ferris, of Michigan; E. T. Meridith, Secretary of Agriculture, and thousands of others of equal prominence.

A FEW EXAMPLES

Personal Experiences

Among over 400,000 users of "Power of Will" are such men as Judge Ben B. Lindsay; Supreme Court Justice Parker; Wu Ting Fang, Ex-U. S. Chinese Ambassador; Assistant Postmaster General Britt; Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, of Detroit; Gov. Ferris of Michigan; E. T. Meridith, Secy. of Agriculture, and many others of equal prominence.

$300 Profit from One Day's Reading

"The result from one day's study netted me $300 cash. I think it a great book and would not be without it for ten times the cost."—Col. S. W. Wilkie, Roscoe, So. Dakota.

Worth $15,000 and More

"The book has been worth more than $15,000 to me."—Oscar B. Sheppard.

Would be Worth $100,000

"If I had only had it when I was 20 years old, I would be worth $100,000 today. It is worth a hundred times the price."—S. W. Taylor, The Santa Fe Ry., Milano, Tex.

From $100 to $3,000 a Month

"One of our boys who read "Power of Will" before he came over here jumped from $100 a month to $3,000 the first month, and won a $250 prize for the best salesmanship in the State."—Private Leslie A. Still, A. E. F. France.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered around" with it—barely eking out a living. To-day this young man is worth $200,000. He is building a $25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling, whenever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work, in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black. Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were $20,000. During 1917 the profits ran close to $40,000. And this genial 64-year-young man is enjoying pleasures and comforts he little dreamed would ever be his.

I could tell you thousands of similar instances. But there's no need to do this as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you. I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help 90 out of every 100 people if they will let me.

How It Is Done

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained, inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years, it would become powerless to lift a feather, from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstance—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

How You Can Prove This at My Expense

I know you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive, not a pamphlet, but the whole "secret" told in this wonderful book, "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you do feel that "POWER OF WILL" will do for you what it has done for over four hundred thousands others—if you feel as they do that it's the next greatest book to the Bible—send me only $3.50 and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a three and a half dollar sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

Special Note

In nearly five years the price of "Power of Will" has been increased only 50c. We find it necessary now to raise the price as soon as the present edition is gone. This means that by July 1st or sooner the price must be increased to $4.50.

Pelton Publishing Company
156-J Wilcox Block Meriden, Conn.

Pelton Publishing Company
156-J Wilcox Block, Meriden, Conn.

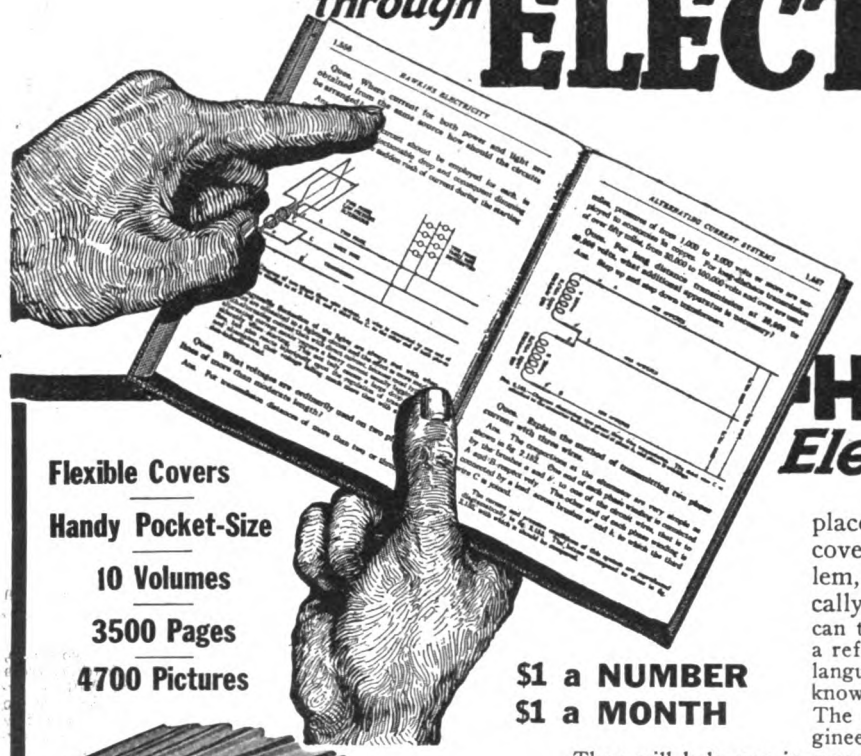
You may send me "Power of Will" at your risk. I agree to remit $3.50 or remail the book to you in five days.

Name .....

Address .....

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS Electrical Guides

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Employed by .....

Residence .....

Reference ..... May

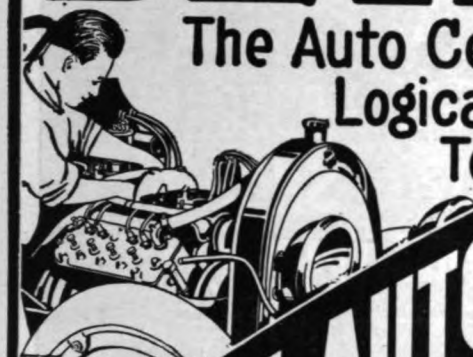
SEND NO MONEY- USE THE COUPON

Digitized by Google

DETROIT

The Auto Center is the Logical Place To

LEARN AUTO AND TRACTOR BUSINESS



Training for Head and Hand

The Automobile, Truck and Tractor business, in a few years, has become the world's greatest industry. In amount of capital invested, in number of men employed, in volume of business it exceeds any other industry. Manufacturers tell us it is still in its infancy. The opportunities for Trained Men in this industry are almost beyond belief; future opportunities will be even greater. Prepare yourself to take advantage of these opportunities by learning every phase of the Automobile, Truck and Tractor business as taught by the old reliable Michigan State Auto School, Detroit.

Earn $100 to $400 Monthly

Factories, Garages and Service Stations everywhere are calling for Trained Men in ever increasing numbers. Hundreds of our students are in business for themselves making $5,000 to $10,000 and more yearly. There are thousands of valuable locations for Garages and Service Stations everywhere—the field is unlimited.

No matter what you have done or what you are doing now, you can **learn this well-paid, pleasant work.** Whether you are young or have reached more mature years, our courses will fit you to command the opportunities you desire. To the men with grit and the determination to get ahead, the future is without limit. Michigan State Auto Training will help you to success in any branch of the Auto, Truck and Tractor business.

Auto Factories Endorse School

The thoroughness of our methods and the completeness of our equipment are well known in the Auto Industry. The biggest factories in the country heartily endorse our Course. In fact, many of the leading Auto Manufacturers assisted in outlining our Course and they give our students the fullest co-operation possible. These factories are constantly calling on us for graduates because they know the type of men we turn out. Everywhere in the Automobile Industry M. S. A. S. graduates are given the preference because ours is the factory endorsed school.



Detroit the Logical Place to Learn

Detroit, with more than 180 Auto and Accessory factories, is the logical place to learn the Auto and Tractor business. 79% of all automobiles manufactured are made in Michigan —71% are made in Detroit alone. Can you think of a better place than the Auto Center in which to learn this business of big opportunities?

Courses Thorough and Complete

Each student is taught Auto, Truck and Tractor construction in every detail. We train both the head and hand. There are over one hundred motors of all types in our block test department. Our Course in Auto Electrics is very thorough—graduates have no trouble locating any electrical trouble quickly and easily. Students get complete, thorough and practical knowledge of Motors, Starting, Lighting and Ignition Systems, Carburetion, Lubrication, Transmissions, Differentials, etc. As a part of the regular Course, students are given complete and thorough training in the care, repair and operation of Farm Tractors. Brazing and Welding and Tire Repairing are taught in separate Courses. Either of these courses may be taken separately but if taken with the regular Automobile Course, make a valuable addition to the equipment of any student. To men who want to sell Autos, Trucks and Tractors, this training gives an exceptional advantage for they know just how to judge the value of old machines they are asked to take in trade on new ones. They know these machines as no average salesman can know them. School is open all year—you can start any day.



Hupmobile

Hupp Motor Car Corporation
Detroit, Michigan, U.S.A.

Having had the pleasure of recently visiting and inspecting most carefully your school, permit me to say that I was deeply impressed with the personnel of your organization, the equipment that you have and the methods you use to teach your students. Yours very truly,
HUPP MOTOR CAR CORPORATION
C. E. Salisbury, Manager Service Department

THE STUDEBAKER CORPORATION OF AMERICA
Detroit, Michigan, U.S.A.

Answering your letter of January 13th, relative to the Michigan State Auto School at Detroit, it is our understanding that they conduct a very good school, in fact, we do not know of a better automobile school that we could recommend to you than the Michigan State.
Yours very truly,
THE STUDEBAKER CORPORATION OF AMERICA

PAIGE-DETROIT
MOTOR CAR COMPANY
Detroit, Mich., U.S.A.

The Michigan State Auto School bears a very good reputation and we believe turns out good workmen. At present time there seems to be no difficulty for their graduates to secure positions. Very truly yours,
PAIGE DETROIT MOTOR CAR CO.
A. A. Wheeler, Factory Manager

Detroit in Summer

In addition to being the heart of the Automobile Industry, Detroit in summer is the center of some of the finest pleasure spots in America. Detroit has 38 parks, the finest of which is Belle Isle—a wooded island in the Detroit River, said to be one of the most beautiful spots in America. Here you find boating, bathing and a score of other amusements within a few minutes boat or trolley ride of the heart of the city. Then there are daily boat trips up and down the Detroit River, through Lake St. Clair,—across Lake Erie to Toledo, Cleveland, Buffalo and Niagara Falls; trips to Sugar Island and to Put-in-Bay where you may explore the caves in which Commander Perry hid his men from the British Fleet in the War of 1812. During the summer months many pleasant evenings may be spent enjoying the cooling breezes from the deck of a boat as it glides through the moonlit waters. Already the Michigan State Auto School has arranged for three of these boat trips for this summer. These are free to students and their friends. At all times throughout the year, Detroit is the logical place to learn the Auto and Tractor business, but the summer attractions in and around Detroit make May, June, July, August and September ideal months in which to get this training and at the same time enjoy Detroit.

NOT A ONE-MAN SCHOOL

This school is founded on the best, newest and most practical principles in the Auto, Truck and Tractor business. Our course is built with the closest and most liberal co-operation from Manufacturers, Garages, Service Stations and Owners. It is not one Man's ideas, but the combined ideas of the biggest and most successful men in each field.
A. G. Zeller, President



Read This Money-Back Guarantee



We guarantee to qualify you for a position as chauffeur, repair man, demonstrator, auto electrician, garage man, automobile dealer or tractor mechanic and operator paying from $100 to $400 monthly, or refund your money, provided you do your part and attend our classes.

Big 176-Page Catalog

Send the coupon today for the 176-Page Catalog and copy of latest "Auto School News" both absolutely FREE. They tell about Courses—show more than a hundred pictures of equipment—give letters from big Auto Factories and Graduates. M. S. A. S. Courses are as reasonable in price as they are thorough in their training. Those who have jumped on a train and come to Detroit to investigate our school, have found the Courses so satisfactory and so reasonably priced that they have remained to get the M. S. A. S. Training. Our Money-Back guarantee protects you. If you can't come, get the catalog. Resolve to learn the business in Detroit—**The Heart of the Auto Industry.** Use the coupon NOW.

SEND THIS COUPON TODAY

MICHIGAN STATE AUTO SCHOOL
3965 Auto Building 687-91 Woodward Ave.
Detroit, Mich., U. S. A.

Gentlemen:—
Please send me, absolutely FREE New 176-Page Illustrated Catalog, "Auto School News," and information as checked below.

( ) **Auto and Tractor Course**
( ) **Tire Repairing**
( ) **Brazing and Welding**

(Mark each course you are interested in.)
Or, better still, you can expect me about .....

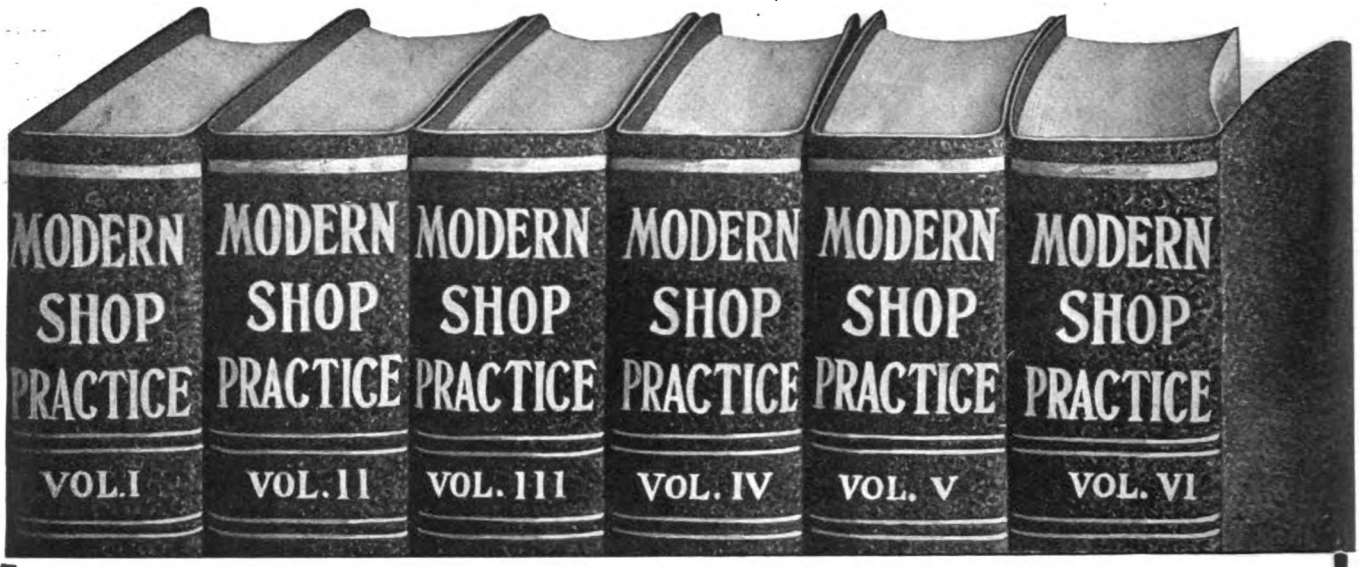
Name .....
Street .....
City ..... State .....

MICHIGAN STATE AUTO SCHOOL

"Most Progressive Auto School in America"—"In the Heart of the Auto Industry"

3965 Auto Building
687-89-91 Woodward Ave. **Detroit, Mich., U.S.A.**

Digitized by Google



Can You Answer these Questions on Shop Work?

Test Yourself NOW

A surface of Cast iron is to be finished in one cut on a milling machine. The casting is 8 inches long and 5 inches wide. The milling cutter has a diameter of 3 inches and a width of 2 inches. How long will it take to do the work? Assume a feed of 2½ inches.

For what purpose is a magnetic chuck used?

How many processes for cutting gear teeth?

How do you determine the ratio of two gears, when the numbers of teeth are given?

The lead screw has a pitch of ¼ inch. What is the ratio of gears to be used to cut a screw with 18 threads per inch?

What determines the cutting speed in a milling machine?

Give a short description of the thermit-welding process.

What is essentially the first step in making any tool from a tool-maker's standpoint?

Why is it advisable to cut the threads of an adjustable tap somewhat smaller than the desired size for the tap to cut?

Under what circumstances would you consider it advisable to use a counter-bore, rather than a drill, when enlarging a hole? Why?

Why should undue accuracy never be indulged in when making drill jigs and similar tools?

What is the practical way to test the temper of molding sand?

How does the riser on a steel casting differ from one for iron?

What are some of the precautions necessary in pouring a mold in order to obtain the best results?

How are the sides of deep molds vented when a flask is used?

What point carbon steel should be used for machine tools, milling cutters, drills, and taps?

Why is it necessary to reheat large pieces after they have been hardened?

What must be the outside diameter of the original wooden pattern for the rim of a pulley with six arms, the diameter of the finished pulley to be 30 inches and the width of face 9 inches?

What are the allowances for shrinkage in the construction of a wooden pattern of a shaft hanger bearing cap?

THE skilled mechanic today is a specialist. He has no opportunity to build a complete machine or even a small part of one. His active work is carried along rather limited lines. But to make the best success in his work—to secure promotion to more responsible duties or to go into business for himself—it is absolutely necessary that he have a broad and comprehensive knowledge of machine work and shop practice. There is only one really feasible way for the mechanic to familiarize himself with other shop lines outside his own individual work—and that is to have specialists in all lines give him all they have learned in a form that will be readily accessible. There you have the reason for the famous standard reference work, called "Modern Shop Practice."

Thousands of Dollar's Worth of Shop Information

"Modern Shop Practice" is a wonderful reference work in Machine Shop Practice and Management, Production Manufacturing, Metallurgy, Welding, Tool Making, Tool Design, Die Making, and Metal Stamping, Foundry Work, Forging, Pattern Making, Mechanical Drawing, etc. It has been tested through six editions, bought by thousands of mechanics, consulting engineers, shop superintendents and owners, production managers, etc.

New Edition Only 7c a Day

Six magnificent volumes, flexibly bound in American Morocco, gold stamped. 2,300 pages. 2,500 illustrations—photographs, drawing, explanatory diagrams, tables, etc. Here you have at your finger tips up to date labor-saving methods that big manufacturers have spent thousands of dollars to develop. Facts that you can use in your everyday work. Information that fits you to earn bigger pay. All this is now yours in the new 6 volume set of "Modern Shop Practice," on payments so easy as to average only 50c a week or only 7c a day!

SHIPPED FREE

No money in advance. Not a cent. See the books in your own home or shop absolutely free at our risk. Read them, examine them, study them for 7 whole days before you need decide whether you want to keep them or not. Send no money to get the books for free examination. Make no deposit. Assume no obligation. Simply sign and mail the coupon herewith and the books will be promptly shipped to you for 7 days' free examination. If you are not more than delighted with the books and do not consider them a wonderful investment, just send them back to us, and you won't owe us a cent.

If you prize the books and consider them worth many times their price to you, send only $2.80 within 7 days and then $2 a month until the special introductory price of $21.80 has been paid.

Extra Feature Free

To those who order promptly, we will give free a consulting membership in the American Technical Society for one year. This gives you the right to ask our experts any question regarding shop practice for an entire year. You may ask as many questions as you please.

A Few of the Subjects Treated

Machine Shop Practice
Machine Shop Management
Production Manufacturing
Metallurgy
Welding
Tool Making
Tool Design
Die Making
Metal Stamping
Foundry Work
Forging
Pattern Making
Mechanical Drawing, etc.

SEND NO MONEY

Merely sign and mail the coupon and the books will be shipped to you at our risk. Get the coupon in the mail at once, before this special offer is withdrawn. Send it today—NOW!

American Technical Society
Dept. M-355
Chicago, U.S. A.

Please send me set of Modern Shop Practice for seven days' free examination, shipping charges collect. If I decide to buy, I will send $2.80 within seven days and the balance at $2.00 a month until $21.80 has been paid. Then you send me a receipt showing that the set of books and $12.00 consulting membership are mine, and fully paid for. If I think that I can get along without the books after the seven days' trial, I will return them at your expense.

Name.....

Address.....

Reference.....

AMERICAN TECHNICAL SOCIETY, Dept. M-355 Chicago, Ill.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

LEARN DRAFTING

AT HOME—IN SPARE TIME

As You Would in Actual Practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher specially qualifies him to give you the training you need to become a successful Draftsman.



Chief Engineer, $5,000 to $50,000 a Year

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions, now open. Here is what "Columbia" training is doing for some of our graduates; Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.



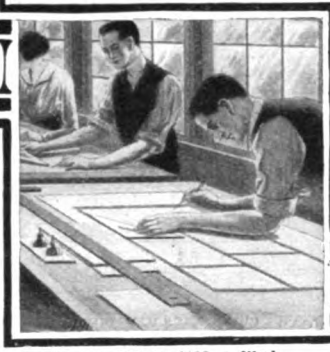
Chief Draftsman, $50 to $150 a Week

BECOME A SPECIALIST

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but you receive the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

Draftsmen Get $35 to $100 a Week

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field, paying as high as $50,000 a year.



Draftsman, $35 to $100 a Week

Big Concerns Employ Columbia Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Our training spells Success for you. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them. General construction companies, manufacturers, railroads, ship building concerns, engineering projects, etc., need draftsmen today in greater numbers and at better salaries than ever before.

SEND THIS COUPON TO-DAY

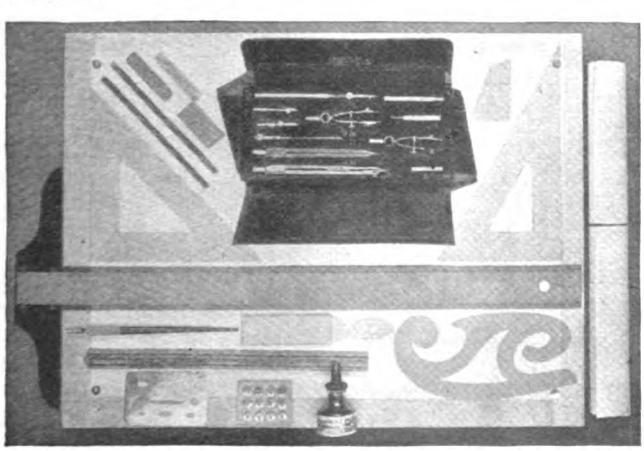
Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write to-day to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1128, 14th & T Sts., N. W.
Washington, D. C.



This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, Pres.
Dept. 1128, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below:

(Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting	Topographical Drafting
Automobile Drafting	Ship Drafting
Electrical Drafting	Statistical Drafting
Aeroplane Drafting	Radio Drafting
Special Machinery Drafting	Automotive Drafting
Sheet Metal Drafting	Hydrographic Drafting
Structural Drafting	Machine Design
Highway Drafting	Tool Design
Patent Drafting	Shop Mathematics
	Builders Course

Name .....

Address .....

City ..... State .....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



As sure as you are a foot high

you will like this Camel Turkish and Domestic blend!

Camel CIGARETTES



YOU will prefer Camels smooth, delightful blend of choice Turkish and choice Domestic tobaccos *to either kind smoked straight!* It gives you an entirely new idea of cigarette enjoyment.

Camels never tire your taste no matter how liberally you smoke. They are always appetizing—and satisfying, because they have a desirable, mellow body.

Camels leave no unpleasant cigaretty aftertaste nor unpleasant cigaretty odor. In fact, every angle you get on Camels is so different from any other cigarette that you will be won as you were never won before!

That's why we say frankly—***compare Camels with any cigarette in the world at any price!*** We know the answer.

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

R. J. Reynolds Tobacco Co.
Winston-Salem, N. C.



Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

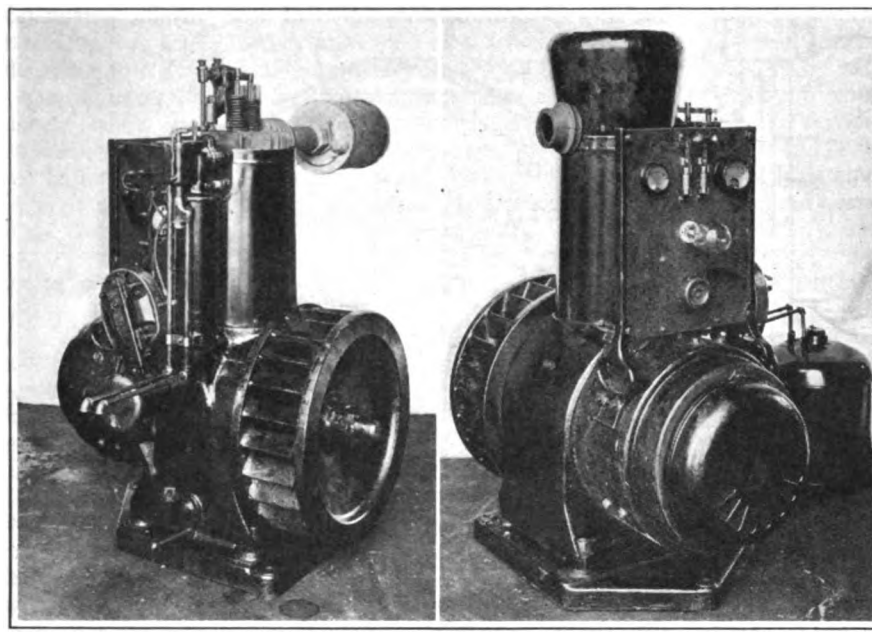
IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 9 MAY, 1920 NUMBER 2

Isolated Lighting Plants

By Jerry Dare

TODAY the country or suburban home can be provided with all of the conveniences possible in the modern city dwelling. This is especially true with electrical conveniences and during the past ten years many thousand small lighting plants have been sold to people who are too far from a power station to have the mains extended to their homes. The isolated lighting plant is really a little power house all in itself. It is so simple to operate and maintain that most any one without any experience in electrical matters can take care of it.



A compact small lighting unit with the generator directly connected to the gasoline engine

Those contemplating the installation of a small lighting plant should first look over the available space in which the plant is to be placed and then make the purchase accordingly. Some plants are more compact than others. The ideal location for such an installation should be light, clean and dry. A concrete floor is also an added advantage and will greatly eliminate vibration. The attic or cellar, unless the latter is very dry and clean, are both bad places to install a private lighting plant. A little corner boarded off in the barn or a small shed are good places to make an installation. Care must be taken to see that the place does not get too cold in the winter else trouble will be had with the batteries. The plant should never be allowed to stand in an atmosphere at a freezing temperature. On the other hand it is not necessary that the building containing the plant should be heated.

For those who are not well acquainted with small lighting plants a general outline of their operation will be given. The generator is really the heart of the system. This is always a direct current machine driven by a gasoline engine. The voltage generated by these machines is generally in the neighborhood of 32 although some are manufactured that operate at 110 volts. The generator is usually directly connected to the gasolene engine but in the case of a gas engine the generator is driven by a belt.

The output of the generator is fed to a battery of storage cells. When the current of the storage battery reaches a certain value the plant automatically stops. This is brought about by a little cut-out or circuit breaker which functions when the current passing through it reaches a certain point. When the current of the storage battery falls below a certain value, the plant is automatically started in most cases although some systems do not have this advantage. Some manufacturers claim that a perfectly automatic system causes the plant to be neglected because the person responsible for its operation does not have to go near it. The author feels that this is a poor argument and that there is a great advantage in a perfectly automatic system. If one makes a practice of looking the plant over every few days there will be no danger of anything going wrong.

TABLE OF SIZES

Size of Generator k. w.	Number of Battery Cells	Voltage of Plant	Ampere Hour of Battery	Light Capacity of Plant 16 c.p. 20 watt.	Capacity Lamps of 16 c.p. 20 watt. Battery	Capacity of Plant when Generator Running and Battery Charged No. of Lamps 16c.p.	20 watt.
1-5	16	32	60	15	7	15	
1-5	16	32	90	18	10	18	
1-5	16	32	120	22	14	22	
½	16	32	120	40	14	40	
¾	16	32	150	50	18	50	
1½	16	32	200	100	25	100	
2	30	60	90	120	25	120	
3	56	110	90	200	50	200	

Once the storage batteries of a small lighting plant are charged, the whole system can remain idle until the charge in the battery falls below a certain value. Aside from general depreciation, the only expense of operating such a plant is incurred while it is in actual operation.

A very novel little isolated lighting plant that has recently appeared on the market is illustrated in the drawing. This has become known as the Sunnyhome Farm Plant and is extremely neat and compact. This little plant comes complete with a small enclosure which obviates the necessity of providing a special building for it. The space occupied is very small and the plant is so designed

Digitized by Google

that it is very efficient in its operation. In the winter the engine is cooled with oil which is carried in a 5-gallon tank in the base of the machine. The same oil is used to lubricate the entire system and is forced into the bearings of the engine under pressure. One filling of the tank is sufficient to run the machine for an entire year.

This plant is probably the most automatic one that has been designed. For instance, if the gasoline in the fuel tank runs out a small red light in the house is lit. If the piston of the engine freezes up, the main switch is caused to open within three seconds time.

This plant is provided with a 110-volt generator and this makes it possible to obtain all the wiring fixtures at any electrical supply house. In the case of a 32-volt system the electrical fixtures cannot be obtained as easily. With this system, however, the standard type electric irons, toasters, fans, etc., cannot be used. This is a very important consideration and should not be overlooked by those who contemplate the installation of a private lighting plant.

The Sunnyhome plant has a 2½-hp. gasoline motor which reaches a speed of 2,000 r.p.m. This motor drives a 1¼-kw. generator which is capable of supplying sufficient current for the average size country or suburban home. Unlike most plants of this nature, the starting and stopping of the generator depends entirely upon the terminal voltage of the storage battery. When the voltage reaches a certain maximum value, a switch is opened and the plant stops. As the battery discharges the voltage drops and when it passes beyond a certain limit a switch is closed and the plant again starts. The starting of the gasoline engine is brought about by feeding the current from the storage battery into the generator which then acts as a motor. This is not a feature of the particular plant in question but is used on most all small lighting systems.

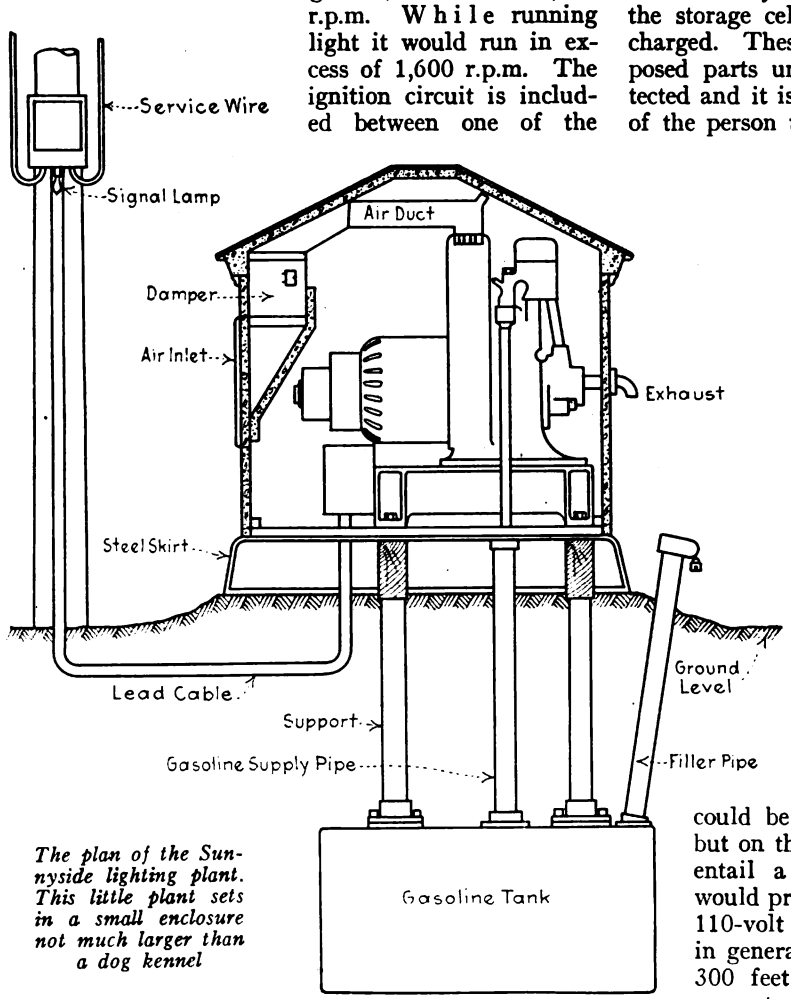
In case the coupling between the motor and the generator of the Sunnyhome plant breaks, the gasoline motor is prevented from racing by a simple form of suction governor which is placed in the inlet passage.

Compactness and simplicity of construction are the two most important considerations in farm-lighting equipment. While dwelling on the features mentioned above a brief outline of a new system employing the Knight sleeve-valve engine will be interesting. This outfit is provided with a 32-volt generator whose armature shaft is extended with the engine crank at one end. The engine is rated at 2 hp. when turning at 1,100 r.p.m. It is fitted with an aluminum cylinder head, particularly designed to dissipate heat. The cylinder is a gray iron casting with the cooling fins cast integral.

The method of govering this engine is by a fixed air passage which restricts the engine under load to 1,100 r.p.m. While running light it would run in excess of 1,600 r.p.m. The ignition circuit is included between one of the main brushes and an auxiliary or third brush. In starting the ignition voltage is 12 but owing to the armature reaction this drops down to about three volts while the engine is running. When the battery is fully charged, the ignition is automatically cut out. The battery cut-out, manual starting switch and overload switch are combined in a single electro-magnetic device. This device carries three windings, one series and two shunt. The electro-magnet also has two armatures arranged side by side one of which carries the switch contacts for both the main line and the field circuit.

The generator of this outfit is constructed along the most modern lines. There are no brush wires, the leads to the brushes being strips of copper imbedded in Bakelite. The control box is mounted on the field frame which gives a very compact outfit. The complete unit weighs but 350 lbs. without the battery. The battery weighs 52 lbs. per cell.

Most farm-lighting outfits are provided with storage cells mounted in glass jars. A shelf or number of shelves must be constructed to carry these cells. It is also necessary to paint these shelves with an acid-resisting paint. The room in which the cells are placed should also be very well ventilated to carry off the gases generated by the storage cells while they are being charged. These gases will corrode exposed parts unless they are well protected and it is also best for the health of the person taking care of the plant that means be provided for removing them.



The plan of the Sunnyside lighting plant. This little plant sets in a small enclosure not much larger than a dog kennel

The voltage of a farm-lighting outfit is a very important consideration as this will depend largely upon the nature of the installation and the distance that current is to be transmitted. The usual outfit which has a voltage of 32 is suitable in all cases where the lighting is confined to a fairly small area. In the average 8- to 10-room house the 32-volt system will make a suitable installation if the current is not to be transmitted over a distance of 300 feet. Of course, if larger wire was used, the current could be sent a greater distance but on the other hand this would entail a greater expense which would probably meet the cost of a 110-volt system. It can be said in general that for distances over 300 feet a 110-volt system will prove to be more economical and satisfactory.

On farms where a gas engine is already in use for driving cream separators, wash machines, etc., a lighting dynamo can be very easily belted to the engine directly or to a point on the line shaft. Some farmers prefer to have the whole outfit together. If the gas engine is powerful enough, the battery-charging generator can be driven while the washing machine or water pump is being operated.

For country use the Edison type of storage battery possesses many advantages over the ordinary lead plate battery. Although the lead type of battery will give splendid service if taken care of properly, it is very sensi-

Digitized by Google

tive to abuse of any kind and when once injured it requires expert attention to put it back into a serviceable condition. The Edison alkaline battery never requires expert attention, does not need to be cleaned, does not make use of a corrosive acid and is not injured if discharged completely. The alkaline battery is also capable of receiving and making use of a charge "at any old time" which is not true of the lead battery which is generally charged only when its voltage falls below a certain point. Another point in favor of the alkaline battery is the fact that an accidental change in the polarity of the charging current will in no way injure the plates. Such an accident would be ruinous to a lead plate battery. The alkaline battery gives off non-corrosive fumes which is a very important consideration as the ventilating problem does not give so much trouble. A lead plate battery is very sensitive to a low temperature and they should never be exposed to a temperature below the freezing point. The alkaline solution used in an Edison type battery cannot be frozen at any winter temperature common to this part of the country as it is capable of withstanding a temperature of 50 degrees below zero. It is possible to leave the alkaline battery standing in a discharged condition for an indefinite period without the slightest deterioration which cannot be done with a battery of the lead plate type.

In a recent issue of *Automotive Industries,* a splendid outline of isolated lighting plants was given. The author has taken the liberty to include this:

"Most of these plants were specially designed for use on farms and country estates, while a few were developed for war purposes and are continued as meeting a certain peacetime demand. An output of 1 kw. or close to it is common, and this seems to best meet the requirements of the average farmer who wants light mainly. The great majority of the engines are single cylinder uprights, but there are two two-cylinder engines listed and four four-cylinder ones. While several of the most prominent makes use ball and roller bearings on the crankshaft, babbitt-lined bearings are used in most instances. Water cooling is common, though air cooling has advantages for an outfit that is expected to run for long periods without attention. In one case, oil is used as the cooling fluid to overcome the freezing difficulty.

"Ignition is almost equally divided between battery and magneto system and one manufacturer gives customers an option, fitting either the one or the other.

"About two-thirds of the systems are adopted to burn kerosene, while the rest use gasoline only. Two voltages are standard, viz., 32 and 110. For the former 16 battery cells are invariably used, while either 54 or 56 cells are used with 110 volts. There is considerable variation in the proportionate amount of battery capacity provided, ranging from about 3 to about 10 kw.-hrs. per kilowatt generator output, but the average is very close to 5.4 kw.-hrs. There is also an enormous range in the governed engine speeds, from 340 to 2,000 r.p.m. Two speeds have recently been adopted by the S. A. E. as standard for farm-lighting plants, namely, 1,200 and 1,800 r.p.m., but there is really little indication in the table that the speeds gravitate toward the two figures."

ELECTRIC MOTORS FOR MODEL LOCOMOTIVES.

By R. D. McMurry.

MANY readers of this magazine who are engaged in the construction of model electric locomotives will probably welcome a few notes along this line that come as the result of considerable experience the writer has had in making and operating such devices.

Experience has proven that the flat type of commutator is much better for this purpose than the drum type. This used in conjunction with a laminated field motor makes it possible to produce a motor that will fit into a very small space and yet be efficient. The writer makes his field laminations of black iron (the thinner the better). After they are all cut out they are packed together and placed in a vise when they are filed and the rough edges trimmed off. When this is done four holes are placed in the pieces and brass studs or rivets used to hold them together.

The armature from an old electric horn motor makes a very suitable type for use in railway motors but, of course, these are not always available when they are wanted most. Armature discs can be easily cut out of sheet iron. First the plain discs are cut and then the holes for the shaft are drilled in the center. When this is done the slots can be drilled out.

Motors constructed along these lines are in general much more satisfactory than those of the permanent magnet type. They are lighter in weight and far less bulky. For given size they are also much more powerful. The one advantage of the permanent magnet type is that the armature can be reversed at any point on the lines by simply reversing the polarity of the rails.

In the drawing, A is the motor the author has used with great success. At Fig. 1, B is the common type of commutator; the disc type is shown at C. This consists merely of a fibre washer with copper segments riveted to it. The holes for the rivets must be countersunk. At D Fig. 2 is shown the method of mounting a small electric motor in a model "steam" locomotive. One is the motor, 2 is the small driving pinion meshed with the main gear 3, which is not on the shaft but on the hub of the driver. Four is a frame fastened to the motor. This acts as a brush holder. Bearings for the motor are drilled and the axle put in place. The hook 7 rests on the cross-pin 8. Five is the contact shoe for the third rail. This is a tube fastened on an insulated cross member on the frame. The shoe has a plunger and fits loose in the tube 6 with a light spring inside the tube.

Motors of this type run heavy trains at a considerable speed and they may be used with either D.C. or A.C. current.

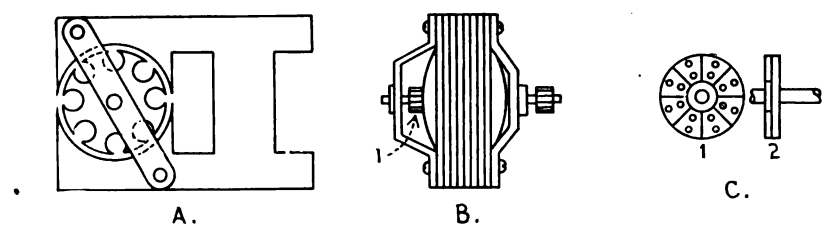


FIGURE 1.

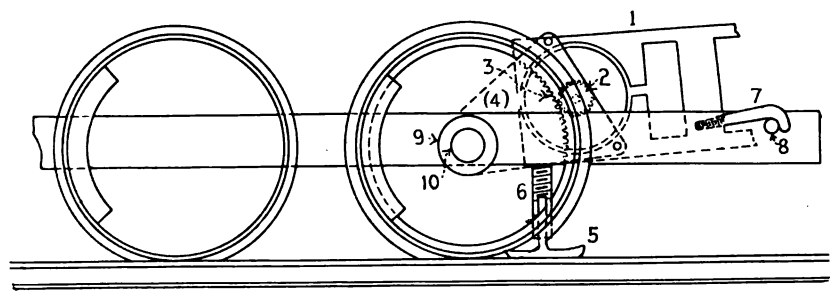


FIGURE 2.

Digitized by Google

Heat Treating Alloy Steels

A Simplified Exposition of the Precautions to be Taken in Heat Treating Modern Alloy Steels to Bring Out Their Physical Properties to the Best Advantage and Reasons Why Such Steels Demand Careful Treatment

By Victor W. Pagé, M.S.A.E.

PART ONE

THE rapid growth of the automotive industries and the increasing use of automobiles, motorcycles, airplanes, and tractors has created an entirely new series of problems for mechanical engineers to solve. The solution of these resulted in the development of alloy steels, that require entirely different treatment than the high carbon steels of a decade back as the alloying elements ordinarily employed, nickel, chromium and vanadium, impart certain qualities to steel only when it is given a predetermined heat treatment found to be best for that particular alloy. It is not within the province of this series of articles to discuss the effects of the various alloying elements as it is not a work on metallurgy. The heat treating department of the modern shop will be given the chemical composition of the steel to be treated and the point to which the steel is to be treated before quenching will have been accurately determined previously by testing samples of the steel in a small electric furnace and finding its critical or quenching point. This means that any particular alloy has a point to which it must be heated, no more, no less, before quenching and the range of temperature permitted in some alloys is not more than twenty-five degrees either side of the theoretically correct temperature if its physical properties are not to be sacrificed.

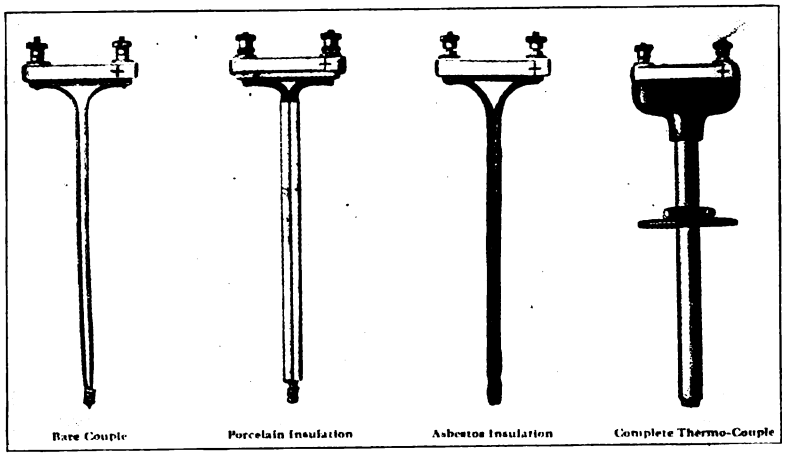


Fig. 1—Steps in the construction of heat measuring thermocouple

Science in Modern Hardening.

The chemist, metallurgist and hardener work in very close relation in the modern manufacturing plant. Scientific research and exacting processes have brought hardening steel from the old hit or miss methods of temperature determination by color to an exact science where the temperature of the furnaces may be determined with great accuracy by electrical pyrometers which show the heat within the furnace on a plainly read scale. Any mechanic who can tell time will be able to read the temperature scale and know the heat without attempting to approximate it by color of the furnace interior. On a light day, the colors do not appear as bright to the normal eye as on a dark day and it is easy to misjudge temperatures by 50 to 100 degrees Fahrenheit, which would be a serious matter if an alloy having a limited range of permissible treatment was to be hardened.

Alloy Steels Demand Multiple-Treatments

Modern alloy steels must receive double, triple and even quadruple treatments in some cases whereas the steels of the usual high carbon variety seldom required more than two treatments, the hardening and a tempering that followed. The tendency of the old-time hardener to guess at the proper heat treatment is no longer in evidence as costly experience has demonstrated that modern alloy steels cannot be treated intelligently unless their critical point and chemical composition are known.

Critical Point Important

The critical point determination is a scientific process based on the principle that steel undergoes a change in molecular structure when heated to the proper point, and that the quenching of the steel, when this point is reached, sets the molecules so that the steel is hard instead of soft. A small piece or specimen of the alloy to be tested is placed in a special holder and heated in a small furnace. The temperature may be controlled with great exactness and is measured and constantly recorded.

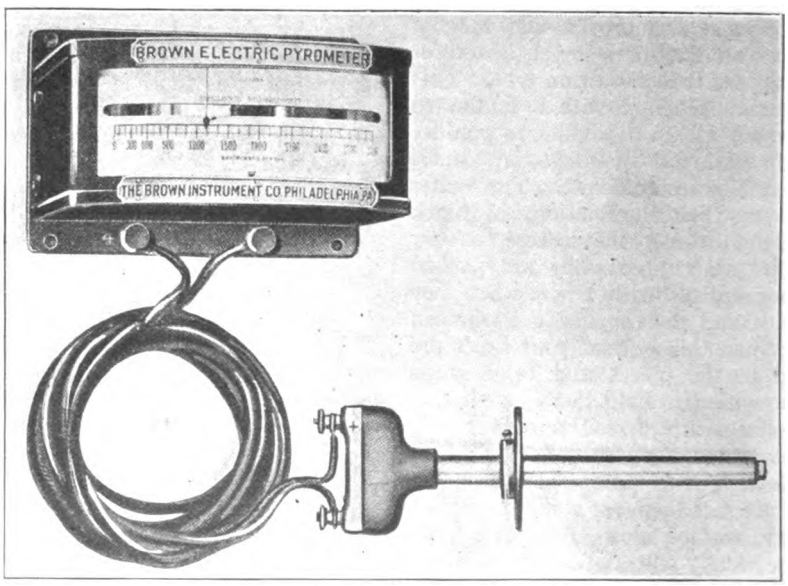


Fig. 2—An electrical recording instrument with calibrated scale is attached to the thermocouple

The temperature of the piece is also recorded and in some types of instruments it is registered on a recording chart. The heat curve rises up to a point where the critical point is at which point the steel specimen heat curve flattens out and finally drops.

Digitized by Google

The steel must be quenched at this or decalescent point and before the curve indicating the changed molecular structure drops.

Specimens of the steel are then hard-

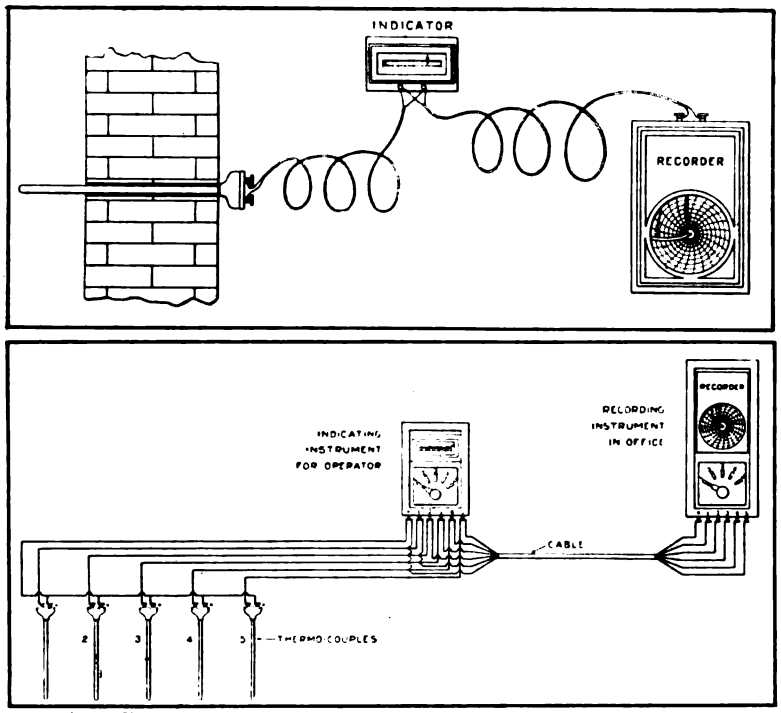


Fig. 3 at top shows how thermo-couple or fire end is inserted in furnace wall, and coupled to indicating and recording instruments. Fig. 4 shows how one set of instruments may take readings from a number of furnaces

ened by the metallurgist who breaks them in a tensile testing machine to determine their strength and examines the structure under a powerful microscope to make sure the hardening process has been accurate. Other testing machines determine the hardness and endurance to fatigue the treated specimen possesses. It is only after the laboratory men have determined accurately the qualities of the alloy, that recommendations are issued to the hardeners for treating the steel in a commercial manner.

Accurate Gauging of Temperature

By the use of recording pyrometers, which are a type of electric thermometer, it is possible for the men in charge of the furnace to regulate them to maintain a uniform temperature at all times, and for those in charge to make sure that the heat has been properly maintained for the period. This is especially valuable in carburizing or case hardening certain work where the proper depth of penetration is only obtained after a period of 10 to 24 hours at the carburizing temperature which is between 1650-1700 degrees Fahrenheit. Pyrometers also indicate the temperature of the oil baths and lead pots for tempering and the hardening furnaces. The secret of heat treating modern alloy steel is control of temperature, quenching at the critical point and then carefully following the subsequent treatment. So accurately do the instruments function that it is possible to maintain a uniformity in the hardness that would not have been possible with the old processes where individual skill of the hardener determined the grade of excellence of the output, which obviously could not be uniform because of the varying conditions.

Electric Pyrometers

Electric pyrometers operate on the principle discovered by Seeback, that if the juncture of two dissimilar metals is heated, an electric current will be generated, the voltage varying in proportion to the heating temperature. Different metals are used for this purpose, as the voltage will vary with the type of metals used. Base metal fire ends are commonly used in commercial application, rare metal couples are used for fine measurements and checking purposes. All that is necessary is a suitable fire end which is joined to a millivolt meter which can have a scale calibrated in temperature units instead of fractions of a volt. This is done by a pair of wires and they may be of considerable length, so the recorder does not need to be combined with the fire end as in the mechanical types. The temperature indicator may be in one building, the fire end in another. Base metal thermo couples are usually formed of nickel alloy wire and generate more current than the more expensive platinum-rhodium combinations. Typical thermo couples, indicators and method of installation are shown in Figs. 1 to 3. A recording outfit and the method of connecting it so it will serve a number of furnaces is shown at Fig. 4. It is not necessary to go deeply into this subject as full information may be obtained by writing the manufacturers of these devices.

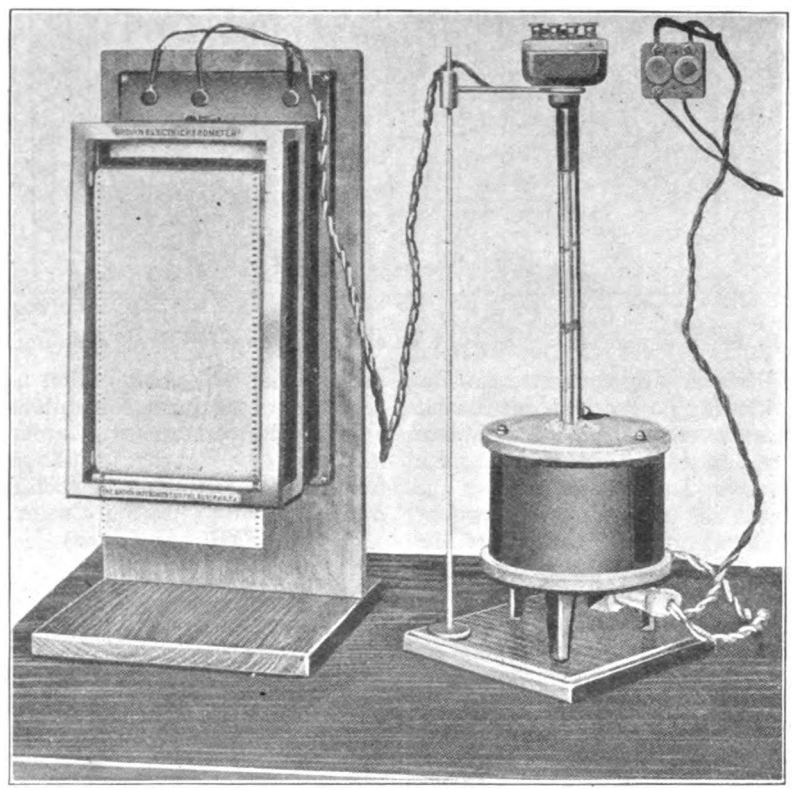


Fig. 5—Special apparatus for determining the critical point of steel specimens and indicating it by making a chart

Transformation Point Determinator

The freqent reference to "critical" point of alloy steel in the heat treatments described can be easily understood when it is explained how this

Digitized by Google

critical or transformation point can be determined with an apparatus such as shown at Fig. 5. Briefly the operation of this instrument is as follows:

There are two small pieces of metal placed in the electric furnace shown. One is a neutral body of pure nickel, the other is the piece of steel to be tested. These pieces are about ¾ inch in diameter and 1 inch long. A 5/16 inch hole is drilled in each piece. It will be noticed that there are two thermo couples, one of which is placed in the test piece and the other in the neutral body.

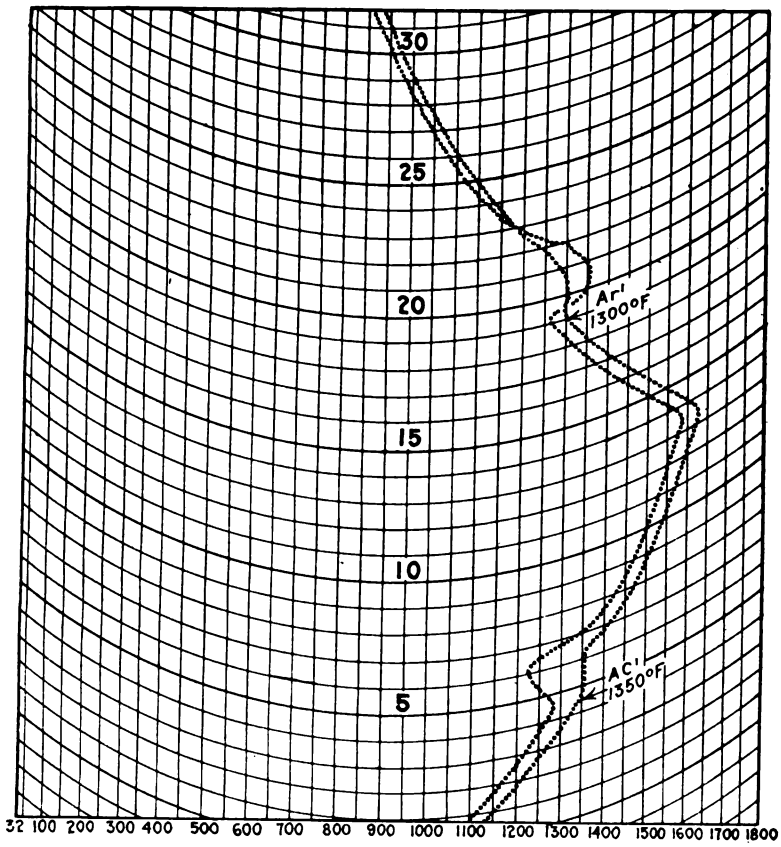


Fig. 6—Chart showing how critical point of steel is recorded by special apparatus

The couples are connected to the proper binding posts on the instrument and current turned on. Each piece heats up at approximately the same temperature. Due to the fact that the instrument has two coils and a switching mechanism, the E. M. F. of the neutral body opposes the E. M. F. of the test piece when one record is made. When the other record is made the switch opens and the true temperature of the test piece is recorded on the chart.

When the point of transformation is reached, however, the necessary work to change the molecular structure of the steel means that the test piece will not heat up for probably several minutes. During this time, however, the neutral body which is not experiencing this transformation phenomena exerts its strong counter E. M. F. and produces a very exaggerated buck in the line made by the combined E. M. F.'s of both pieces.

An actual transformation chart at Fig. 6 made by this instrument gives a clear idea of the well-defined record line. On a rising temperature, the transformation occurs at which is known as the "decalescent" or "Ac" points, while those occurring on falling heats are known as recalescence or "Ar" points. At the highest Ac point the steel will have the finest grain and should be quenched when that point is reached. Steel should be quenched on a rising rather than a falling heat, so the highest "Ac" point is that usually chosen and the furnace maintained at a higher temperature to allow for the inevitable cooling that results during transfer of the piece to the cooling medium.

(To be continued)

For brazing steel, immersion in melted spelter is found very efficacious. The spelter picks up traces of iron, and this makes it much stronger. The joint may show from 10,000 to 20,000 pounds to the square inch strength. The steel is attacked at the rate of one thousandth of an inch for each two minutes of immersion. In the brazing the metal may be kept in the spelter for three minutes up to an hour.

It seems to be the oxygen in water which makes it corrode pipes. In hot water practice it is found that if no new water is added that the pipes will not corrode. If water has to be added from time to time, it is good practice to keep such water in a tank with expanded metal or other form of iron of large surface. This takes the oxygen out of the water.

WELDING COMPOUND

THIS process relates to the use of certain chemicals and ingredients which are dried and mixed to form a fine powder, and in this form are ready to apply to the iron or steel to be welded, when these metals are in a heated state and nearly ready for welding.

The chemicals and ingredients form a flux which spreads over the surface of the metal and prevents the steel or iron from burning if it be slightly overheated and in part so protects the heated surface from oxidation, so that a clear, sound weld is easily secured, the flux being driven out from the joint by means of the hammer carrying cinder or other impurities with it.

To prepare this welding compound use the materials listed below and in the proportions specified.

	Ounces
Boracic Acid	11
Fused Borax	4
Fine Iron Filings	3
Fine Steel Filings	4
Carbonate of Potash	2
Chloride of Ammonium	½
Potassium Nitrate	3
Silver Sand	½

All the chemicals and ingredients given above are dried on a tray over a low frame, and then finely powdered by tamping with a hammer, and when reduced to a fine powder are intimately mixed together by sifting.

After mixing the various ingredients, unless wanted for immediate use, they should be stored in airtight metal containers.

In using the mixture, the intended weld is first scarfed in the usual way, and when the parts to be welded approach welding heat withdraw each part from the fire and apply a small portion of the mixture to what will be the actual joint and then return it to the fire and bring the heat to a little less than the heat required for ordinary welding.

When the parts are then brought together, apply the hammer slightly at first, and then more heavily to complete the weld. If any part of the scarf is imperfectly welded, it can again be reheated and some of the composition sprinkled over the defective joint, and heat again to the desired point and complete the weld under the hammer.—*American Blacksmith.*

The water-power of British Columbia has been estimated lately at three millions horse power. One falls, Helmokon, has a clear descent of 450 feet. In the United States the steam railroads use 25 per cent of all the coal mined. The utilization of water power and the more economical generation of steam will have a profound effect on the future of the coal question.

Digitized by Google

Putting the Boat Hull in Condition

A Spring Cleaning Process that Keeps the Boat Looking Fit

By Andrew Jackson, Jr.

WHEN spring comes around and you are ready to get your boat in the water, you should commence in plenty of time. To properly put a boat in commission requires considerable time and care. The hull, both above and below the water line, should be well cleaned and all loose or scaly paint scraped off and sandpapered smooth. Any cracks, open seams or other spots that may leak should be well caulked with spun cotton and finished off with white lead or some good calking compound. For many places marine glue or similar preparations can be used to advantage. Jeffrey's marine glue or "Petro" liquid calking are excellent. These compounds are applied hot or semiliquid and are allowed to harden after which the excess is scraped off. If the edges of the crack, or hole, are cleaned and free from paint and are dry the compound will adhere firmly to the wood and will expand and shrink with it, thus insuring a tight seam. White lead is good for finishing a seam or crack but ordinary putty should be avoided. Any badly rotted, decayed or worm-eaten wood should be cut away and replaced by new timber or if on the bottom of the keel or skeg it may be merely cut away to solid wood, planed smooth and given a good coat of copper paint.

Tools and Supplies Needed

The following tools and supplies will be found of value in putting the boat in commission. If the boat is a large one, an old hoe will be very useful for removing marine growths. On smaller craft, cabinet scrapers or putty knives of large size will be adequate. A steel wire brush is also useful in this connection. A plumber's gasoline torch is very good for paint burning. Small calking irons and a calking mallet and two old files for cleaning out seams can be used advantageously. Paint and varnish brushes will be needed, two flat brushes about 2½ to 3 inches wide for paint and a varnish brush about 1½ or 2 inches wide. For sharpening the scraper fine-cut flat files are valuable. For general work around the engine, an auto tool kit will be useful.

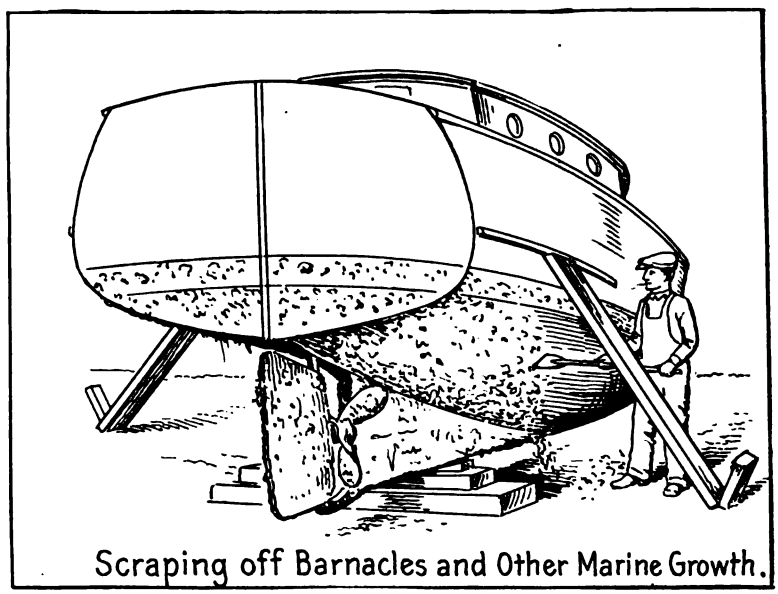
The materials used will include white lead and raw linseed oil, turpentine for thinning paint and Japan dryer for insuring that the paint will not take too long to dry. Special prepared paint may be obtained for canvas decks and anti-fouling or copper paint will be needed for the bottom. Spar varnish of the best quality will be used for natural finished woodwork. If one wishes to do a real good job, the engine should not be neglected and a small can of engine enamel can be purchased to advantage. Paint and varnish remover will help in stripping off the old colors. Sandpaper and steel wool, about No. 1 grade, will help in smoothing down the wood preparatory to painting. If a wooden deck is used, some seam filler composition will prove useful to fill cracks and if calking is found necessary, special seam composition and calking cotton should be provided.

Removing Old Paint

Sometimes the old paint and varnish may be so badly cracked, blistered or worn that it must be removed. This may be done either by burning and scraping or by the use of some good paint and varnish remover. A number of these preparations are on the market and all are about equally good. Be sure and scrape off the old paint and varnish thoroughly after softening with the remover and then rub well with gasoline. When thoroughly dry sandpaper until smooth and do *not* apply new paint or varnish until the wood has dried and aired for 8 or 10 hours: if you neglect this the new paint may peel or soften from the action of chemicals remaining in the pores of the wood.

Old, hard paint or paint of several thicknesses is best burnt off. A gasoline torch should be used and as fast as the old paint blisters up it should be scraped off with a ship scraper, putty knife, broken glass or old knives. After all the paint has been scraped off, sandpaper smooth and rub with gasoline. The use of gasoline on scraped or cleaned woodwork is of great value as it removes all old traces of oil, paint, varnish, etc., remaining in minute cracks or pores and gives a fresh, clean, surface for the new paint. Boiling oxalic acid solution will bleach out woodwork and provides a clean surface for paint or varnish.

While almost any sort of paint will cover up wood and almost any varnish will give more or less of a gloss, yet for marine work you cannot be too careful in getting the very best and highest grades of paint and varnishes. Many paints and varnishes which will answer very well for use on shore are absolutely unsuited to boat work for the conditions are totally different and are far more severe and moreover the paint and varnish stands all the hard knocks and wear on a boat. For underwater parts either a high grade copper, anti-fouling, or bronze paint should be used. The particular kind and color which you put on will depend upon your own taste, for practically all the standard copper and bronze paints are equally good. Do not expect too much from any of these compounds however; they will prevent worms and marine growths to some extent but the best made will not prevent some weeds and barnacles from growing on your boat.



Scraping off Barnacles and Other Marine Growth.

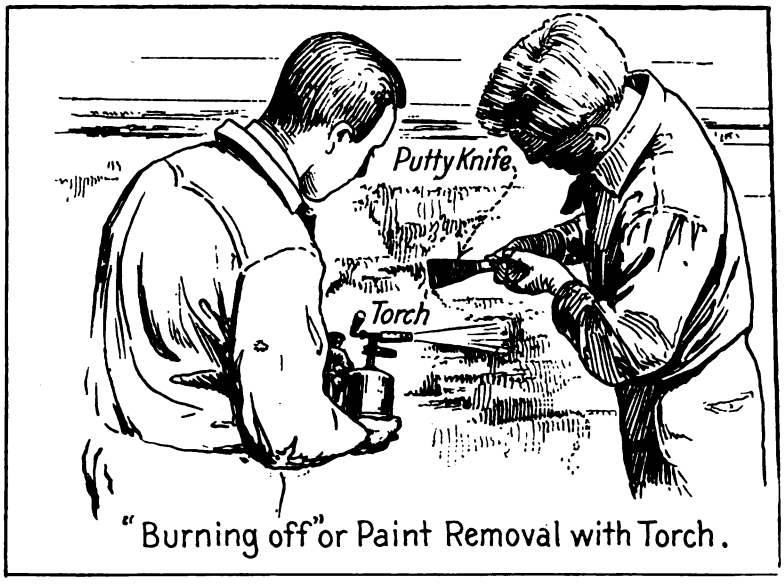
If you are situated near a river you may readily keep your boat free from salt water growths by occasionally running her into fresh water and leaving her there for a day or two. If you cannot do this, it will be necessary to beach her, or haul her out, two or three times each season and thoroughly scrub or scrape off all marine growth and when dry give her another good coat of

Digitized by Google

paint. A wire brush is excellent for cleaning a boat's bottom but barnacles, young oysters and other shell fish must be scraped away with a ship's scraper, an old putty knife or a short-handled hoe.

Painting the Hull

For the topsides above the water line you should use either the very best yacht paint or mix your own paint with white lead, oil and a little turpentine. Avoid zinc white as it dries very hard and is almost impossible to scrape off while too much dryer renders the paint less liable to stand the weather and hard usage. If colors are to be used you may either mix them yourself by adding the desired color to the lead paint or you can purchase them ready made. If a durable glossy surface is desired add some spar varnish to your paint or better still use the "Enamolin" colors. These paints are made in black, white and various colors for both above and below water and for exterior and interior work. They are brilliant, durable and will stand up two or three times as long as ordinary paints.

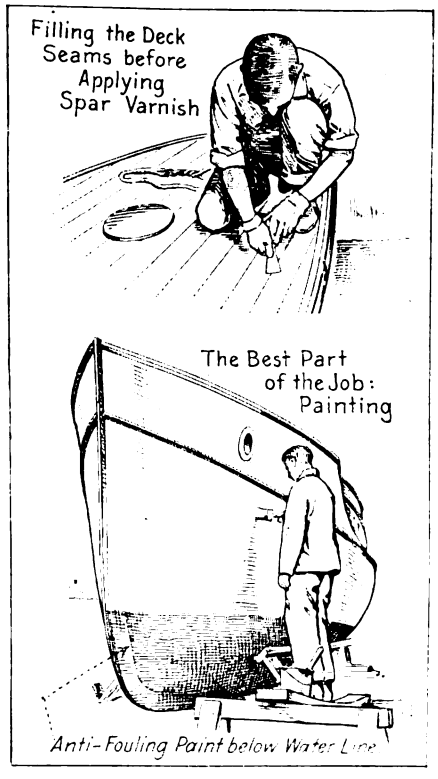


"Burning off" or Paint Removal with Torch.

Use Only High Grade Varnish

For varnishing, use the highest grade marine or spar varnish you can buy. "Valspar," is as good as any but several other makes answer practically every requirement. In varnishing you must be sure to have your surface smooth, clean and dry and if you wish a high finish you must first use a "filler" and apply two or three coats of varnish and if unusually fine work is required each coat should be rubbed down with pumice stone and water before applying the next coat. A good brush must be used and cheap brushes do not pay. Rubberset brushes, or brushes which are guaranteed not to shed their bristles, should be used and before using on the boat they should be broken in by painting or varnishing an old board or plank, for the best brushes will always shed a few hairs at first. Keep each brush for a certain purpose and keep them clean. Cleanliness is one of the main points in successful painting or varnishing.

For metal work use enamels or aluminum paint but avoid gilt, bronzes, etc.: if gold stripes are required use size and gold leaf as no other gilt will stand salt water use. For decks use regular dark paint or mix the color desired with your spar varnish until the proper shade is obtained. White is the most common color for boats but it is hard to keep clean and looks badly when scarred or dirty. Black is a neat and good color but it is harder to keep in good shape than white and makes a boat very hot, as well as dingy looking.



Many boats are now painted bright colors and this custom is to be recommended as the colors serve to identify the boats and on small launches it gives an excellent appearance. Blues and greens wear well and are easily kept presentable but reds fade and turn color badly. The various "battleship grays" that have recently become so popular wear well but are not at all attractive.

It is economy in the end to keep a boat in good shape outside as well as in for a boat badly painted or with the paint scarred and rubbed, is an eyesore besides being more liable to rot, injury and decay than a well painted, clean craft. A boat may be readily touched up above the water line without pulling out but if the spots or places to be touched up are badly rubbed they should be smoothed with fine sandpaper before painting and care should be taken that they are thoroughly dry. Varnish should be kept smooth and bright at all times for if varnish is allowed to get scurfy, white or rough a new coat cannot be applied until the old is removed. As fast as varnished surfaces show scratches, wear, or discoloration they should be rubbed with fine sandpaper or with pumice stone and water and revarnished. Varnish that is in good shape but is scratched, bruised or dull in spots may be revived by rubbing with a soft rag dipped in oil and turpentine. Never use alcohol, kerosene or gasoline on varnish or paint; it may brighten it temporarily but will ruin it sooner or later.

LARGE BRITISH DIRIGIBLE AIRSHIP

Reliable reports indicate that the British Government has started to build the largest airship that has yet been constructed in any part of the world. This is to be large enough to carry six airplanes as auxiliaries for its own protection against enemy heavier-than-air craft. This airship and the two hangars to be built for it will cost $9,000,000. It will have a capacity of 10,000,000 cu. ft., will be 1,100 ft. long, 137 ft. in diameter and capable of lifting 100 tons, which would be about five times the lifting capacity of the R-34, which has recently completed a round-trip voyage across the Atlantic. The cruising radius of the new airship, which will be completed in about twenty months, is estimated as 16,000 miles. It looks as though Britain will have the largest air fleets as well as being mistress of the seas.

In Switzerland electric steam boilers have been experimented with. The current at a voltage of 10,000 is sent through vertical tubes immersed in the boiler contents. By changing the position of the electrodes in the tubes the current is modified as desired.

Digitized by Google

Building A Two-Passenger Seaplane

By Charles E. Muller, M.A.E.

Consulting Aeronautical Engineer

THE dynamic balance and easy control of any airplane absolutely depends on the alignment, providing the machine is designed correctly. The first airplane that I was responsible for was a Farman type in 1911 which was badly out of balance at the first trial. But realigning it several times by varying the incidence in the main planes and the empennage planes it was considered a fairly stable plane. The final alignment of a new machine can only be made by actual trial, but it is absolutely necessary to diligently check up and inspect every detail before flight is attempted.

The method of alignment generally accepted by manufacturers and followed by the Air Service, U. S. A., is as follows:

1. Place the airplane in its normal flying position, *i. e.*, the top longerons to be levelled laterally and longitudinally, supported by wooden horses or blocking under the tail struts at station 7 and the nose station 1.
2. Alignment of the fuselages.
3. Alignment of the landing gear.
4. Alignment of leading edge of lower plane—dihedral, stagger and incidence.
5. Alignment of leading edge of upper plane.
6. Alignment of trailing edges.
7. Tightening and safetying all wires, turn buckles, nuts and pins.
8. Alignment of ailerons.
9. Alignment of stabilizers.
10. Alignment of elevator flaps.
11. Alignment of rudder.
12. Adjustment of rudder control wires and foot bars.
13. Adjustment of joy stick and its control wires.
14. Checking up propeller.

Fuselage Alignment

1. Level up the fuselage by a spirit level or in its absence a device may be made by combining a straight edge 90 degrees to a plumb line, shown at Figure 4.

2. Align the fuselage by starting at Stations 3 and 4, Plate Seven (January, 1920, issue). When tightening the diagonal wires be sure to loosen the opposition wires. Stations 2, 5 and 7, Plate 7, should have diagonal wires laterally in a plane parallel to the motor bulkhead.

The engine section should be checked next. Then work from the starting point aft to the tail post, which must be plumb, as it determines the position of the rudder.

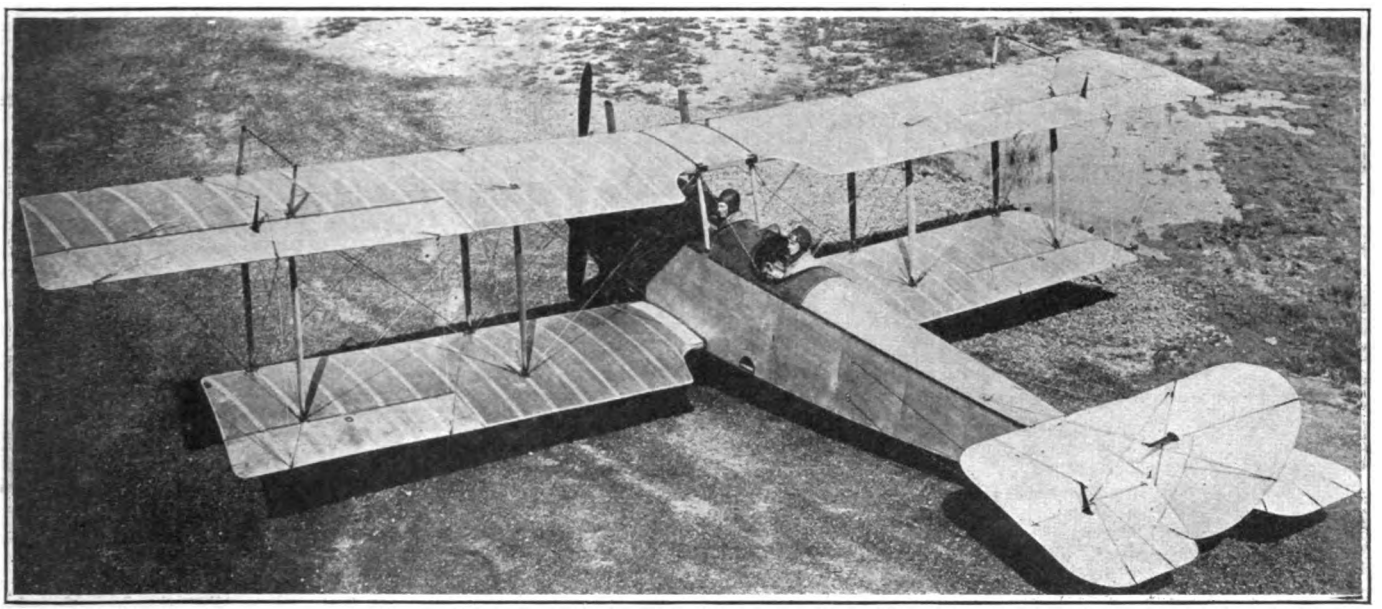
The dynamic balance may be checked up approximately by rigging up a bearing with a round edge to set under the lower longerons or the pontoons directly under a center midway between the centers of pressure of the top and lower planes as shown in the side elevation Plate 1 (August, 1919, issue). Bags of sand equaling the weight of the pilot, computed at 165 pounds, must be set in the rear cockpit for this.

3. The landing gear is then aligned. The pontoons must be properly blocked to avoid damaging the planking. This is usually done by constructing a cradle with padded blocking that bears along the chines and keel runners. It is a wise precaution to always support the tail end of the fuselage when working on the machine or when in storage. The above cradle may be equipped with wheels to serve as a truck.

The end of all struts, particularly the landing gear struts, must fit solidly with a full cross area bearing, otherwise the ends squash or flatten out, which slackens the wires, throwing the entire machine out of alignment.

Pontoon Alignment

The alignment of the landing gear is accomplished by adjusting the "incidence" wires shown in Figs. 2 and 4, Plate 8, and the cross wires, Fig. 3, Plate 9, and Fig. 12, Plate 13. The bow of the pontoons should extend 3 ft. 10 in. forward at the end of the lower longerons. The center of the wheels of the wheel chassis should be 10 inches in the rear of the same point. A plumb bob should be dropped from the center of the propeller shaft to the center established between the pontoons at the bows and one similarly at the stern. The pontoons must line up fore and aft. The wheel chassis must also be correspondingly aligned. Take all measurements from similar points on the longerons and tack light strips across the bows and stern of the pontoons shown in Fig. 12.



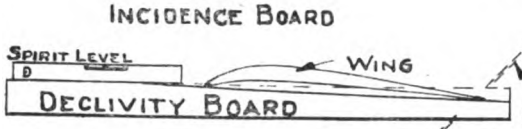
Curtiss JN4D Biplane viewed from above shows clearly all wiring and controls of typical standard design

Digitized by Google

ALIGNMENT DETAILS
TWO SEATER SEA-PLANE
Designed By C.E. MULLER M.A.E.

~ PLATE XIII ~

FIG. 1.
INCIDENCE BOARD



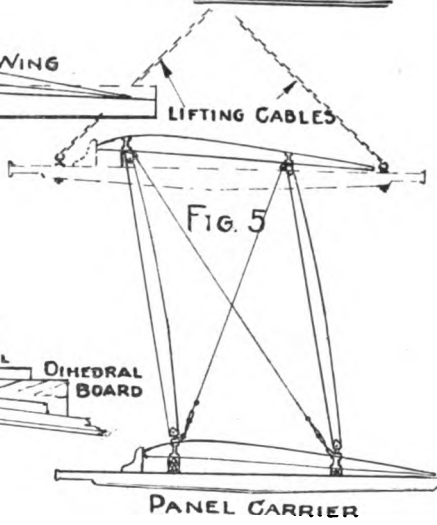


FIG. 5

FIG. 3
SPIRIT LEVEL
DIHEDRAL BOARD

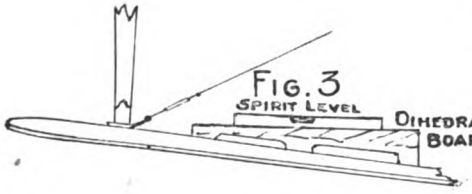


FIG. 2.

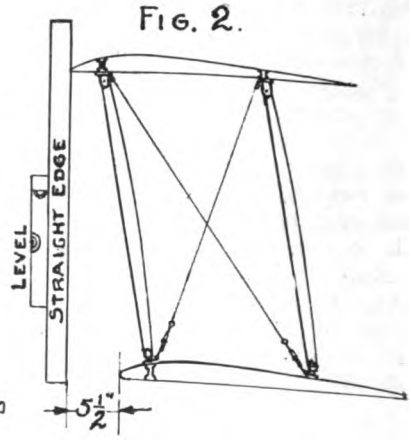


FIG. 13

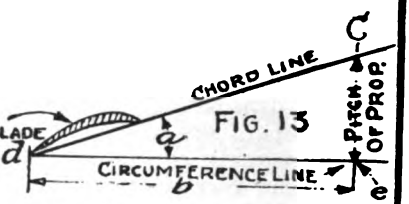


FIG. 6.

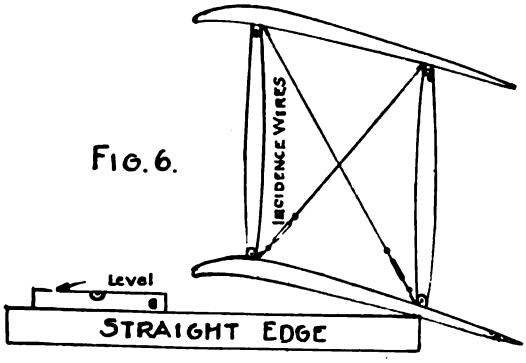


FIG. 4.
CHECKING STAGGER

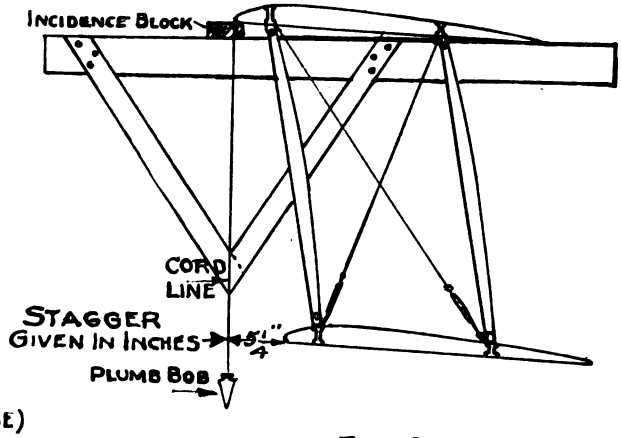
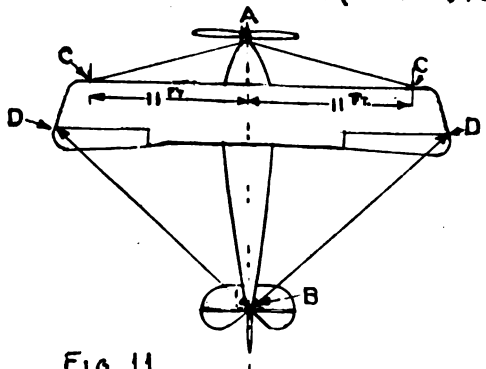


FIG. 7.
CHECKING ALIGNMENT (WINGS & FUSELAGE)



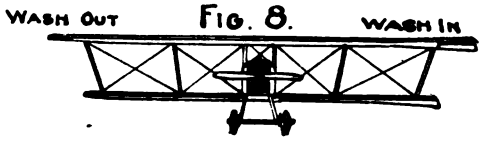


FIG. 8.

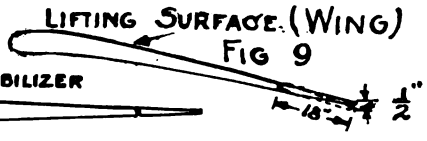


FIG. 10.
NON-LIFTING STABILIZER

FIG. 11.
CHECKING DIHEDRAL

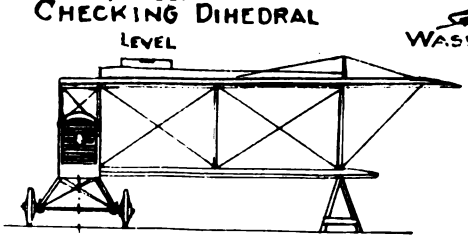
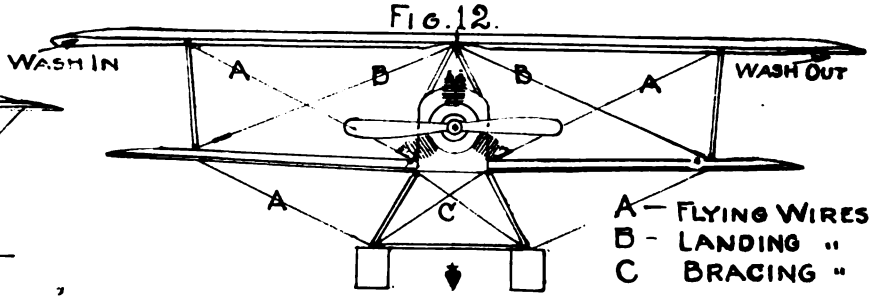


FIG. 12.



Digitized by Google

Determining Dihedral

4. Align the leading edge of the lower plane for a dihedral of 3 degrees for each wing. This may be increased to 4 degrees at the option of the builder. The more the dihedral angle, the better inherent lateral stability and the reduction in lift is unappreciable up to 7 degrees dihedral to each wing. The dihedral or declivity board may be also used as an incidence board, as they are the same in this particular case. A number of methods are shown in Figs. 1, 3, 4, 5, 6, the method outlined at Fig. 1 being the simplest.

This board may be made by laying off 1 inch in height to every 57 inches in length for each degree, therefore there is a taper of 3 inches in a 57-inch straight edge for the 3 degrees incidence and dihedral. The level may be used as shown, or along the under edge if parallel or if the declivity is laid out from the lower edge. The natural sine is .017452 for 1 degree, which equals .994764 inches in 57. A block of wood on a straight edge may be used if figured and placed correctly as suggested in Fig. 4.

Adjusting Incidence and Stagger

5. The angle of incidence and the stagger of the top plane may be adjusted considerably by the manipulation of the wires shown in Figs. 2, 4, 5, 6. They are therefore known as incidence or stagger wires. If a machine proves nose or tail heavy, due to a difference in weight of materials used from that estimated, or if it is desired to allow for a difference in the weight of operator and that computed, it may be compensated for by slightly increasing or decreasing the stagger as decribed in a previous issue. The stagger of the plane with the 2-ft 6-in. plane is 8¾ in, for the 4-ft. chord it is 5¼ inches. Two methods of setting and checking the stagger are shown by Figs. 2 and 4.

6. The trailing edge is now aligned for "wash in and "wash out" to compensate for the propeller torque. This is accomplished by the rear flying and landing wires that are a duplicate of the A and B wires shown at Fig. 12.

7. All wires must be carefully inspected, particularly for over tension, as this is a common error even with experienced men. When tightening or loosening a wire, be sure to test all opposition and adjacent wires, as the adjustment of one always affects one or more.

Wire Tension Important

Too great an emphasis cannot be placed on the importance of the even tension of all wires, otherwise the airplane will become distorted and fly badly. The tension should only be sufficient to keep the framework rigid, if in excess of this it reduces the safety factor and by undue compression in various components of the framework crushes the fitting into the wood, thereby distorting the entire machine. There is no one best rule for tensioning wires. Experiments have been made with many devices for this purpose, but with little success. Only by careful observation can one be assured that the wires are not over tensioned.

When adjusting turnbuckles do not use a pair of pliers because the barrels are not as stout as they look. They are easily squashed out of round, thereby rendered useless. A piece of heavy wire or a nail-set inserted in the holes provided will answer the purpose much better. All turnbuckles must be properly safety-wired in the right direction, if not the barrel is liable to unscrew from a quarter to a half turn, destroying the fine adjustment necessary for the success of the airplane. A piece of 16 to 20-gauge soft copper or iron wire is threaded through the eye in the barrel, then carried in the direction that tightens the turnbuckle, then through the stem 3 or 4 times. Do this to both ends. The rule that the eye bolts of turnbuckles be screwed into the barrel for a distance equal to at least twice their diameter should be exceeded.

Control Surface Alignment

8. The alignment of controlling surfaces is of utmost importance, as the pilot depends upon them entirely in managing the airplane. Figure 9 graphically depicts the manner of allowing for the necessary slack of the aileron control wires. The general rule is to allow ½-inch drop for every 18 inches of chord in the controlling surface. The air pressure in flight will hold it in the stream line.

9. The stabilizer or tail plane on this machine was designed to set at a zero angle of incidence and must be carefully aligned to be horizontal. It is supported by ½-inch 20-gauge tubing braces from the trailing edge to lower part of the stern post. The same bolts that are used for the center hinges of the elevators may be used to anchor these braces. The ends of the braces are reinforced with a 16-gauge plate internally, then flattened and brazed to accommodate the anchor bolts. The stabilizer cross section is known as a symmetrical wing surface, which produces a lift even at 2 to 3 degrees negative angle of incidence, varying with the depth of the section.

10. The elevators (flaps) are set as shown in Fig. 10, because any adjustment needed is taken care of by a slight movement of the "stick". Each should have three hinges described later.

11. The rudder is aligned with the stern post, which is essentially plumb. It should have three hinges, as suggested in Figs. 5-9, Plate 4 (November-December issue), or may be simply modified strap hinges with a plate brazed to it to form a yoke section similar to Fig. 30, Plate 5. Another method of attaching these members is to have the rudder post, the trailing edge of the stabilizer and the leading edge of the ailerons of 20-gauge Shelby tubing ¾ to 1 inch in diameter, and then use 16-gauge shaped brass strips 1 inch or more wide, to pass around the tubing, bolting on to the adjacent components.

This arrangement if properly lubricated is simple, neat and effective.

Adjusting Control Wires

When adjusting control wires the joy stick and rudder bar must be operated smartly to be sure there is no binding over the pulleys or that there is no snatch due to slackness. If the adjustment is correct the control surfaces should show a slight movement when the joy stick moves ⅛ inch either side of the neutral position. After every flight examine the control wires, especially when they run over the pulleys by passing the hand over them; if a strand is broken, take no chances, replace them. Keep all internal wires well enamelled and external wires well greased or oiled for protection against rust. When inspecting the wires the airplane must be level or blocked up in the flying position, otherwise it is liable to have a twist, throwing some wires in undue tension and slackening others. If you find a slack wire do not jump to the conclusion that it must be tensioned, perhaps its opposition wire is at fault.

Get the habit of sighting the leading edge to see if it is parallel to the wing bars, the trailing edges allowing for wash in and wash out, the position of the stabilizer, etc. With practice you will become expert in determining by the eye faults in efficiency, stability and control.

Checking the Propeller

The propeller is usually the last thing to be attached and adjusted. The performance of the machine varies considerably with various propellers. Not only is the R. P. M. of the engine influenced by the careful checking up of the propeller, but the thrust of the propeller itself is greatly influenced by the correct pitch and tracking of the blades.

"Pitch" is the distance that the propeller would screw or travel forward in a medium if there were no slip. "Slip" is the difference between this (theoretical pitch) and the actual distance travelled.

(*Continued on page* 188)

Digitized by Google

The Knack of Carburetor Adjustment

Some Easily Understood Instructions for Adjusting Various Types of Carburetors to Secure Smooth Engine Action and Maximum Fuel Economy

By Victor W. Pagé, M.S.A.E.

THE average motorist who takes care of his own car and many of those engaged in running automobiles or for caring for them as a means of earning their living do not realize the importance of carburetor adjustment and usually any setting that will run the motor, regardless of the amounts of air and gasoline vapor in the mixture, is considered satisfactory. The result is often a waste of valuable fuel and actual mechanical depreciation may be caused by the dilution of the engine sump oil with excess fuel. Careful carburetor adjustment is especially important in these days of low grade gasoline, or rather motor fuel, which bears but little resemblance to the liquid known as gasoline several years ago for which most of the carburetors were initially designed.

Carburetor Construction

The modern form of spraying carburetor is provided with two chambers, one a mixing chamber through which the air passes and mixes with a gasoline spray, the other a float chamber in which a constant level of fuel is maintained by simple mechanism. A jet or standpipe is used in the mixing chamber to spray the fuel through and the object of the float is to maintain the fuel level to such a point that it will not overflow the jet when the motor is now drawing in a charge of gas.

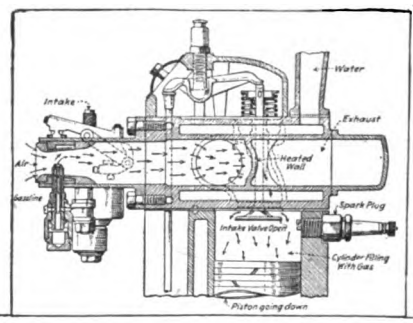
The design of the components of modern carburetors differ largely, but most of the modern mixing devices operate on the same general principle. Certain features of design have been accepted generally, such as automatic mixture compensation by auxiliary air valves, Venturi type of mixing chamber, float and mixing chamber concentric, separate adjustment for gasoline and air, and simplicity of construction. Various carburetors have been devised of late in which auxiliary air valves are done away with and proper compensation for mixture variation due to the various engine speeds is made by ingenious applications of double jets. In some manual, regulation of the incoming air is again resorted to.

Automatic compensation is made necessary because a satisfactory mixture must be furnished at all engine speeds without the operator constantly varying the fuel supply or air proportions to allow for different conditions of operation produced by varying speeds. On early types of carburetors it was necessary to constantly vary the mixture proportions by working the air shutter or fuel valve from the driver's seat while the vehicle was in motion. The aim was to secure a mixture that best adapted to the conditions of operation then present, and while a skillful driver would manipulate the adjustments in a way to deliver well proportioned mixtures to the cylinder the average operator did not control the mixture exactly and the results obtained did not make for efficiency.

The velocity of entering gases depends upon engine speed, and as the draught diminishes it will not pick up as much fuel as when it is traveling at a higher rate. The present type of compensating carburetor provides for a sufficiently rapid flow of gas at low speed by constricting the mixing-chamber bore at the spray nozzle so that the gas speed will be sufficiently high when the engine is pumping slowly. The reduced diameter of the mixing chamber increases the velocity of the gases because the cylinder must be filled through a smaller hole in a certain unit of time than would be the case if the bore were larger. Therefore to insure a full supply reaching the cylinder the gases must pass the top of the jet at a high rate of speed even if the piston is working slowly. As the opening is constricted not enough air will be drawn in at high speed, and it is necessary to supply it through an auxiliary opening usually controlled by some automatic form of valve. This can be adjusted to open only when the suction effect is sufficiently high to overcome the tension of the spring which holds the valve to the seat, and this increased suction effect obtains only at high speeds.

The Venturi type of mixing chamber is being widely used at the present time because it has properties, when properly proportioned, of insuring high gas velocity at low engine speed. Special care must be taken in the proportions of the air passage, as it is necessary that the area be large enough to allow the air stream to pass through freely, yet at the same time it must be constricted to such a point that the entering air stream will pass the top of a standpipe with sufficient momentum to draw an adequate supply of gasoline from the spray nozzle. The velocity of the air stream has been variously estimated, but most authorities are agreed that it should be from 7,000 to 9,000 feet per minute to insure picking up a sufficient amount of liquid as it passes around the spray nozzle.

It is not possible to describe in detail several hundred carburetors that are procurable in America in an article of this nature, so, representative types



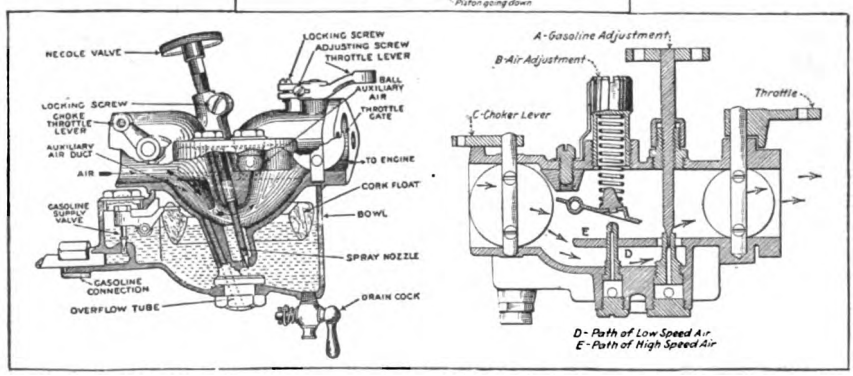


Fig. 1 at top center shows how the mixture is drawn in by descending piston through inlet valve opened by rocker arm on intake stroke

Fig. 2 at left shows sectional view of one model carburetor used on Ford cars. Fig. 3 at right outlines simple two jet mixing chamber

Digitized by Google

are selected to familiarize the reader with the essential features of modern vaporizing devices, as well as suggestions for their adjustment.

One Adjustment Forms

One form of Ford Carburetor is shown at Fig. 2. This is a "puddle" type that is exceptionally simple in construction. The gasoline is admitted to the float bowl through the usual form of gasoline supply valve regulated by a float, which determines the proper level of fuel in the float chamber. The mixing chamber is a peculiar form, so designed that all air entering through the main air intake must pass over the small pool of gasoline at the bottom of mixing chamber before it can reach the engine. The amount of gasoline supplied the mixture may be varied by a regulating needle valve, and the amount of gas reaching the cylinders is controlled in the usual manner by a butterfly throttle valve. At low engine speeds, as when starting, the air cannot fail to pick up gasoline vapor no matter how slow it passes over the top of the spray nozzle. At higher speed the mixture is diluted by auxiliary air supply. Only one adjustment is provided, that regulating the fuel supply by a needle valve.

The Packard carburetor is an exceptionally simple device of the single jet type having auxiliary air valve control of the extra air needed at high engine speeds. As all parts are clearly lettered in the diagram, Fig. 4, the construction and operation can be readily understood.

The carburetor is placed above and between the cylinder blocks. Thus the heat derived from the exhaust pipes in addition to the hot water jacketed cross and cylinder block manifold permits a uniform temperature and insures efficiency in mixing the sprayed gasoline with air. The mixing chamber is a cylindrical chamber around and above the spray nozzle. The vacuum created by the pistons, causes air to rush into the mixing chamber through both the primary and the auxiliary air inlets. The air passes through the mixing chamber around the nozzle, atomizes and mixes with the gasoline sprayed through the latter. In this carburetor, the adjustment is by varying the air valve spring tension. Changing spray nozzles or altering float level is work that should be attempted only by expert factory service men.

It is important that the proportion of air and gasoline in the mixture be correct for all motor speeds. Consequently, although the primary air inlet valve is controlled by springs, so that while the valve opens slightly at low speed, the increased vacuum of high speed opens it still more, letting in the greater amount of air required to maintain the correct proportion of the mixture. The carburetor thus automatically produces a correct mixture for all motor speeds, the auxiliary air valve hand wheel on the control board being used only for the regulation of the mixture for starting and to suit different atmospheric conditions.

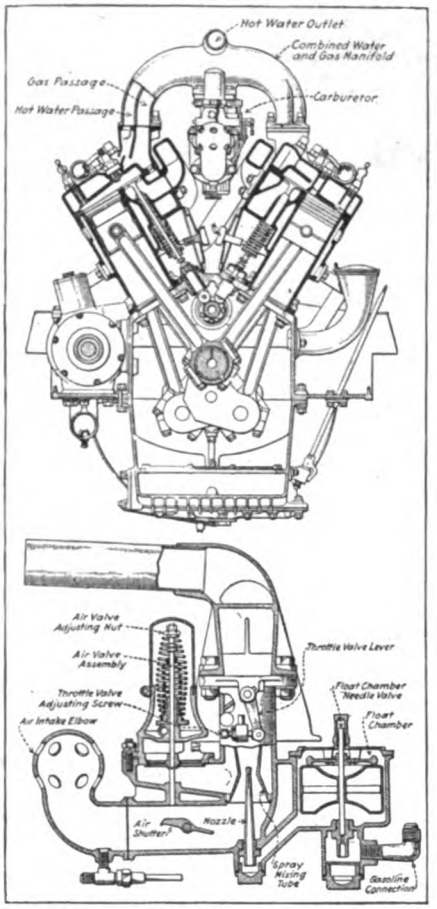


Fig. 4—The Packard carburetor and its installation

Multiple Nozzle Vaporizers

To secure properly proportioned mixtures some carburetor designers have evolved forms which two or more nozzles are used in a common mixing chamber. The usual construction is to use two, one having a small opening and placed in a small air tube and used only for low speeds, the other being placed in a larger air tube and having a slightly augmented bore so that it is employed on intermediate speeds. At high speeds both jets would be used in series. Some multiple jet carburetors could be considered as a series of these instruments each one being designed for certain conditions of engine action. They would vary from small size just sufficient to run the engine at low speed to others having sufficient capacity to furnish gas for the highest possible engine speed when used in conjunction with the smaller members which have been brought into service progressively as the engine speed has been augmented. The multiple nozzle carburetor differs from that in which a single spray tube is used only in the construction of the mixing chamber, as a common float bowl can be used to supply all spray pipes. It is common practice to bring the jets into action progressively by some form of mechanical connection with the throttle or by automatic valves; as shown in the simple mixing chamber of the two jet type shown at Fig. 3. This carburetor has two adjustments, one regulating the air flow valve for high speeds, the other a gasoline adjustment for low and medium speeds.

Tillotson Two-Jet Type

This is a double jet, variable Venturi carburetor and has been widely used on Overland cars. A partially uniform vacuum is maintained at the fuel nozzle by two flexible reeds mounted on a cage designed so that the maximum opening takes care of the volume required to fill the combustion chamber at maximum piston speed. When the reeds are seated they provide the highest possible vacuum at slower engine speeds. They are placed so as they move they form a virtually variable Venturi. A secondary nozzle comes into operation at higher engine speeds and is not in use at the lower speeds. The body design of the carburetor permits only one air intake, and thus it is quite simple to pre-heat the entire

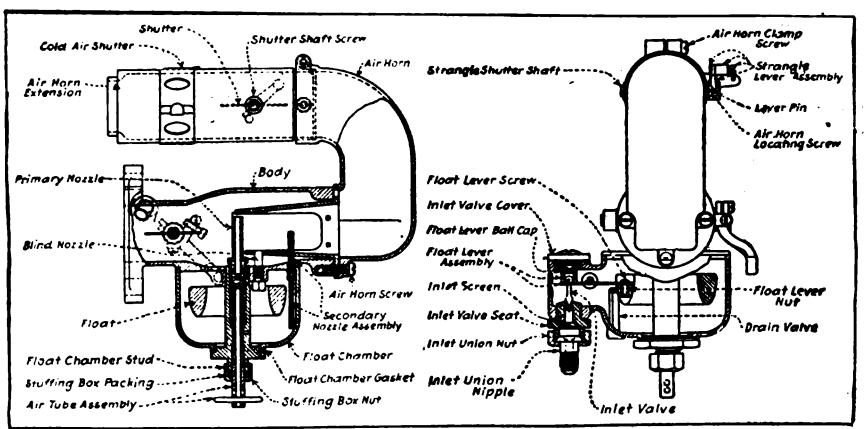


Fig. 5—Views showing construction and adjustment of Tillotson Carburetor, a simple two jet type

Digitized by Google

air supply. The particular feature is that the heavier fuel is taken care of by the pre-heated air and that the velocities through the variable Venturi are as high as possible. The construction is clearly shown in the sectional views at Fig. 5, and the relation of the carburetor to the engine is outlined at Fig. 6.

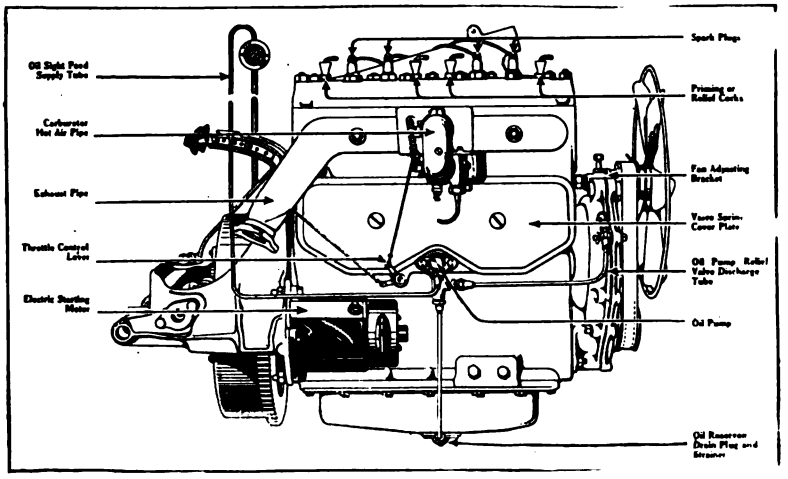


Fig. 6—How the Tillotson carburetor is installed on popular four-cylinder engine

There is but one adjustment necessary in the Tillotson instrument—the low speed adjustment or needle valve. The air supply is controlled by automatic valves.

1. To regulate the carburetor first run the motor until it is warmed up.
2. Retard the spark and set the throttle so that the motor is running at a car speed approximating fifteen miles per hour.
3. Turn the needle valve to the left or right until the best results are attained. When this adjustment is made the valve should be from one to one and one-half turns off its seat. For the most economical adjustment the valve should be gradually turned into the carburetor until the motor starts to miss and then slowly turned out again until firing becomes perfect.

Metering Pin Carburetors

Another carburetor classification is the type in which some form of metering pins are placed in the nozzle and provision made to lift this pin by raising or lowering it. The metering pin is like a pointed pencil, made with different degrees of taper to supplement the auxiliary air valve, the air valve perhaps caring for the high speeds and the metering pin for all intermediate speeds, while idling and low speeds may be taken care of in other ways such as pilot nozzles.

Controlling the metering pin is accomplished by various methods. In one design it is raised by the throttle as at A, Fig. 7, in another by the auxiliary air valve, and in a third by an air valve within the mixing chamber. In the Schebler carburetor Fig. 7, the metering pin is controlled by the auxiliary valve; when the valve moves downward in opening, it carries the metering pin with it, the latter being designed to increase the jet as it is lowered.

In the Stewart carburetor, the metering pin action of which is shown in diagram form at B, Fig. 7, the entire spray nozzle and air valve combination move together, the action being dampened by a dashpot. The metering pin may be regulated from the dash board

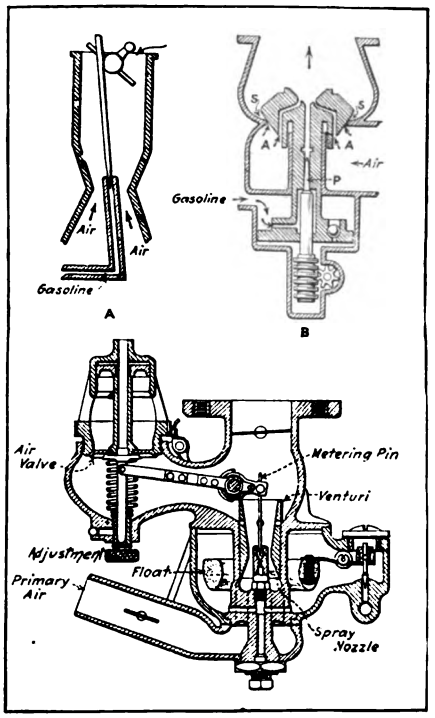
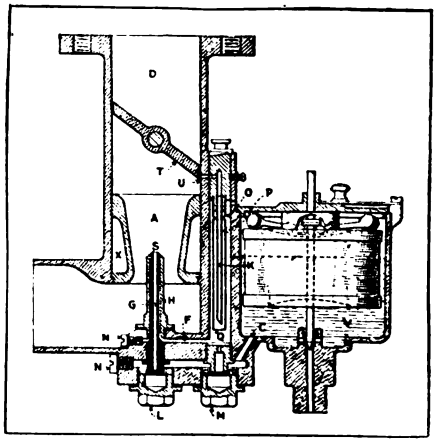


Fig. 7—Metering pin carburetor designs

but when once set it is intended to be left alone. At higher suctions, the air valve and spray nozzle combination lift away from the metering pin.

Compound Nozzle Form

In the Zenith carburetor which is shown at Fig. 8, a compound nozzle is used, this being composed of two jets designated as G and H. The center nozzle G is the main member and concentric with it is a tube which forms the compensating jet H. The inner nozzle communicated with the float chamber through passages E and C while the annular space between the main jet and the cap of the compensating member is supplied with gasoline by the passage F. At one side of the mixing chamber, and between that member and the float compartment, is a cylinder in which the secondary well P and the priming tube K are suspended. The upper end of the priming tube is in communication with the passage U in the mixing chamber walls. The passage U is controlled by the throttle T. When the throttle is closed the suction through the priming tube K is so great that it drains the gasoline from the secondary well and furnishes a very rich mixture through the opening U in the wall of the air tube D. The gasoline enters the sec-



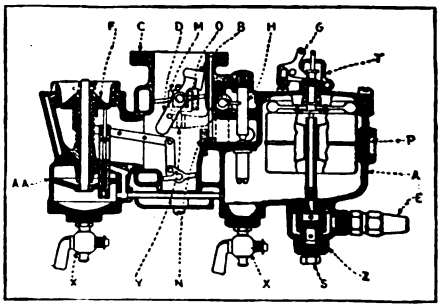


Fig. 8 at top shows Zenith carburetor construction

Fig. 9 is a sectional view of Rayfield carburetor

ondary well P through the small hole Q at the bottom. With this vaporizer the quantity of air increases almost directly as the engine speed but the gasoline supply does not.

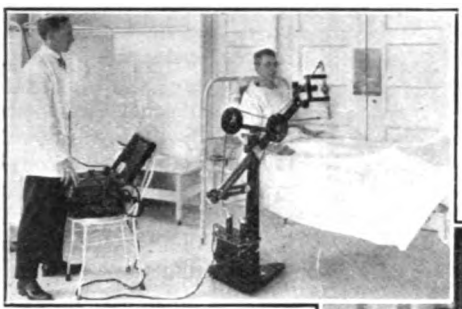
Since the air supply increases with a constant ratio the amount of gasoline must be regulated to such proportions that a correct mixture will be obtained at all speeds. This is the function performed by the double nozzle because at low speed the outer or compensating nozzle has a large quantity of fuel, but this decreases as the engine speed augments until at high speed the compensating nozzle does not add much fuel to

(*Continued on page* 186)

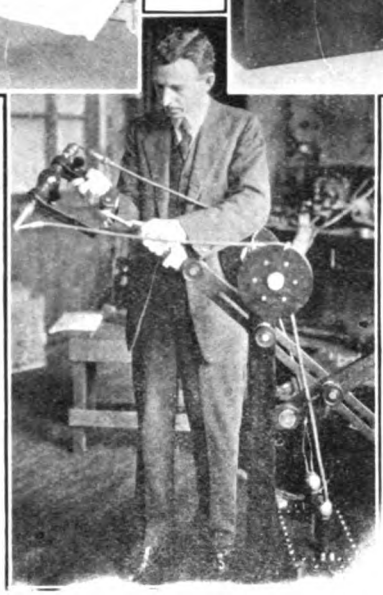
Digitized by Google

A New X-Ray Outfit

FOR many years the X-ray has been the invaluable ally of surgery and medicine, but until recently it has been necessary always to transport the patient to the X-ray laboratory. Those sufferers whose condition forbade this, were, through no fault or desire of their own, deprived of the X-ray's benefits with the result that medical skill has been handicapped in diagnosing conditions which otherwise might not have been recognized. Dr. W. D. Coolidge and his associates in the Research Laboratory of the General Electric Company at Schenectady have recently perfected a portable X-ray outfit which meets this need. The U. S. Army Portable Outfit, which they devised, rendered service of a high order in the European war and the new and more compacted outfit is the peace outgrowth of the army set.







Dr. Coolidge, inventor of the new X-Ray outfit

It is now possible for any doctor to transport the entire new outfit, packed in four hand-borne units, to any home wired for electricity and produce radiographic results as good as those secured in a completely equipped X-ray laboratory. The process of operating the machine is simplified for him by control systems enabling him to use the exact ray intensity he needs and a time switch that accurately controls the length of each exposure. With these adjusted, the doctor merely presses a button and the machine does the rest. Plates can thus be produced which show remarkable uniformity. An ordinary incandescent light circuit supplies all the necessary current.

The portable Coolidge X-ray outfit is made also for hospital use, so that it can be taken to the bedside of patients who cannot be conveniently moved to the X-ray laboratory. The results produced with this outfit are comparable with those of any ordinary X-ray machine except its power is too low for instantaneous gastro-intestinal radiography which requires greater speed and power.

The portable Coolidge set has been greatly compacted and simplified over the army type familiar to medical corps men. The bulb itself has been reduced in size to 2½ inches. By making the tube of thick lead glass thus replacing a heavy shield, the total weight of the tube and its protection was reduced five pounds with a consequent lightening of the frame which supports it. This lead glass made from a formula developed in the Schenectady laboratory contains about 57 per cent metallic lead and in its resistance to X-rays, is equal in protective power to lead one-sixteenth of an inch thick.

The new tube rectifies its own current, thus doing away with a heavy, bulky rectifier and adding to the efficiency of the set as a whole. The transformer has been reduced in size by the use of smaller windings and a case shaped to fit the coils. A minimum of weight and bulk is secured in all other parts of the outfit by a careful choice of materials and a study of sizes and shapes. Thus when the outfit is ready to be taken out for use, the doctor carries an ordinary size suit case, containing the tube, reels, cables, base of the stand and other small parts, the transformer borne by a special carrying cover, the tube stand in a cloth container resembling a golf bag and a small instrument and control box. The whole load is such as can be put easily into the tonneau of a small automobile and as easily carried in or out of a house. The transformer, which is the heaviest unit of the four, weighs 43 pounds with its case. It is oil insulated and delivers to the tube 10 milliamperes at 60,000 volts.

DETACHABLE BROOM MADE POSSIBLE BY LOW COST OF OXWELD MANUFACTURE

THIS is the day of H. C. L. plus—but it is also the day of new and crafty ways of sidestepping the onslaughts of the ugly ogre. The latest device to enlist on the side of the people is the detachable broom handle.

At first thought the broom handle seems inconsequential. Isolated and individually it is. Multiply it by some fifty millions or more, which probably approximates the number of brooms sold yearly in the United States, and you have something quite different.

The detachable broom handle is a brand new idea and it is "taking". At the present time there is a factory in Vermont devoted exclusively to manufacturing brooms with this type of handle. The handle is of wood fitted into an oxwelded metal holder that clamps easily onto the brush of the broom. The metal part is light but very strong, being securely welded by the oxy-acetylene process, which not only makes it rigid but allows the entire piece to be neatly finished.

This is but one of a long list of interesting new departures from man's habitual thriftlessness that have sprung out of the need for widespread economies to combat living costs. In fact, the oxy-acetylene process itself is perhaps the most far-reaching of all modern economies in the metal working industries. Owing to the superior quality of welds made by this process, its remarkable speed and almost unbelievable economy, it is now almost universally applied in manufacture, construction and repair work. All that is required for a complete portable outfit is an Oxweld blowpipe for welding, a cutting torch, a cylinder of Linde oxygen and a tank of Prest-O-Lite dissolved acetylene, with which practically everyone is familiar.

HOW TO FILL HOLES IN FURNITURE

A CEMENT for stopping holes in mahogany and other furniture or woodwork may be made by melting together five parts of shellac with one of Indian red and enough yellow ochre to give the correct color.

Or beeswax may be used, in the proportion of one part to Indian red to four of wax. When properly mixed and applied this filler after drying cannot be distinguished from the wood itself.

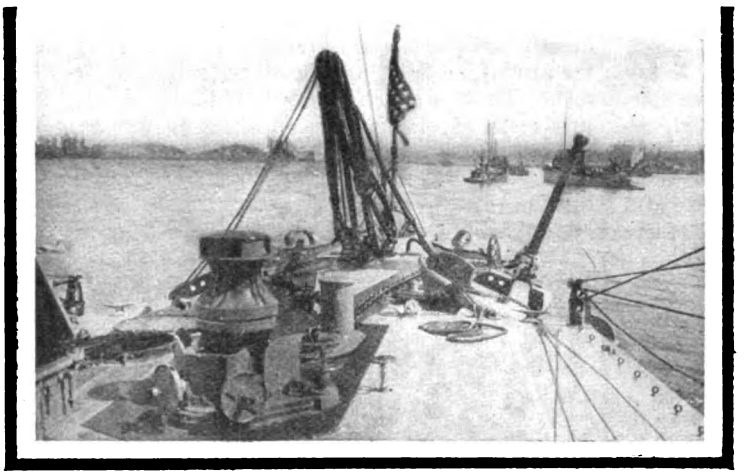
It is also good for other woods of a dark color, as oak and cherry. The proportions may be varied to suit the shade of the woods and all cracks and holes which are not too prominent may be well hidden.—JOHN UPTON.

Digitized by Google

A Model Engineer Aboard A Destroyer

By Harvey Dale

THE writer is a member of that unfortunate class of model makers whose desire to build models is aggravated to an intense degree by the sight of a suitable subject. Consequently, when the new twelve-hundred-ton destroyers of the United States Navy first made their appearance he suffered an acute attack of the building fever which raged for a long time unquenched owing to the absolute dearth of any data regarding the boats. Most people whom he consulted knew nothing about the boats except that they didn't look like the old ones, and the few who did know were forced by the censor to maintain an exasperating silence. At last, however, the Atlantic Fleet paid a visit to New York, and for the first time since the war visitors were allowed to go on board the various vessels and even to take photographs.



The bow of the destroyer

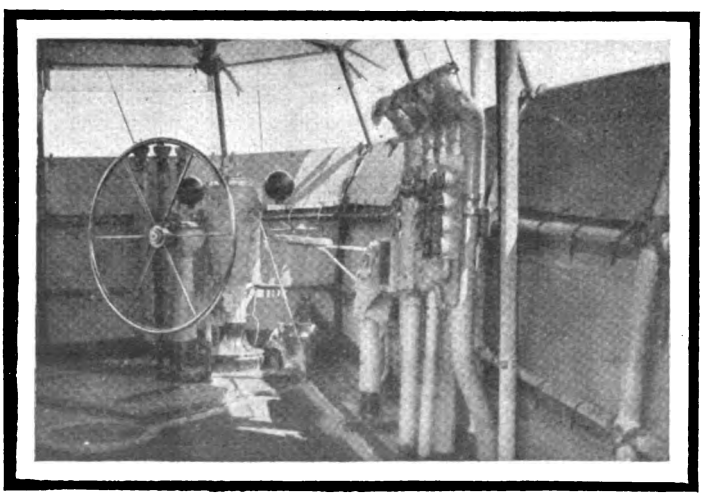
The writer promptly hied himself to the Naval Landing and jumped aboard the first small boat from a destroyer that came to the float. It happened to be a dory from U. S. S. Blank, No. 000, a brand new boat, a month off the ways of Cramp's yard at Philadelphia. He explained his mission to the officer of the deck and was taken below to the ward room and presented to the commanding officer. Both these gentlemen showed him every kindness and gave every assistance in getting sufficient details of the boat for a model, and although the writer unfortunately cannot disclose their names, he, nevertheless, thanks them for their courtesy.

After the consultation in the ward room the writer sallied forth in search of fair game for the all-seeing eye of his camera. There were many details of deck fittings that he recognized only in outline, and which were necessary for the construction of a presentable model. Chief among these were the appearance of the gun and torpedo tube mounts and the arrangement of bridge and bow fittings.

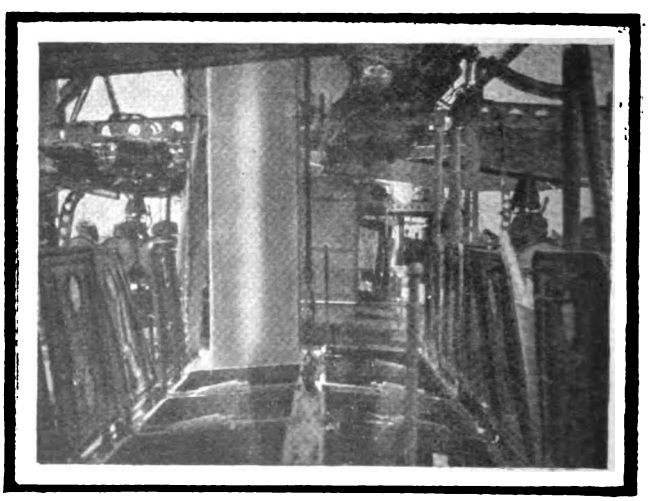
This is a vivid little article prepared by a "young salt" who would rather build model boats than call on his best girl—if he has any. It gives many details that will greatly assist those who contemplate the construction of a model of one of the new destroyers.—EDITOR.

On the system of starting at the bow and working aft the ground tackle came in for first consideration. By getting a fairly general view from the top of a hatch the details of the chocks, chain guides, anchors and anchor davit were fully taken in. The next things of interest were the forward 4-inch and anti-aircraft guns, but they were so shaded by the awning as to prevent detailed photographs, so one of the after guns was used as a model instead. The forward gun differs from these only in a small steel shield designed to keep some of the water away from the mechanism in a heavy sea. The shape of this is apparent from the photographs.

Next, of course, came the bridge, and this furnished opportunity for several pictures and also for nice model work in the future. First a general view of the bridge taken from the extreme starboard after corner covered the arrangement of steering wheel and indicators fairly well. A close-up of a torpedo director, one of which was mounted on each side, gave an excellent idea of the appearance of these interesting and intricate range and deflection finders. The signal and searchlight platform atop the bridge deck house seemed difficult of photographing until a climb up the foremast to the crow's nest spread the whole ship out like a map. The searchlight platform with its two signal stations at the sides was taken and a view looking aft, which was not of



The bridge of the new destroyer



The group of open hatches

Digitized by Google

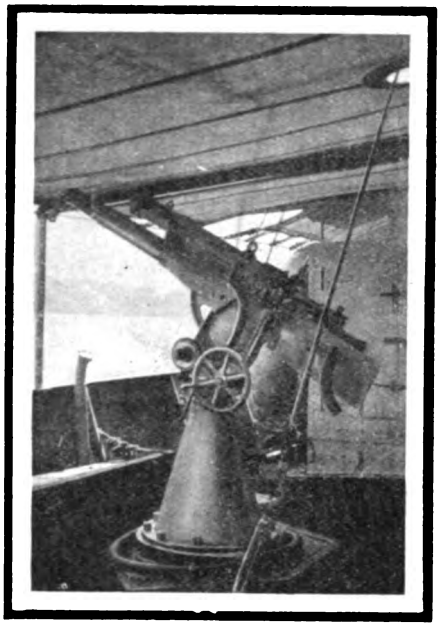
great help owing to the awnings which hid almost everything on deck from sight.

On coming back down to the deck the ship's mascot, a young and lively goat suitably tinted a low-visibility grey obligingly posed with the assistance of one of the men and was snapped on the last picture on the film. It is sure that no model of the vessel would be complete without the ever-present goat, but the writer is afraid he may be difficult to copy, especially his bleat.

The gun platform over the galley and beween the two funnel groups looked interesting, but the photograph shows its shape and arrangement better than a word description could. However, the two 4-inch guns gave an excellent opportunity for views of both sides of their mouths, which were promptly taken.

The anti-aircraft gun on the port side between the first and second funnels was next taken and although shaded by the awning a short time exposure recorded its details very well. In passing it may be noted that the guns differ on different boats. The one shown is a short barreled three-inch with a high angle mount. Other boats are fitted with a semi-automatic one-pounder, which is of quite different appearance.

Any picture of the general appearance of the deck was unobtainable owing chiefly to the awning, but one was taken looking forward over the after engine room skylight which is of some assistance. One of the four units of triple torpedo tubes was photographed both from the side to show its mount and from the rear to show the breach mechanism. The "tin fish" fired is a Whitehead 21 feet long and 21 inches in diameter overall.

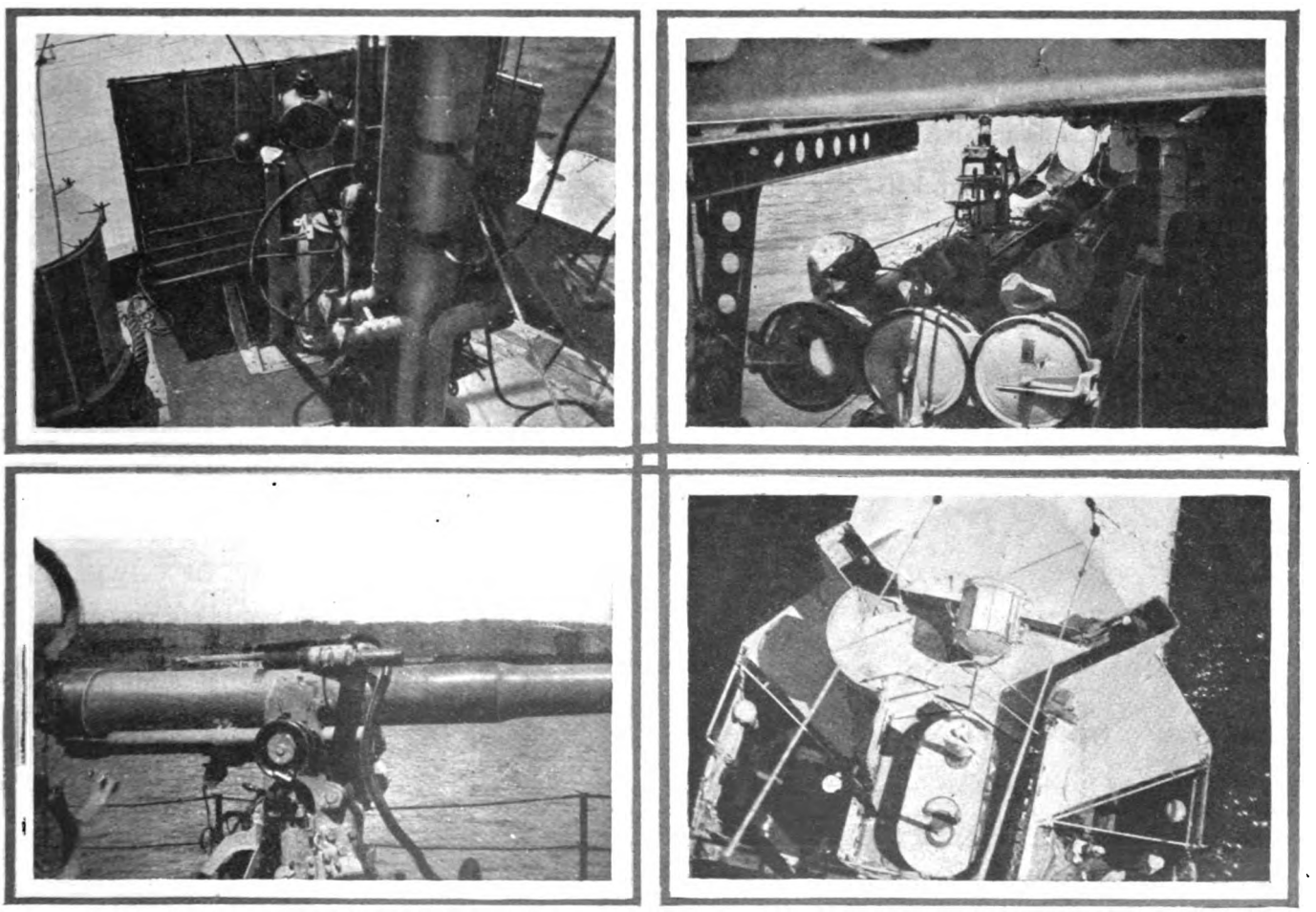


The anti-aircraft gun carried by the destroyer

The afterdeck house came next, and was taken from the after searchlight platform. Unfortunately, the depth charges and "Y-gun" for throwing them were not in their places, but the name "ash-can" is almost sufficient description of the charges and several pictures of the projectors have appeared in the press. Just what is contained in the Radio Compass Box is a mystery to the writer, but its external appearance is simple enough.

The after gun gave another opportunity for pictures, and one of the men obligingly swung it so as to show the view from the muzzle when elevated and from the breech when depressed. The four pictures of a mount of the same mark and modification should be sufficient to enable anyone to draw up plans of a very accurate model.

The possibilities for useful photographs and the film being both exhausted at about the same time, the writer went below decks and tried to puzzle out the maze of pumps and piping connected with the powerful turbines that drive the vessel at a thirty-seven knot clip. These consist of a high pressure and low pressure turbine connected to each shaft by reduction gears. The necessary condenser is mounted alongside each engine. The port engine is forward of the starboard



A group of interesting pictures showing the top of the bridge from above, the torpedo tubes and a deck gun

Digitized by Google

making two separate and complete engine rooms.

When the writer finally set his feet on the shore he was in possession of the following information:

Length over all, 314 ft.

Length between perpendiculars, 310 ft.

Beam, 31 ft.

Draft, 9 ft.

Molded depth, 20 ft. 7 in.

Top of main mast 100 ft. 10 in. above water.

177 frames spaces 21 in. apart.

Small boats.

1 24-ft. motor sailing launch.

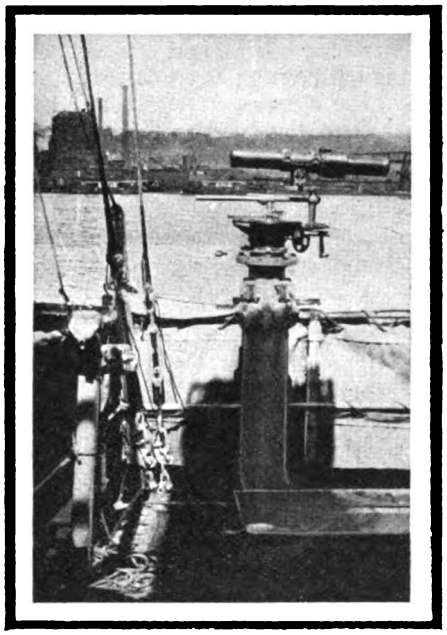
1 24-ft. whale boat.

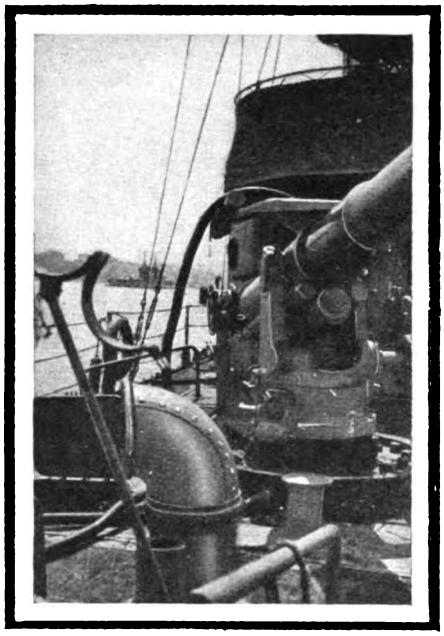
1 21-ft. motor dory.

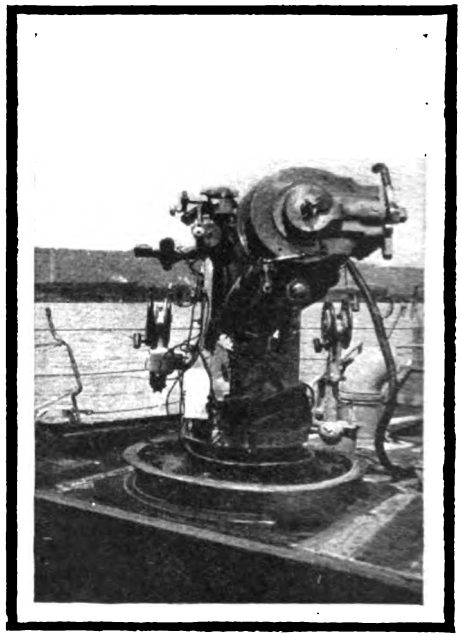
1 14-ft wherry (carried between cutter and dory).

1 10-ft. punt (carried on deck by galley).

at the top about three feet high and shaped as shown. The two power boats are carried on steel supporting frames when hoisted aboard ship, but the whale boat not having the weight of an engine simply hangs from its davits six feet above the deck. The sections shown are taken on the frames as numbered, and are not evenly spaced as is the usual procedure. This accounts for the apparently somewhat irregular







This group of pictures show two more views of the deck gun and one of the range finders

Shafts incline downward and aft at 2 deg. 40 ft. 54 in.

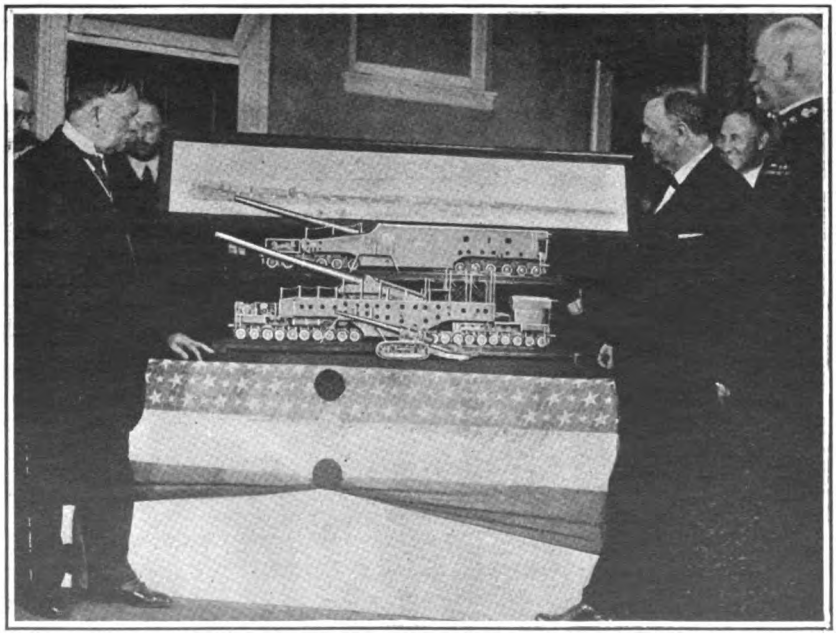
Shafts diverge from center line at 1 deg. 16 ft. 12 in.

Screws 110 in. x 122 in. Port, left hand; starboard, right hand.

The photographs are very nearly self-explanatory, but one or two things are worthy of note. The forced draft blowers on the port side of the galley are simply steel boxes with a wire grating

shape of the hull. The separate details show the tops of the three deck houses, while the main deck plan shows the shape of the house itself. It will be noted that in each case the two are quite different. One detail not shown in the photographs is the railing stanchions. These are slender steel rods spaced about eight feet apart and carrying two wire hand lines. They run wherever no obstruction such as torpedo tubes interfere.

It is sincerely hoped that this brief account and the pictures and drawings will enable many builders to make an accurate model of these magnificent boats which have doubtless already attracted their interest.



Secretary of the Navy Daniels was recently presented with several very elaborate models of the new coast defense guns now being constructed by the Baldwin Locomotive Works. The guns are of the railroad type and are somewhat similar to those employed in France. The models are exact scale reproductions, and cost several thousand dollars to build

ENDURANCE OF OXWELDED JOINTS

OUT of the debris of a $400,000 fire that swept two blocks of Tampa's industrial district last December practically the only salvage was a 12,000-gallon oxwelded oil storage tank, which was afterwards found intact excepting for dents and scars that were later removed. Inspection showed that the oxwelded seams held tight at every point, no leak developing anywhere in the welds. The tank contained 5,000 gallons of gasoline at the time of the fire.

Digitized by Google

Turning Wheels and Pulleys*

THE machining operations on flywheels, pulleys, rings, casings, etc., are not so simple as those on objects of smaller diameter because of difficulties attendant on the chucking and the production of true running surfaces in the finished article. The proportions of the diameters in relation to thicknesses of rims and arms or webs are so great that it is very easy to spring and warp the castings with a chuck or clamp pressure that does not appear to be actually excessive. The resistance of a disc-shaped casting in the flat plane direction is not very effective against clamping pressure, unless the metal is supported on firm bedding in a line with the direction of the pressure.

Neither is the power to resist distortion circularly on open portions of a rim or flange. Yet, unless a sufficient hold is obtained for driving, the piece will move in the chuck, or on the face-plate, possibly after a certain amount of work has been performed on it, with resulting waste of time, sometimes damage to the surfaces, or occasionally a loss. The large diameter on which cutting has to be done renders the problem a difficult one, especially if the amount to come off is considerable, or the metal is hard. The secret of success in the majority of awkward examples lies in getting a drive somehow without making the friction of the chuck jaws or of the face-plate clamps assume all this duty. The inclusion of bolts, pegs or occasionally of special clamps projected in a suitable manner solves the matter and reduces the machining time and the risks of disaster.

In considering this subject, the question of concentricity takes an important place. It looks very bad to see a flywheel or pulley or other element running slightly eccentric on the rim, or wobbling ever so little sideways, while in the case of gear blanks, friction wheels, brake drums, certain types of covers, etc., any error in these directions is fatal to correct fitting and running. The relation of a bore to an exterior must be ensured correctly by careful workmanship at one chucking, or the operation must be divided, turning the outside, (or, at any rate, finishing it) while the piece is mounted on a mandrel. Very careful boring is required to get accuracy by the first named method, as a small deviation from truth, by reason of the spring of the boring tool or fault in the lathe head or the slide-rest, is much magnified at the periphery of the casting when mounted on its shaft. Hence the popularity of the practice of putting the job on a mandrel, which enables concentricity to be more easily gained and any faint imperfections to be seen readily, either with the eye or more closely by an indicator.

Two important variations arise in respect of the methods of chucking, say, a flywheel or pulley of good size—that is, whether one desires to have the rim portion free for turning or at least roughing out, or whether its covering with jaws or clamps does not matter, when boring the hub is the only operation desired. The relative advantage of having the rim available for holding depends on several factors, such as the diameter in respect to that of the chuck or face-plate, the thickness of the section, the presence or otherwise of arms or spaces in the web. In certain instances it becomes advisable to drill two or three holes in a solid web for the purpose of passing bolts through, being an easier way than trying to secure a hold on the rim with a chuck that barely reaches thereto while the jaws are but inadequately supported in their slots, and also leaving the rim clear for the action of a tool.

The matter of support really settles the point whether a wheel will spring and warp out of truth during the time it is held. This applies both to pressure radially and axially. For example, a severe degree of pressure exercised radially against a rim where it is unable to offer effective resistance is certain to cause disturbance of circular truth. The pressure may come on an open portion of the rim, away from arms, or the thickness of the metal may

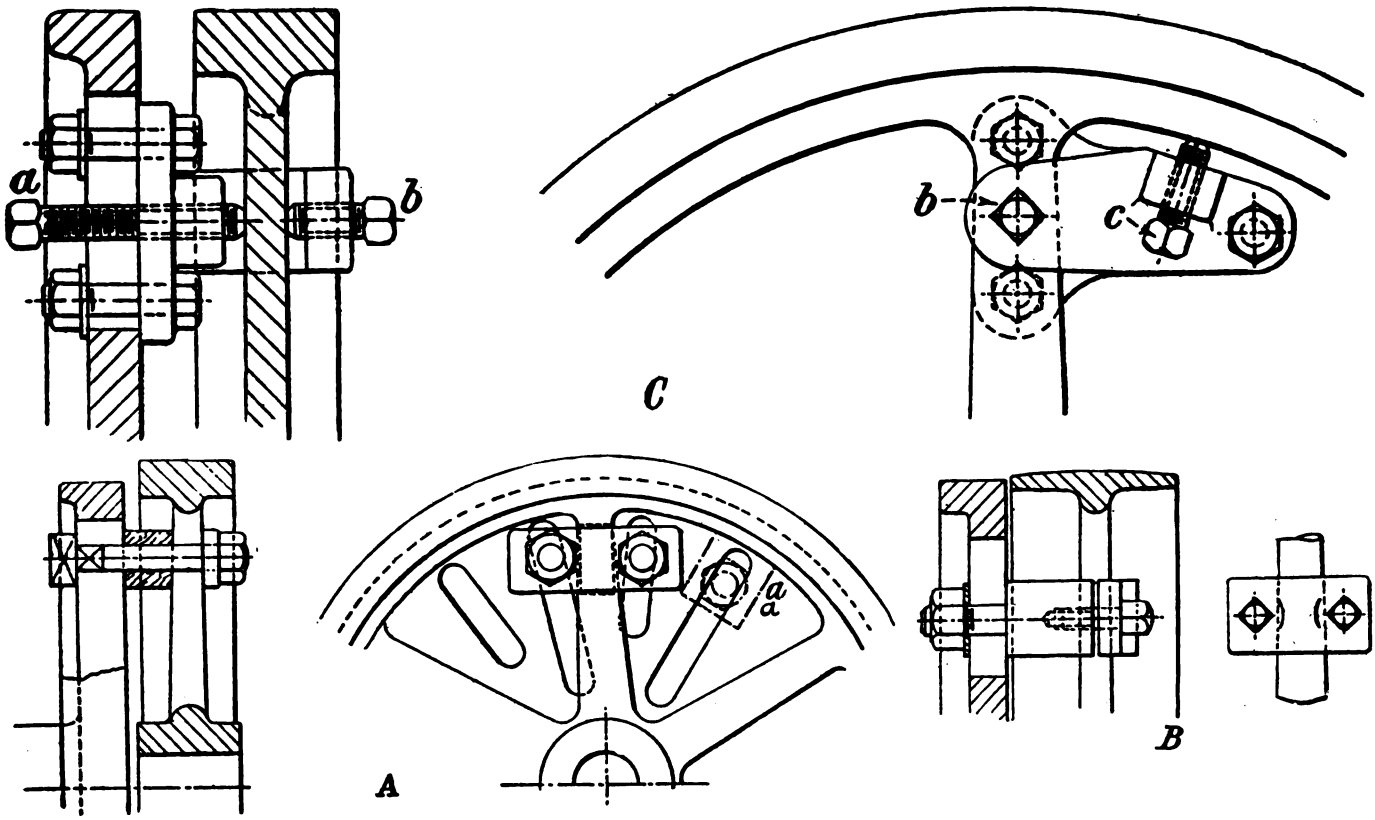


Fig. 2

* Reprinted from the English *Model Engineer and Electrician.*

Digitized by Google

be not enough to resist the push of the jaws or screws; chucking force must therefore be always tempered to the circumstances. If arms come suitably the grip should be taken directly in line with them in holding on the outside of a rim, and as closely adjacent to them as practicable when gripping from the outside. Some of the risks can in any case be obviated by the expedient of bolting a driving pin to the chuck, thereby carrying the wheel around positively and lessening the need for hard setting out of the jaws.

If clamping-plates are employed to fasten a wheel on a face-plate the effects of their pressure upon the shape of the casting will depend upon the degree of support that is afforded to it. Bearing down at positions where the metal lies over air must inevitably introduce chances of deflection. The ideal method, and a simple one, is to rely on the well-known three-point principle, giving three supports, with an equal number of clamps placed directly over them, and not adding to

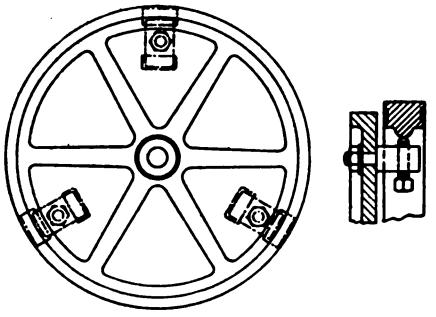


Fig. 1. A correct method of packing and clamping wheel to avoid distortion

these with a view of gaining greater holding power. This is illustrated at A, Fig. 1, the rim in this instance resting on packing blocks and the clamps biting on the curve of the inside of rim. A peg may be projected from the face-plate to give a circular drive, if found desirable. Two pegs are really more correct, located at opposite positions of the circle, otherwise the cut may induce the casting to slew round in an eccentric path. Increase of friction is easily secured by the dodge of placing emery-cloth between the packings and the meeting surfaces, or by using wood packings. These give an excellent drive on rough castings, as the metal sinks into the wood slightly where the little bumps and nodules occur. The inclusion of inside dogs is common in dealing with such objects as these, as they assist the drive, but still better, provide a rapid means of setting to adjust the interior of the rim, see B. The screws are not tightened up more than to a moderate degree or the risk of bulging out the rim is involved. Three clamps seen in the previous view are retained as given.

The alternative practice of setting the clamps across the arms in order to leave the rim entirely free is represented at A in Fig. 2, with packing directly beneath the pressure spot. Prevention of skidding here is dealt with by stop-plates, one being dotted at A, these being tightened up while pushed against the rim with the fingers. No actual driving friction is thereby brought about, but the wheel cannot change its concentric position so long as these plates remain firm. The idea is specially useful in chucking thin pieces, such as rings and washers; for these the projecting bolt-head may be in the way of the tool, so a countersunk head will be let into the plate to leave a flush face. Where wheels and pulleys with regulation shapes of arms are frequently handled it pays to make special dogs for their chucking, to avoid the time consumed in preparing packings and fixing up them and their bolts. A simple device comprises the preparation of small plummer-blocks, either cast on a disc at fixed radii for repetition work. or with stems adjustable in the standard face-plate B, the only operation for chucking and releasing being the manipulation of the two setscrews on each cap, which can be done rapidly with a socket wrench. Another useful arrangement may be observed in sketch C. Three of these castings are employed for a six-arm pulley, and after the latter has been gently pinched and adjusted to run true laterally, through the medium of the screws a and b the screw c is adjusted (in collaboration with its two companions on the other clamps) to bring the rim concentric. Incidentally, the rig-up brings the wheel clear off the face-plate so that with suitable hooked tools it may be practicable to turn the inner faces of the rim and boss.

Limitations of size often bring the turner up against difficulties when his face-plate does not reach to the diameter of a rim. A mode of giving a temporary increase of range consists in bolting on straps or plates of a sufficient thickness to form a firm support for the work, and fixing the latter in any of the ordinary ways with dogs or clamping plates arranged inside or outside the rim. These extension portions can be either formed in link shape for convenience, Fig. 3, A, or made from plates B, this showing countersunk bolts so as to present a level surface right across. Sometimes it may be preferable to utilize a complete ring or a disc, should such a one be available; this procedure offers more variety in the choice of holes or slots on the enhanced temporary diameter, since there is more metal around the circle for drilling suitable holes into.

Reduction of overhang of bolts is usually prevented by reversing them, running the tail into a nut at the back of the face-plate. Or, on occasion, it may be necessary to employ hook bolts so as to get the least possible projection at the front, to avoid dulling the tools. Another matter in connection with bolting, that concerns the turner more in repetition work than in occasional and varied jobs, is that of keeping the bolts stationary while removing a wheel and putting on another. The bother of the bolts slipping in their slots, and flopping about with much waste of time, can be avoided by locking them with a nut, C, Fig. 3, the body being threaded down to permit this; the bolt is thus held out rigidly always at the same spot on the plate ready for setting up or releasing the work. In dealing with thin-rimmed pulleys, a handy type of bolt or clamp is the hooked design, applicable when it is not required to turn the rim, but only to bore the boss at the first chucking. Either the bolt head is shaped to catch round the rim D, or a loose clamp of similar outline is slid over the bolt. The second idea enables bolts of different lengths to be used with one clamp.

TWO INTERESTING EXPERIMENTS WITH BORAX

THE writer has performed two very interesting experiments which, he believes, ought to be familiar to the chemistry student. They are both easily performed, using borax.

For the first experiment a concentrated solution of borax is prepared. It has been found advisable to saturate the solution in the hot, and get the best results by dissolving about 20 gms. of borax in the least quantity of water necessary. The success of the experiment depends on having the least amount of water possible. Some blue litmus is added, followed by acetic acid until the litmus is just red; if water is now added the solution is diluted and turns blue.

The reason for this is that boric acid is a very weak acid; its salts consequently are highly hydrolyzed. When, after the concentrated solution of borax is reddened by acetic acid, the water is added, the base (sodium hydroxide) is set free and colors the litmus blue. Boric acid is so weak that it has scarcely any effect on litmus.

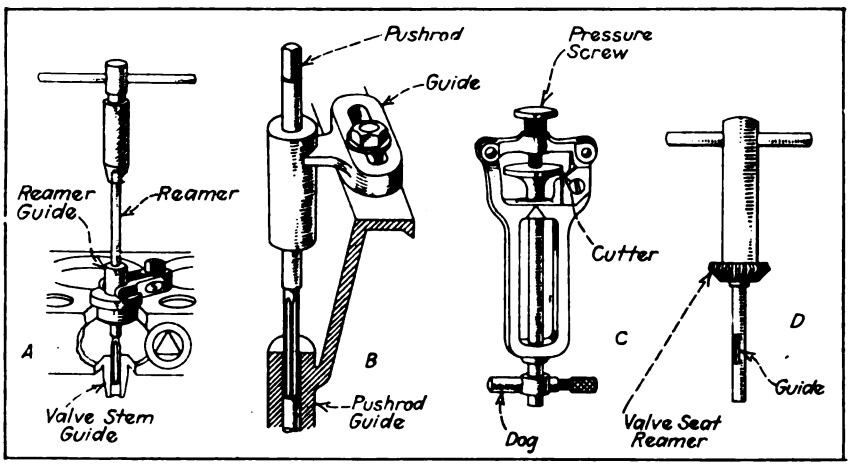
The second experiment is also the result of hydrolysis—in this case of silver borate. Silver borate is formed by mixing concentrated solutions of borax and silver nitrate. It is thrown down as a white precipitate. If, instead of using concentrated solutions, dilute (usually dilute solutions should be used) ones are used, a dark brown precipitate of silver oxide is obtained This brown precipitate may often be hastened by application of heat. The reason for this is that silver borate is completely hydrolyzed to silver oxide and free boric acid in the dilute solution.

Digitized by Google

EVERYDAY MOTORIST

SPECIAL TOOLS FOR VALVE REPAIR

AFTER an engine has been used for a time, valve grinding no longer suffices to keep the valve mechanism in proper condition because of depreciation at various points. For example, the valve stem bearing guides at the top of the cylinder block and the push rod guides at the bottom are apt to wear out of round which will result in noisy action. The remedy is to ream out the guides when they are cast integrally with the cylinder block and use valves having oversize stems or use oversize push rods in their guides. If these holes are reamed out larger than can be taken care of by oversize valve stems or valve plungers, as the case may be, it may be possible to place thin bushings of steel tubing in the enlarged guide bearings. The important thing to observe in this connection is to centralize the reamer tools so that they will not bore out the holes one sided and so the parts will be in absolute alignment after restoration is complete. Two forms of guiding fixtures are shown that do this work on the Ford motor, in accompanying illustration. The sketch at A shows the use of a simple fixture for reaming out the valve stem guides. That at B shows a similar fixture for reaming out the push rod guides. In order to restore the valves to proper condition after they have been in use for a time, it is advisable to reface the valve head in a special fixture such as shown at C and ream out the valve seat in the cylinder block with a special form of reamer shown at D. When the valve head is properly dressed off and the pits and scores reamed out of the seat, it will be a very easy matter to grind them to a correct seating.



A RESILIENT WHEEL FOR AUTOMOBILES

THE pneumatic tire, which has helped to bring the bicycle and the automobile into common use, cannot be said to be a wholly satisfactory solution of the problem of minimizing vibrations and joltings on uneven roads. The risk of puncture is an ever-present source of trouble. A French inventor, M. Guiot, has devised an elastic wheel which is free from this defect of the pneumatic tire. It may be said to have passed the experimental stage, for it has stood the test of a 6,250 miles trial adapted to a 4-seater car, with a full load.

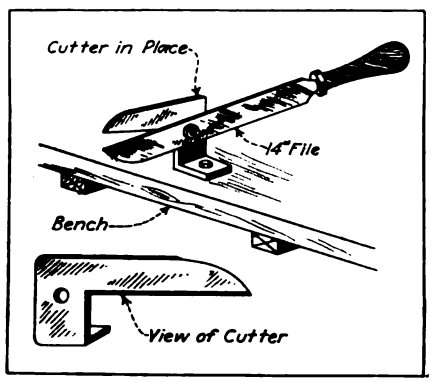
The wheel consists of two concentric rims, both rigid, but joined together by steel helical springs. The axes of these springs are not set in line with the spokes of the wheel, but obliquely, so as to withstand the maximum strain of starting and when stopping with the brake on. The outer rim is provided with a solid rubber tire. Experience has shown that on rough roads, this elastic wheel runs quite as easily as the ordinary pneumatic-tired wheel, and that the springs have a long life when the speed does not exceed 50 miles an hour. Breakage of one of these springs does not involve stoppage, so that no repairs or change of wheels on the road are said to be necessary. This type of elastic wheel is claimed to be suitable for motor trucks and other heavy vehicles, as well as for motor carriages and cabs. This is but one of a legion of similar devices as the resilient or elastic wheel has long been a problem that has defied complete solution and the Patent Office archives of all civilized countries have thousands of patent applications pending and have granted hundreds of patents on devices of this character during the past decade. In spite of this, the air filled tire still reigns supreme for passenger cars, bicycles and motor-cycles and is gaining ground in the heavy vehicle field as well.

HOLDING SHORT STUD

TO hold a short stud while threading the end sometimes troubles the mechanic. A stud box is useful to hold the stud, also to drive it into position. But as an off-hand kink the writer learned a new one the other day. Simply hacksaw a nut lengthwise across the centre of one of the flats through to the thread. This gives the nut a spring hold. Run the stud into the nut, place the nut in the vise and you have a perfect hold for the stud without injuring the thread.

CUTTING SHEARS

SHEARS for cutting sheet metal and intended to be attached to a bench can be constructed by any mechanic. The stationary jaw that is fastened to the bench may be formed from a section of wagon spring. Heat the spring in the forge and bend to the shape shown in the illustration. Drill holes near the end to fasten to the bench and another hole as a bearing for the cutting bar. Grind the cutting edge on a sharp bevel so that it will retain its edge. The lever is made from a 14-inch file, the teeth of which are ground off on an emery wheel and the cutting edge beveled. Clamp the two sections together with a bolt which is used as a bearing. The file must be annealled to drill the hole in it as a bearing.

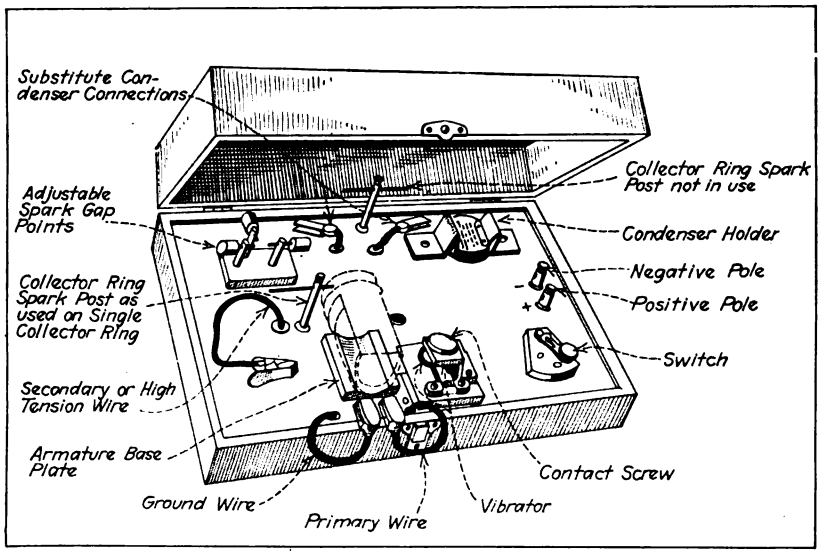


The electrical resistance of carborundum diminishes with increasing voltage. This makes it valuable to be used in parallel with any apparatus which needs to be protected from sudden increases of voltage or so-called surges. For series resistance this property is undesirable.

Digitized by Google

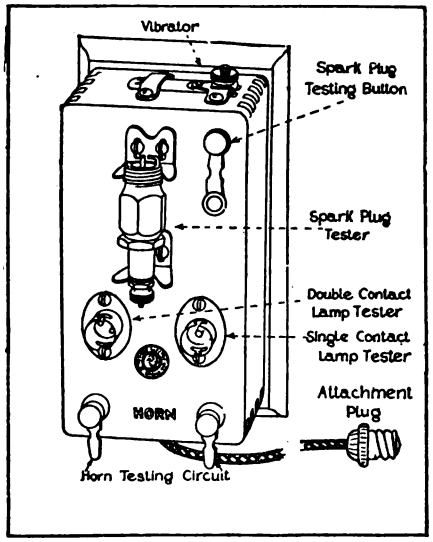
ELECTRICAL SYSTEM TESTERS

THE Defectometer is a new and useful device for those engaged in magneto repair work. It enables the repair man to quickly locate shorts in the various parts of the magneto. It is designed and manufactured by a firm, who are authorities on magnetos. It



is the first instrument of its kind ever put upon the market and should prove to be a valuable assistant to electrical repair men, as its possibilities are very extensive for test work, as all parts may be tested for short or open circuits and any other electrical faults that may prevent proper generation of current.

Another handy all around testing device for the repair man and accessory dealer, as well as the individual,



is illustrated. It is designed for testing spark plugs, single or double contact lamp bulbs, horns, or for locating general electrical troubles. There are two types, the first for attachment to alternating current lighting circuits, and the second for battery attachment. In either case lamps of any candle power or voltage, spark plugs of any length, or electric horns of any voltage can be tested.

THE HEAT TREATMENT OF DROP FORGINGS

THE forging heat of the part is so far above the average critical temperature that it is necessary to heat-treat the steel after the forging process to restore its physical properties; all forgings which will be subjected to severe shocks or strains should, therefore, be properly heat-treated. Simply allowing the forging to cool from the forging heat is by no means proper heat-treatment. Heat-treatment begins after the forging has cooled. The forgings are taken from the hammers to the heat-treating department. Here they are given a preparatory heat to reduce forging strains. Next they are treated to the critical temperature and quenched and then drawn and tested to the proper hardness. This hardness is the proof of the suitability of the forging for the wear and strain of actual use. The forgings are then pickled to remove the scale.

The forging is then subjected to an oil and water-quenching operation. An abundance of water insures absolutely uniform cooling and consequently a uniform hardness. After the forgings have been heat-treated, it is necessary to heat them again to reduce the quenching strains, and prepare the metal for the machine. This is known as the "draw-heat," and is considerably lower than the critical temperature. After the forgings have remained in this heat for the required length of time, they are removed from the furnace, and allowed to cool in the air.—*American Blacksmith.*

In the southwestern part of the United States much trouble is experienced with the presence of fine silt in the water used in irrigation developments. In the Zuni reservoir 4.86 per cent. of its capacity is filled up annually. Sixty per cent. of the volume of the reservoir is now filled. No solution of the problem of getting rid of the silt has as yet been evolved.

POLISHING WOOD

A VERY nice polish on wood is obtained by using the following mixture: ½ pint of alcohol, ¼ ounce of shellac, and ¼ ounce of resin. Dissolve the shellac and resin in the alcohol; then add ½ pint of linseed oil, and shake the whole mixture. Apply with a sponge, brush or flannel. Rub the wood thoroughly after the application.

TO CASE HARDEN CAST IRON

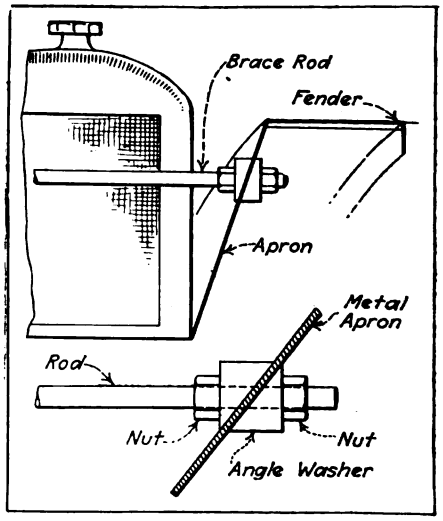
A CORRESPONDENT has successfully case hardened cast iron, using the following receipt. Pulverize and mix together equal weights of saltpetre, prussuate of potash and ½ ounce of sal-ammoniac. Heat the cast iron pieces till red hot, roll them in the powder, and then plunge them into the liquid.

HARDENING FORMULA FOR CUTTING TOOLS

TO make a hardening solution for metal-cutting tools, mix, saltpetre, 2 ounces; sal-amoniac, 2 ounces; alum, 2 ounces; salt, 1½ pound; and soft water, 3 gallons. Keep the solution in a stone jar for it will eat a wooden tub and rust an iron pot. Do not draw the temper but only warm the tools enough to relieve the hardening strains. It is also well to rinse the tools well in water, for if this is not done, the solution will rust them.

BRACING MUDGUARDS

MANY cars rattle at high speeds due to vibrating front fenders. These can be reinforced and made more rigid by joining them with a rod



below the lamps. Make two angle washers of metal and draw the rod tight into place. Pull the fenders back first by hand to get the length of the rod and the angle at which to make the angle washers. Make the rod of one-quarter inch iron and cut the thread long enough so a nut can be placed on each side of the fender apron as shown in accompanying illustration.

Digitized by Google

A Universal Lathe Attachment

By H. H. Parker

Drawing by the Author

PART I

THIS device is called a universal attachment for the reason that it is used on a small lathe for surface and other grinding; milling, with the work held in the lathe chuck, clamped to the lathe bed or to a table between centers, or in the attachment itself. It can also be used for indexing and shaping or planing. One three-quarter inch bolt clamps the device to the cross slide and the drive may be either from an overhead drum pulley or, as in the writer's case, from a small electric motor bolted to a wooden base which is screwed directly to the vertical slide. The work can all be done on a small screw cutting lathe, the round column with slide keyed to it being chosen as more adapted to amateur construction than flat or vee-d sliding surfaces which require a planer or shaper to finish accurately. The long keyway in the column is cut in the lathe, after first drilling a series of shallow holes to remove some of the material, by clamping a cutting tool on its side in the tool post and by running the carriage back and forth by hand, thus making the tool cut the groove like a shaper tool. The keyway in the slide casting, of course, must be sawed and filed to shape by hand.

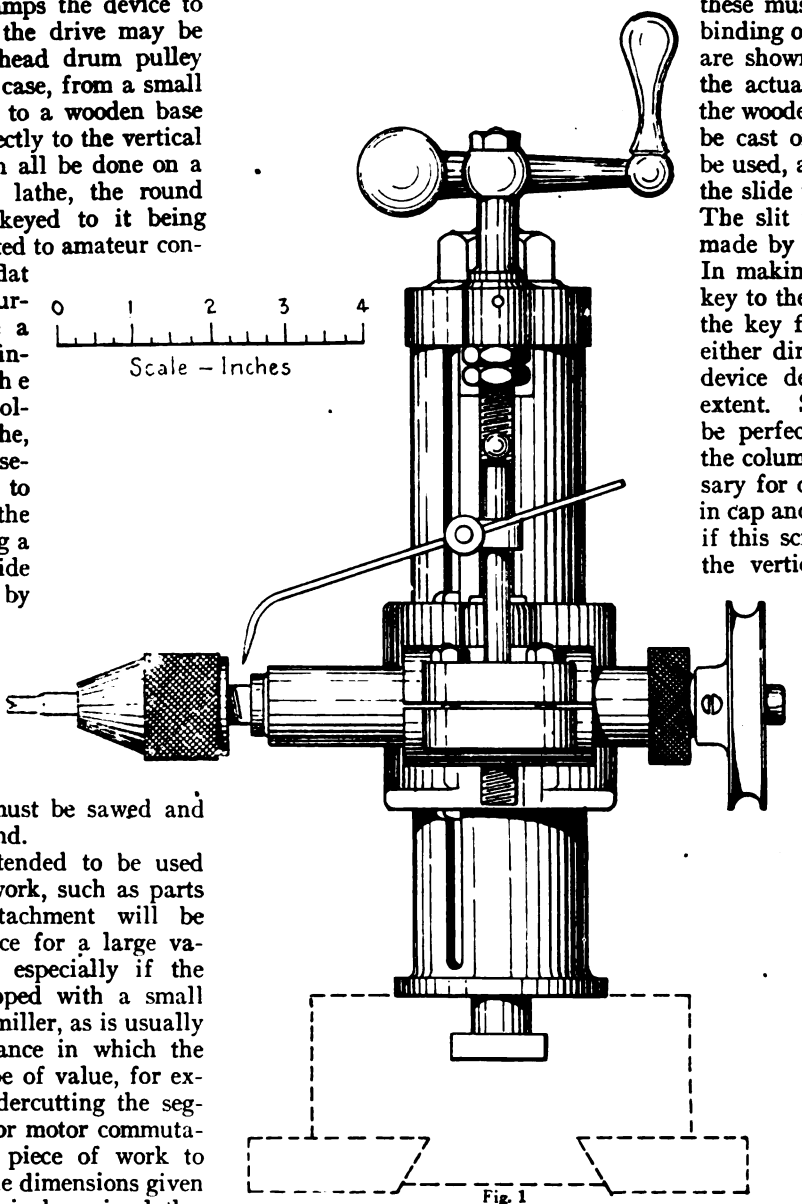


Fig. 1

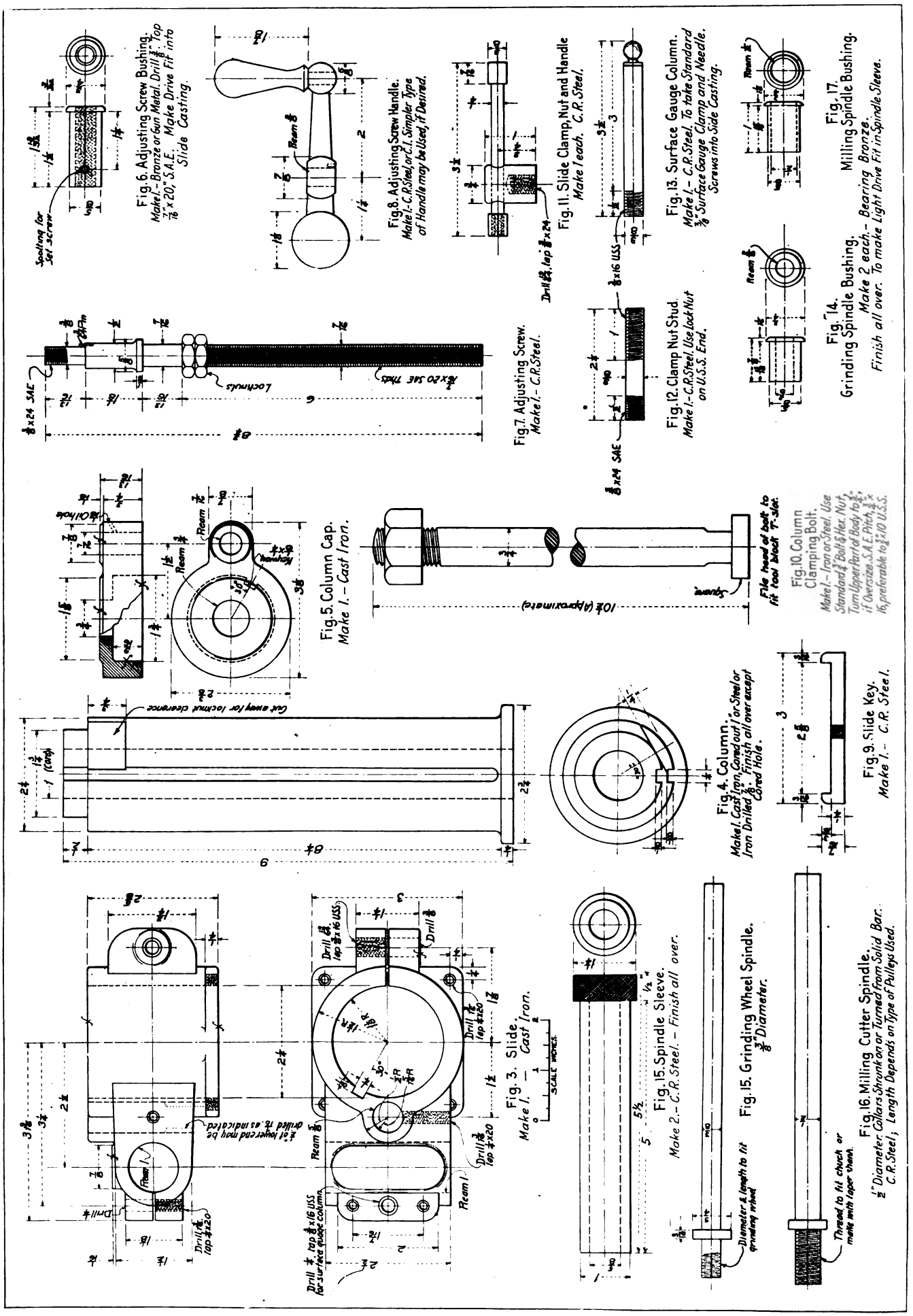
Although only intended to be used on small and light work, such as parts of models, this attachment will be found of great service for a large variety of operations, especially if the builder is not equipped with a small grinder or shaper or miller, as is usually the case. One instance in which the shaper head would be of value, for example, occurs in undercutting the segments of a dynamo or motor commutator—rather a mean piece of work to attempt by hand. The dimensions given are suitable for a ten-inch engine lathe, but these may readily be altered to suit any individual machine. It would be a good idea to draw a rough plan view of the column, slide and spindle sleeve and cut out a cardboard templet. Then by laying this upon the cross slide of the lathe and moving the tool slide in and out, any changes in the dimensions necessary to be made could be decided upon. We will not go into a detailed description of the various machining operations, believing this to be unnecessary except in a few instances, but will give a general idea of the various parts and their uses.

Figs. 3, 4 and 5 show the vertical slide, column and cap, all of cast iron, though the column could be turned up from a piece of steel shafting drilled for the clamping bolt. No complicated core work is used in the patterns, the cores all being straight and cylindrical. It is optional with the builder whether or not the horizontal hole in the slide casting is cored out or drilled out of the solid; the latter method being perhaps preferable, as there would be no sand or chilled surfaces to throw the boring bar out of true or dull the cutter. If the column is cast, it should be cored out to one inch, and it will be unnecessary to drill out this hole later.

The machining of the column is a simple lathe job; if the builder understands lapping he could make a lead lap and finish the surface accurately, and another lap mounted on a taper mandrel could also be used to smooth up the slide after boring; in any event, these must fit over each other with no binding or play at any joint. Four lugs are shown on the bottom of the slide; the actual purpose of these is to hold the wooden motor base, but they should be cast on even if the motor is not to be used, as they are a means of holding the slide to the face plate while boring. The slit through the clamping lugs is made by hand with a hack-saw frame. In making the keyways and fitting the key to the slide care must be taken that the key fits into place without play in either direction, as the accuracy of the device depends upon this to a great extent. Similarly, the keyway should be perfectly parallel with the axis of the column. A jig will be found necessary for drilling and reaming the holes in cap and slide for the adjusting screw; if this screw does not stand parallel to the vertical axis, binding will occur.

Fig. 6 shows the bushing into which the adjusting screw turns. This is made a driving fit into the slide, but not so tight as to split the casting, and held by a set screw as an extra precaution. The screw, Fig. 7, is fitted with two lock-nuts which will take up all lost motion through the cap. In Fig. 8 there is a rather elaborate handle. Castings and forgings of such handles are on the market or one may be turned up on the lathe, or, if the builder prefers, a more simple form can be substituted. The quarter-inch square steel key is shown in Fig. 9, and Fig. 10 is the clamping bolt. This is a standard iron or steel three-quarter inch bolt with the head filed down to fit into the tool block. The S.A.E. pitch of sixteen threads to the inch would allow of an easier tightening of the bolt than the 10 pitch U.S.S., though either may be used. The split slide is tightened on the column by a nut into which is fitted a sliding handle and screws down over a three-eighths inch stud screwed fast into the clamping lug. Figs. 11 and 12. In setting up work when the attachment is to be

Digitized by Google



Digitized by Google

used, a surface gauge or dial indicator is necessary, and in Fig. 13 is a short three-eighths inch steel upright which screws into the slide at any convenient joint and over which is slipped a standard surface gauge or dial or other indicator. We are now ready to take up the various grinding, milling and other attachments.

Surface Grinding

For surface grinding a narrow two to three inch wheel is used, the spindle of which rotates in two bronze bushings (Fig. 14) set into a steel sleeve (Fig. 15). The sleeve makes a snug sliding fit into the horizontal one-inch hole in the clamp. The obvious way to make this hole is to clamp the slide to the column and the latter to the tool slide, making sure that it stands vertical. Then move the cross slide over until the boss can be drilled out about seven-eighths of an inch in diameter and finish nearly to size with a boring bar between centers. A reamer is then run through to finish the hole, and the boss is split with a hack-saw. To return to the spindle sleeve, this is first drilled and reamed to five-eighths inch inside diameter, then set on centers and turned down to one inch, thus making the surface concentric with the bore. Then the bushings are drilled with a reamer drill, turned down, driven into the sleeve and a finishing reamer run through. If the builder desired he could fit tapered, split adjustable bearings to take up the wear, otherwise they are discarded when worn and new ones fitted. The grinding wheel spindle is three-eighths of an inch in diameter and carefully lapped to fit the spindle sleeve. The pulley depends upon the type of drive.

As mentioned above, the writer has used a one-sixth horsepower electric motor, running at 1750 r.p.m. mounted directly upon the slide casting, to drive the grinding wheel. This has given good results, but if no motor was at hand an overhead driving drum would have to be rigged up. Fig. 2 shows a plan view of the motor drive. (To appear in Part II.) If a wooden base bolted directly to the bottom of the slide interfered with the lathe cross feed handle, an offset flange could be made of cast or plate iron which would raise the base up higher.

Some work may be held between centers for surface grinding; sometimes it is clamped directly to the lathe bed or to the face plate or to an angle plate, but small flat pieces are best operated upon by being clamped to a small flat table held between centers (Fig. 18) provided with adjustable legs to level the table transversely. The size of such a table would depend upon the builder's tastes and the size of his lathe. A pair of Starrett Toolmakers' Clamps, Fig. 19, are very useful for work of this kind, as they may be fastened to the table in any position by flat head screws and the work clamped in them. This table is also used for milling, when the cutter is rotated in the sleeve spindle as described later. Cylindrical grinding also, to a limited extent, may be performed by swinging the sleeve around parallel to the lathe bed.

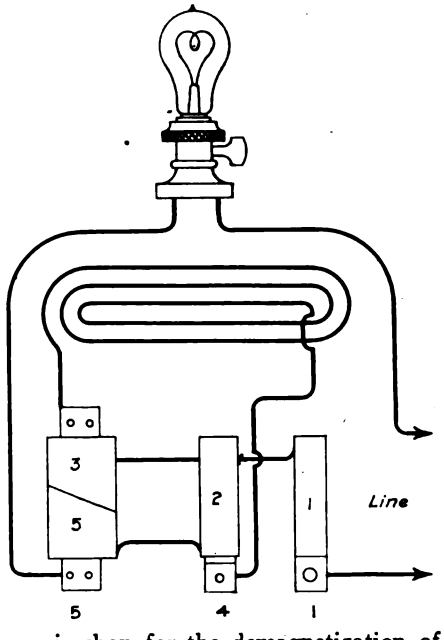
Milling, Cutter in Spindle Sleeve

A side elevation of the attachment is shown in Fig. 1, where the device is fitted up to do milling. A second spindle like that of Fig. 5 is made and fitted with bushings reamed out to half-inch, Fig. 17, and a half-inch shaft. The business end of the shaft is machined to take a drill chuck, lathe chuck or whatever is used to hold the milling cutters, while a pulley is fitted to the other end. Of course, the pulley must be taken off when the sleeve is to be removed. The electric motor can be used here also, the same as in surface grinding, but the spindle would rotate at a much lower speed. Fig. 1 shows the adaptation to overhead drive.

A SIMPLE DEMAGNETIZER

By J. A. Statler

THE little demagnetizer illustrated in the photograph will be found very useful in different work. It can be used very successfully in a jewelry



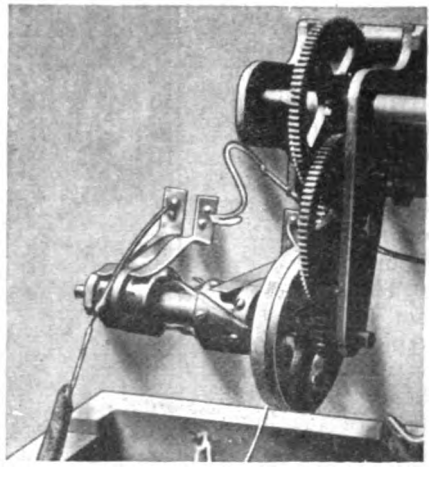
repair shop for the demagnetization of watches. It will also find a number of uses about the experimenter's laboratory.

The connections for the device are sketched in on the drawings. By rotating the shaft carrying the reverser and collector rings, the polarity is changed at each revolution of the shaft. The ratio of the gearing is such that the current reversals can be made very rapid by turning the handle slowly. If A. C. current is used with the device, the handle need not be turned. Of



The completed demagnetizer

course, magnetizing cannot be done with this current. When the device is used with batteries, a fuse is merely inserted in place of the lamp seen in the photograph. The lamp is used when the device is employed on a 110



The gearing of the demagnetizer

volt circuit. A 50 C. P. lamp is employed because it draws a heavier current through the coil.

The author has since made a machine similar to that described above but driven with a spring motor so that the hands are free to manipulate the work.

A TIP ON DRILLING

THE average mechanic who uses a handdrill always reverses the rotation of the drill when he desires to take the drill out of the hole made. This is bad practice, as it not only helps to take the edge off the flutts but is also liable to break the drills. In removing the drill it should always be revolved in the one direction.

Digitized by Google

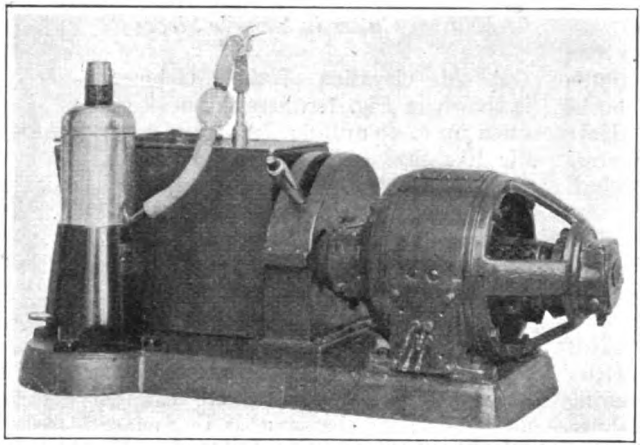
The Langmuir Condensation Pump

By L. A. Hawkins

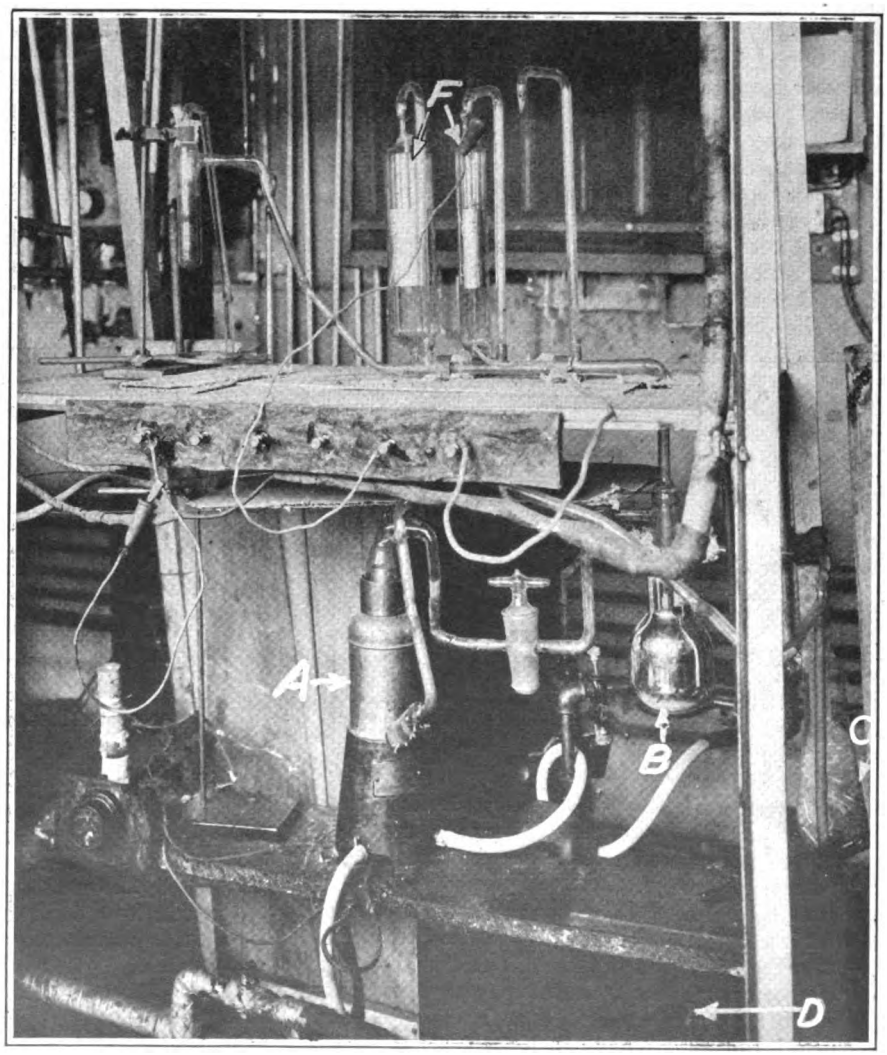
SCIENCE and industry have produced many triumphant feats through the agency of vacuum. for in it there can be no loss of energy through heat conduction and matter cannot decompose by oxidizing. So the degree of achievement has been in proportion to the perfection of vcauum attained. Many machines have in the past been devised to extract as much air as possible from containers. Suction pumps are sufficient even today for exhausting such containers as electric light bulbs, but for the higher grade vacuua such as those required for Coolidge X-ray tubes and for high power tubes for wireless use, a mechanism of much higher efficiency is required. Many types of pump have been designed to produce a specially high vacuum, but the crowning triumph in their construction was reached when Dr. Irving Langmuir devised his mercury vapor mechanism since come to be known as Langmuir Condensation Pump.

This device is not only the most rapid of all high vacuum pumps, but it also will produce the highest vacuum.

It came into being as the result of efforts to get higher and higher vacuum for the purpose of research and to get it quickly. The pump, in spite of its remarkable effectiveness, is simplicity itself in operation. It has no moving mechanical parts. A stream of mercury vapor, produced by a small electric boiler, and moving at high velocity, entraps and sweeps along with it the air or gas molecules from the vessel undergoing exhaustion and delivers them to the rough pump, which ejects them into the air, while the mercury vapor itself is condensed and flows back into the little boiler.



A Langmuir pump with driving motor for the two-stage rough rotary pump



The Langmuir pump in use: D is the rough rotary pump; A the Langmuir pump, and F the vessels being exhausted; B is a liquid air trap for the mercury vapor

Like most new tools of science, the Langmuir Condensation Pump has found a field of great practical utility. All the Coolidge tubes, which have revolutionized X-ray practice, and all the high-power radio tubes or pliotrons, as they are called, which have made long-distance wireless telephony practicablefi are exhausted by this pump.

Its speed has been stated in this way—it will reduce the pressure in a 1-liter vessel (approximately 1 quart) from 100 microns (approximately 1/10,000 atmosphere) to 1/100 micron (approximately 1/100,000,000 atmosphere) in two seconds.

But such a statement, while it tells the whole story to a physicist, does not mean much to a layman, so suppose we put it this way—Since a million is about as large a number, and a second about as short a time, as have a real meaning to the average man, how long would it take to accomplish the result above stated, if, from the vessel in question, we removed a million molecules a second? The answer is 750,000,000 years.

As for the degree of vacuum which may readily be obtained with the Langmuir pump, the physicist would say: Better than a tenthousandth of micron. This can be expressed approximately as 1/10,000,000,000 atmosphere; but, even so, the statement lacks clear-

(*Cont. on p.* 180)

Digitized by Google

Surface Combustion

A Special Process of Burning Hydro Carbon Gases in Industrial Furnaces

By Prof. T. O'Conor Sloane

SURFACE combustion is the term adopted to designate a system of burning hydrocarbon gases, in industrial furnaces, using just enough air to give an explosive mixture. The air and gas are mingled intimately outside of the furnace by means of a sort of mixing-valve. If such a mixture is ignited at a given point, time is required for the explosion to be promulgated, the explosive wave travels at a definite

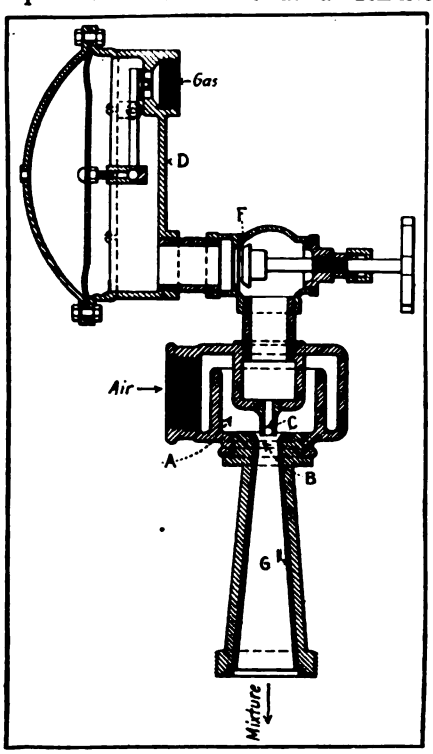


Fig. 1. Low pressure mixing valve

speed of so many feet per second, according to the proportion of the constituency. If therefore the velocity of the current of the air and gas in a pipe or conduit exceeds this rate the mixture cannot explode back. As the explosive gases rush out of the nozzle into the furnace its velocity of current or of flow rapidly diminishes, and a few inches from its point of entrance the velocity is lowered to that of the explosive wave transmission. At this point the mixture burns instantly in a very limited space, with almost no flame, but with intense heat.

If the point of instantaneous combustion were to be determined simply by the velocity of the current as it was reduced by its entrance into an open furnace it is evident that the element of uncertainty would be considerable. To fix an unchanging place of combustion the current is received by a mass of refractory material, carbonundum or alundum are two substances which have proved available. The refractory material is soon brought to a white heat by the combustion, and thus fixes the zone of such combustion.

Air is a mixture of about four volumes of nitrogen to one volume of oxygen. In burning hydrocarbon fuels the heat is produced by the chemical combination of the oxygen of the air with the carbon and hydrogen of the fuel. If the combustion is perfect theoretically, the products of the operation will be carbon dioxide and water, and if the theoretical result is attained, the highest practical efficiency will result.

While it is possible to combine nitrogen with oxygen no such combination occurs in ordinary burning. The nitrogen is inert, does no good except as a diluent, making the reaction less intense and more manageable, but adds no heat. After the combustion it is still nitrogen, unchanged in all respects. It has been aptly termed the ashes of the air. As the nitrogen leaves the furnace it inevitably carries off some of the heat, so that its presence impairs the economy of the process. Now suppose that, as in ordinary furnace work, there is a large excess of air. Such air does no good whatever, but does harm, as it carries off a quantity of heat up the chimney. The excess of oxygen is nearly as harmful in impairing the economy of the process as is the same quantity of nitrogen, and with the excess of air there is the more serious nitrogen to waste heat by carrying it up the chimney.

The clue to the practise of surface combustion is the quiet and regulated burning of an explosive mixture of air with a hydrocarbon gas. The theory is simplicity itself; the practical application is now to be described.

The cut, Fig. 1, shows the construction of the low-pressure mixing valve. The gas in the pipes is maintained at a pressure of from 2 to 6 inches of water. The air is supplied from ¼ to 4 lbs. per square inch; this is over ten times the gas pressure. The air and gas inlets are named in the cut. As the air rushes in through A, it produces a slight vacuum around the mouth of the nozzle, C, so as to draw the gas in with its own current. The two mix rapidly as they pass through B and G; the pressure of the gas is kept constant by a governor, D, and the amount passing the nozzle is regulated by the valve, F. There is a valve to regulate the flow of air; this is not shown. The mixture thus produced is carried through pipes connected to G, to the furnace. As the gas pressure and air pressure are constant once the setting of the valves is effected so as to produce the explosive mixture all goes on indefinitely without further attention, except for watching the minor adjustments.

It is seen that the low pressure system needs two pipe lines—one for air and one for gas; the air at the higher pressure does the inspirating. In the high-pressure system the air is taken in at atmospheric pressure; the gas, at a pressure of 10 to 25 lbs. per square inch, issuing from a small jet enters the open end of an outlet tube, draws in air from the atmosphere, and the mixture is thus formed. Only one line of pipe, that for the gas, is used.

The cut, Fig. 2, shows the gas inlet at the top; at C is the jet, above which is the screen, B, to remove any dust from the gas. At D is the adjutage,

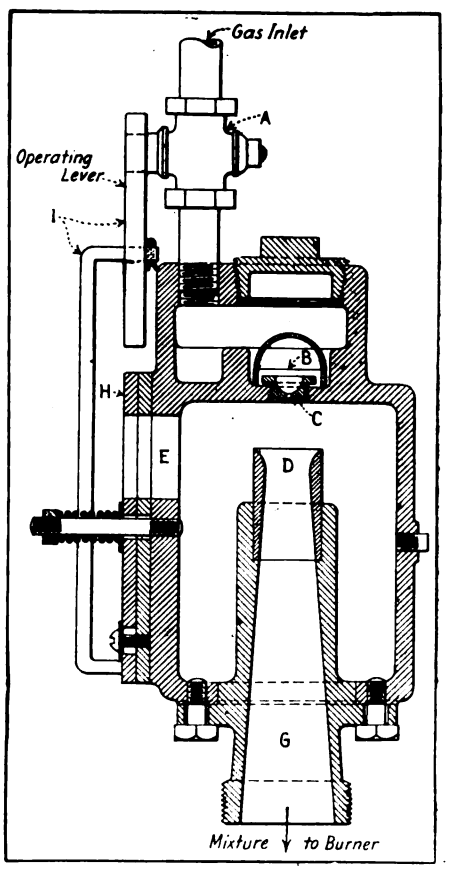


Fig. 2. High pressure mixing valve

coaxial with the gas jet. The small high-pressure stream of gas draws with it through the opening, D, a quantity of air, which enters directly from the atmosphere through the opening, E, adjusted as to area by the shutter, H, by

Digitized by Google

setting this shutter more or less open, the proportion of air to gas is regulated. The handle of the gas-cock is connected by a link, I, with the air-shutter. When the gas is shut off, the shutter is closed with the cock. This is necessary because there is always maintained in the furnace a slight pressure above that of the atmosphere, and closing the air-shutter prevents back-draught. The mixture passes into the conduits to the furnace through the pipe, C.

The burners are generally of what is called the impact type. After various trials of material, cast-iron was selected for their construction. Their contour is seen in the cuts of furnaces. It is an object to keep them as cool as possible. Accordingly outside of the furnace each burner is provided with cooling fins, of disc-shape, shown in the cuts; the air circulating around and between them keeps the burners from over-heating.

In front and below each burner is a pile of refractory material, to localize the locus of combustion. The furnaces are so arranged that the pressure within them exceeds that of the atmosphere. No air enters except that which comes in mixed with the fuel gas. The analysis of the escaping gases shows perfect combustion as far as the burning of the gas is concerned, and the absence of free oxygen indicates the absence of any excess of air. These are the two conditions ensuring economical operation.

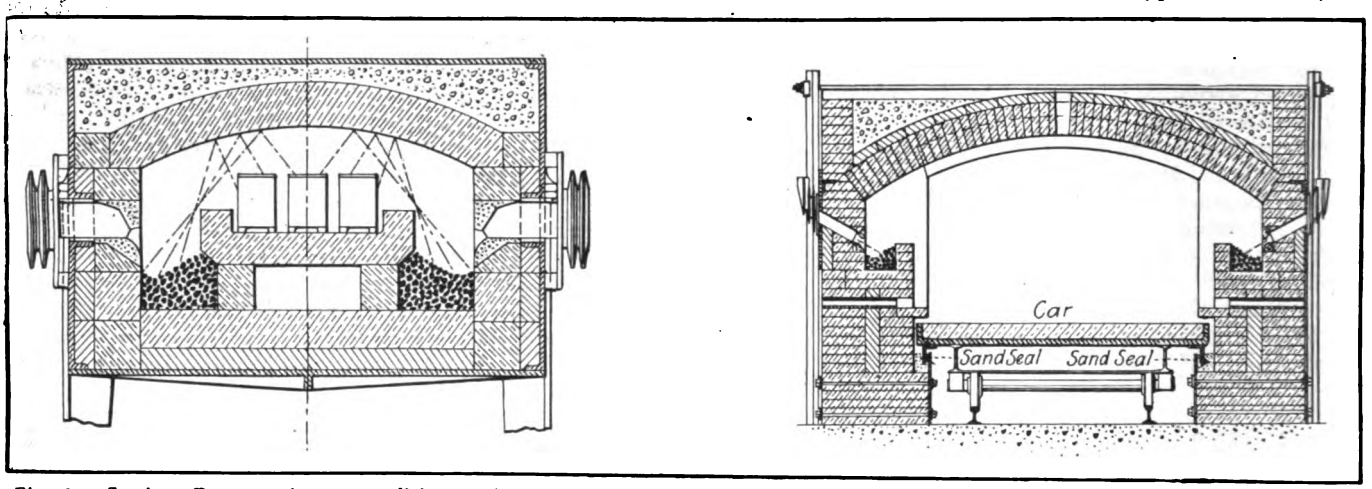


Fig. 3. Semi-muffle type furnace utilising surface combustion principle

Fig. 4. Furnace in which charge is run in on a car

In one of the cuts, Fig. 3, is shown a furnace of semi-muffle type. The oblique lines indicate the radiation and reflection of the heat from the intensely heated refractory material. The principal heating effect is attributed to radiation, rather than to convection in this type of furnace.

The next cut, Fig. 4, shows a furnace in which the charge is run in upon a car. The floor of the car is a little longer than the furnace so that a few inches at both ends project, like shelves, at each end. The vertical doors of the furnace rest upon these shelves. To right and left of the car and underneath it are sand-seals to exclude air.

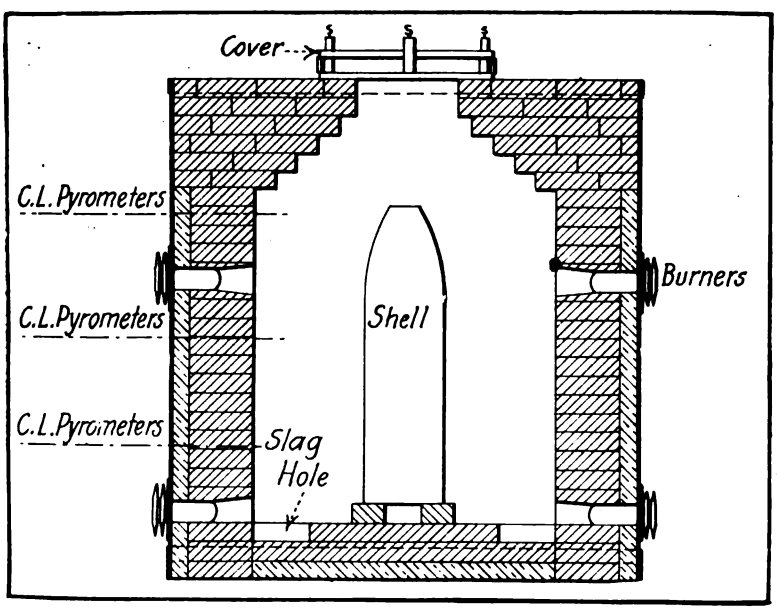


Fig. 5. Annealing furnace for large objects

An annealing furnace, Fig. 5, working on thirteen-inch shells is next shown. This is different from the preceding ones. There are no heaps of refractory material and the burners are horizontal. The mixture enters somewhat tangentially against the walls of the furnace. High- and low-level burners are used to secure an even distribution of heat.

There are other types of burners, but those shown are the ones most largely in use. In one type of burner, of the utmost interest from the scientific standpoint, the mixture was passed through a diphragm of porous material, such as fire-clay. It burned on the surface of the diaphragm, with intense and localized heat. There was absolutely no flame visible, and the heat was confined to the thin outer layers of the plate of refractory material.

TURNING COPPER

THOSE who have had to turn copper in the lathe have generally wished that they had let someone else do the work and that they stood by and jeered when it was being performed, or else criticised it after it was done. Soap and water do not help; turpentine or kerosene is a delusion and a snare; but milk does the trick with neatness and dispatch.

Under existing conditions it is calculated that there is room on the earth for only twelve first-class wireless stations. But by directional methods, varying wave lengths and such features of operation it is thought that eventually there may be room for 175 times as many. The trans-Atlantic wave lengths are 40,000 and 80,000 feet.

Electric heating furnaces for work on guns are being constructed for France. The largest are 90 feet deep. They are built in sections, so that they can do different work. For shrinking on a breech lock 37 kilowatts, and for the longest pieces 1,000 kilowatts are used. The chamber is seven feet in diameter. The temperature control is automatic. For shells a special furnace is made in which graduated temperature can be applied so as to produce a shell with a different temper for the nose than for the body. It can cover a range of 300° F. in the length of a projectile.

Digitized by Google

Manual Arts and Crafts

Projects in Wood and Metal Work for the School, Home or Shop

NOVELTY SEWING BASKET AND SMOKING SET PEDESTAL

PROJECT No. 1 graphically depicts a very easily made, yet decidedly convenient, Sewing Basket that any one ever sews will appreciate more and more each time they use it. A few slight changes as described later will produce a wonderfully convenient Smoking Stand. It is designed particularly for the beginner and may be made of any convenient and easily procured wood such as ash, oak, mahogany, walnut, cherry, hard pine, chestnut, red wood, white wood, white pine, cypress or spruce, and if stained carefully will make an ornamental as well as useful article of funiture.

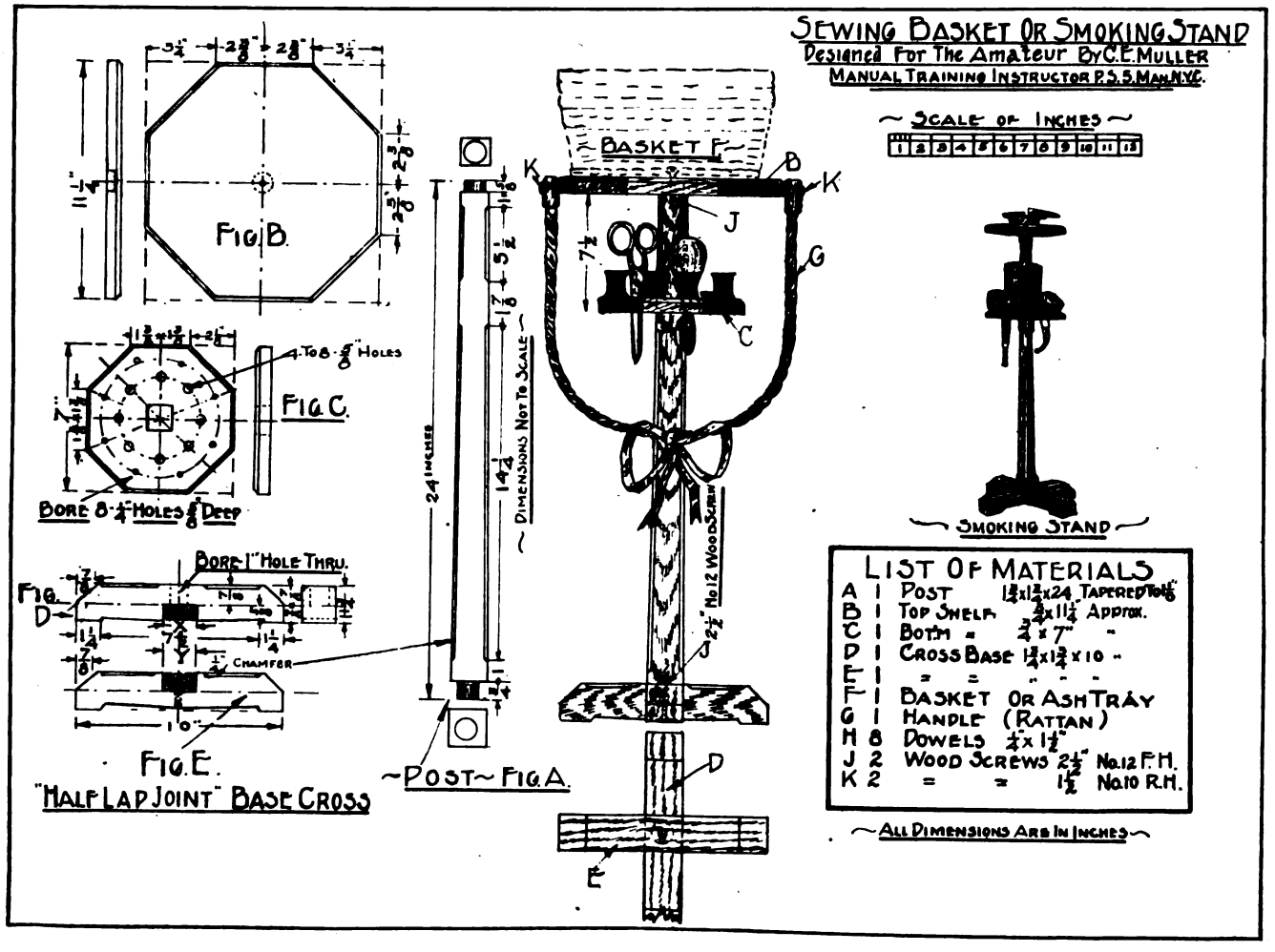
The tools actually required for this project are: 1 Plane (Smoothing plane preferred), Block or Jack will answer; 1 Saw—Fine tooth Cross Cut preferred; 1 Screw Driver or Hammer and nails instead of screws; 1 Pencil; 1 Ruler; 1 Brace and Bits or Holes may be burnt with red hot irons; 1 Try Square or a Tee Square.

The central post, Fig. A and the base, Fig. E-F, may be made of one and one-half inch to two inch sq. stock, the shelves of boards 5/8" to 1" thick. A basket of proportionate size with or without a handle, Fig. G, will suffice for the Sewing Basket or may be substituted for by a suitable ash tray which will make the "Smoking Stand".

The first step is the careful selection of the lumber. It should be thoroughly dry, free from knots, cross grain, weather of kilm checks (which appear as slight cracks running with the grain and are found usually in the ends of the board). Frequently the boards are found badly warped across their width and sometimes sprung lengthwise due to being poorly stacked when drying. These should be avoided if possible. These defects are often not noticed by the amateur until assembling. They are very annoying and detract from the appearance of the article and more often it is found necessary to replace them at additional expense and trouble. If care is taken in the proper selection and if the parts are stood on edge while waiting for operations, no difficulty will be met with.

It is strongly recommended, especially for the novice, that they work as closely to the dimensions as possible, especially where the parts fit together as a slight deviation may affect the other finished pieces. However, if allowances are made in all the adjacent parts, the dimensions may be altered to suit the available material.

The first step in construction is to lay out the length of the post accurately, as in Fig. A, squaring the lines on all four sides of the post. Saw off squarely to the overall length. Next lay out the 1" pins on both ends. From experience gained in teaching elementary school boys from the 4th year to 8th year inclusive (ten to sixteen years of age) I found that better results were obtained by using a twenty-five cent piece as a template to draw a circle on end grain in lieu of the compass, which has a tendency to follow the grain. It is easily centered, by sighting the margin on the four sides. Now plane the taper, using the top pin as a guide



Digitized by Google

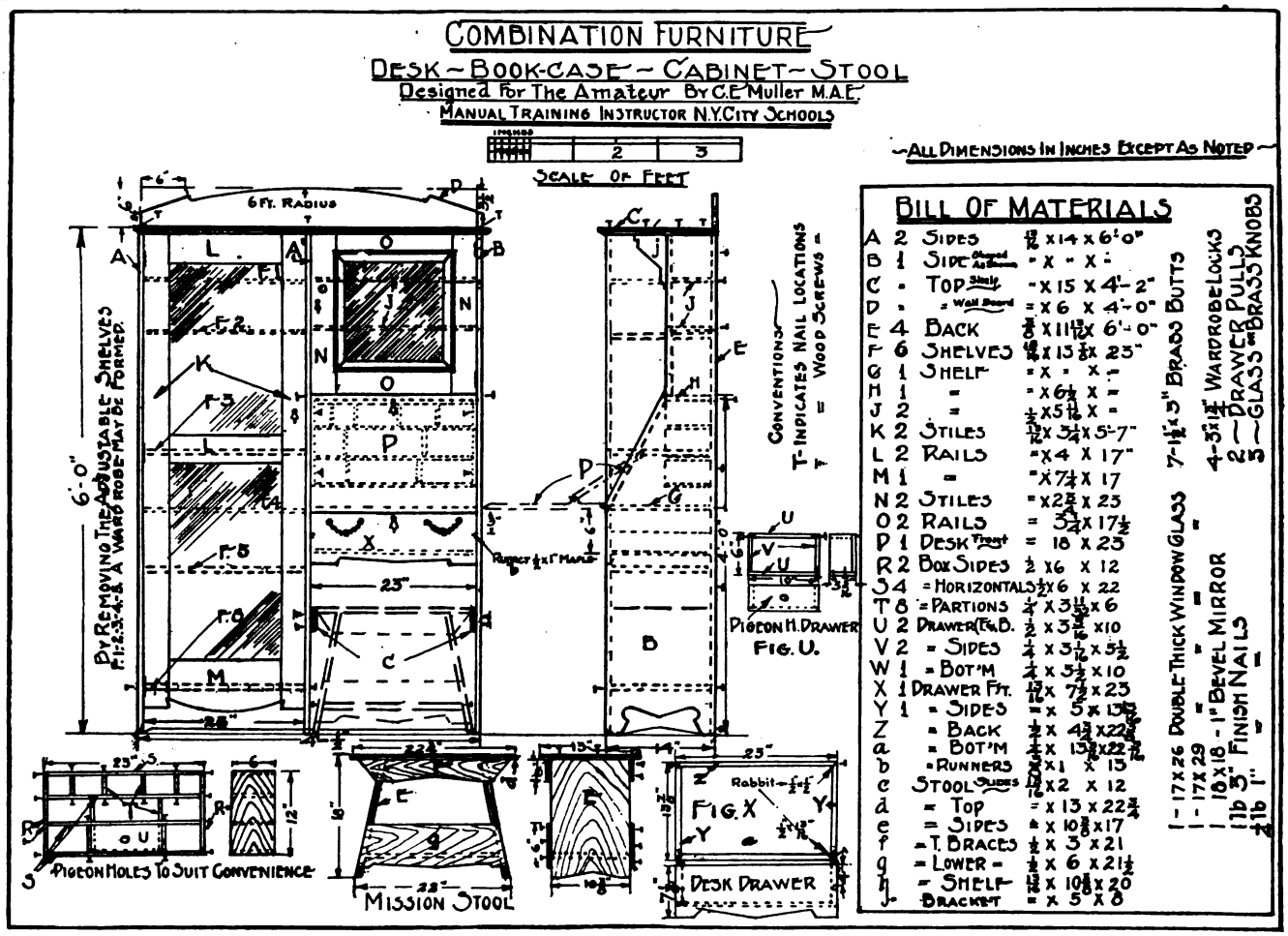
maintaining the relation of the sides square to one another. Of course it is optional to taper the post to a 1" or 1⅛" square. If the pins are dressed to a 1" square, then sawed across the corners and pared down to an approximate octagon, then these corners dressed down to the 1" circle, a slight rub of a flat file or the corners scraped off with glass will produce a fairly rounded dowel. By using a 1" hole bored in a spare piece of wood as a template, the dowels may be carefully and gently rotated to a very satisfactory fit.

Stop chamfers, Figures A, E and F are easily made if care is taken to equally thumb gauge pencil lines on

The pieces shown at Figures E and F are made of the same size material as the post and are the next to be produced. Lay out 2—10 inch lengths, square the lines on all four sides. Saw close to but leave the lines; if carefully sawed as directed it will save the trouble of block planing. After the pieces are all fashioned ready for assembling, a piece of No. 2 sand paper will remove all saw marks. Lay out the shape as shown with center lines, lengthwise with 2 opposite sides and crosswise on all four faces. This should be very carefully done with a try square. The center line lengthwise is the depth of the cut for the half lap joint shown at

end ¼" deep, then chiseling a tapering cut from the center to this kerf. The principal reason for cutting this tapering recess is that it often requires skillful manipulation to avoid slivering when cutting in confined limits and when paring diagonally to the fibers of the grain this difficulty is avoided.

It is now time to decide whether it shall be a Sewing Table or Smoking Stand. If the former, proceed as per drawing. If the Smoking Stand be desired, make both shelves approximately 7 in. The top shelf has only one 1 inch hole to about 2/3 of its thickness, with a smaller hole to admit the 2" to 3" No. 10 to No. 14 flat head woodscrew



both sides of each corner. Proceed very slowly, using a chisel or knife, taking a little off at each time. The mistake that the inexperienced usually make is to slice off too much at the first cut and where the wood is curly or cross grained a bad tear results.

Through chamfers, Figures B and C are always planed with a slicing cut, holding the plane at an angle, especially across the grain. One must be constantly on the watch for cross or curly grain also when planing the corners of diagonal cuts (corner cuts of polygons) to cut with the grain, otherwise the corners will split off. The grain of the wood may be compared to the hair on one's head, the shape or angle of the piece will not present any difficulty if the cuts are always made with the grain.

X Fig. D and at Y Fig. E, the cross hatched section must be removed so that the components D and R fit snugly in the form of a cross. If repeatedly tested before cutting and during the process of cutting out, it will safely guide even the beginner to a satisfactory fit. If this cross half lap joint is made before the contour is shaped it will avoid any possibility of the mistake of having the bevel ends upside down. The 1 inch hole is then bored or burnt through Fig. D only. The piece shown at Fig. E or the lower part has a small hole just large enough to admit the wood screw used to clamp both members of the base Figs. E and D to the post Fig. A when finally assembled.

The recessed clearance is made by first cutting a saw kerf 1¼" from each

that clamps the basket or ash tray to the post. The lower shelf for the Sewing Basket is laid out as in Fig. C 8—¼" x 1¼" dowel pins are glued in the ¼" holes. These are used to hold the spools of thread. The inner set of ⅝" holes are bored through the shelf to hold the scissors, thimble, darning ball, etc.

When boring a hole through any wood it is necessary to protect the under-surface from splitting. This is accomplished in several ways; the preferable method is to bore from the top down until the worm or point of the bit protrudes through the under side, then using this tiny hole as a center, bore from the opposite side.

The most elementary way to produce a hexagon is to lay out a square, then lay off the corners as shown. The first

Digitized by Google

step in all wood work is to establish a working edge, *i. e.,* plane the edge smooth, straight and square with the face side. Second step, mark out a square end with the side of a try square held tightly to the working edge, then square this line on the other three faces. (This method is excellent practice for the amateur, as it enables him to watch the saw cut very closely and it surely repays in the results for the additional time so spent.

Now lay out the rest of the octagon. There are many ways to do this, but the simplest one is to follow the drawing. Another way is to inscribe a circle tangent to the square, then use a 45 degree angle and project the other 4 sides tangent to the circle.

Next inscribe a 6″ and a 4″ circle from the center of the hexagon. Connect the corners with lines passing through the center at the intersection with the 6″ circle bore 8 ¼″ holes until the point of the bit just protrudes through the under side. Then halfway between the ¼″ holes bore the ⅝″ holes as stated above. When boring be sure all holes are perpendicular so that all the parts affected look "plumb".

The hole through the lower shelf to fit over the post is surely a test for a beginner. However, if you will follow these directions carefully you are assured of success. First bore or burn a hole a trifle less than the diameter of the post at the location of the shelf, then file or chisel the hole to a square and constantly test it by placing it on the post. Be sure to maintain all shelves level or truly horizontal when fitting and assembling.

For the Smoking Stand the only changes required are the size of the top shelf, which is the same size as the lower shelf; also omit the outside circle of holes and dowels in the lower shelf.

Now assemble the project. Always sandpaper carefully with the grain where possible, using Nos. 1½ to 2, followed with No. 1, then ½. Precautions must be taken not to mar the sharp corners, as these are the signs of good workmanship. Stain the completed article the desired color. This may be purchased in many shades. The directions with the stain will clearly explain the method particularly recommended for that stain.

A satisfactory stain may be made by thinning out green or brown paint or burnt umber with turpentine, applying it with a brush or cloth. Let this dry from 6 to 24 hours, then apply prepared polishing wax or, instead of the wax, a coat of shellac (orange preferred), which will dry in a few hours, then rub down with fine sandpaper, No. 0 or 00. Another coat of shellac or thin varnish will complete the finishing process. If a finer finishing surface is desired read the process described for advanced projects to come later.

PROJECT NO. 2—COMBINATION BOOK CASE OR WARDROBE, SECRETARY, WALL CABINET

WHILE this combination is designed especially for the advanced student and wood worker, there is nothing in the construction or execution that should deter the ambitious handy man or boy from successfully and satisfactorily completing it. There are no useless or complicated joints. Every joint is practically a square cut butt joint. The rails are fastened to the stiles by ⅜″ dowel pins in all the doors. All cuts may be made with a fine tooth cross cut saw (even the rip saw may be omitted), followed by a slight paring with the chisel. Anyone who will lay out the work accurately, make all cuts squarely, leaving the guide lines until completed, may be absolutely assured of success.

The only tools necessary are: One ruler and pencil, 1 try square, 1 cross cut saw and ripsaw if convenient, 1 smoothing plane and jack plane if convenient, 1 brace, 1⅜″ twist bit and 1 screw driver bit, 1 hammer, 1 1″ or 1½″ chisel.

The following precautions if observed faithfully will avoid the disappointing mistakes so liable to creep in amateur work:

1—Careful selection of all materials. 2—Careful handling of materials. 3—Faithfulness to details. 4—No change in dimensions without carefully studying the adjacent components. 5—Establishing the *true* working edges before laying out, *i.e.,* straight, lengthwise, square, crosswise, and smooth. 6—Accurate layouts. 7—Work close to, but leave the guide lines until assembled. 8—When assembling avoid all bruising by the hammer, the clamps, or by any foreign material on the floor or bench. An excellent shop rule is to clear the bench of all nails, blocks, etc., before operations. A nail or screw that is left accidently lying on the bench may cause a very ugly scar in an otherwise beautifully grained surface in a most conspicuous place. 9—Sandpaper always with the grain wherever possible, as the sandpaper invariably leaves scratches, but if they run parallel to the grain are not noticed. 10—Stain and paint always with the grain so that the brush strokes will blend with the grain.

The Bill of Materials practically tells the complete story. Outside of a few suggestions no further instructions are needed. A drawing usually to scale, but sometimes only a sketch with overall dimensions is given to a cabinetmaker or carpenter to build the project accordingly. If the components are fashioned and assembled in the order listed and temporarily nailed, *i. e.,* the nails are not driven in completely, but allowance made for the claw of the hammer to fit under the nail head to withdraw it if desired, surely one should be sufficiently experienced to proceed without further assistance.

The first assembly is made by nailing the sides A and A′ to M and F. 1, then A-1 to H and G, shown in the side view, then the top shelf C to A—A1 and B, then the back E to the top shelf and to F. 8 and H and G. The sides A and B are rabbitted ½ of their thickness to accommodate the ⅜″ back. The side A′ is made 14 inches minus the thickness of the back, approximately ⅜″. The top shelf C is also rabbitted or cut out to allow the back to fit flush. The shelves marked J are nailed in position or may be adjustable. The pigeon hole rack is amply strong if made only of butt joints; it is built up as a unit, then screwed in position. The secret of nailing permanently is to lock the nails by slanting each nail alternately. This acts as a dove tail and they will hold more than the wood. Especially is this necessary in the end grain.

The slides for the drawers should be made of hard wood and screwed in position. The cleats or supporting runners for the stool may be made of the same material as the cabinet. They should be screwed in position to hold the stool about ½ inch above the floor. The door stiles and rails K-L-M-N-O should be rabbitted for the glass, which is held in place by narrow strips bradded in.

The small drawer Fig. U may be just butt joints, the bottom bradded to the sides and back. Observe very carefully that each part butts to its adjacent component.

You will note the drawer fronts are one piece, the bottom butting against the back so that the joint is not visible from the front.

The large drawer is similarly constructed. It is advisable, however, to rabbit the sides into the front ⅜ of an inch, also the back into the sides. The bottom may be dadoed into the front or a butt joint with a cleat fastened to the front would suffice.

Another very elementary way, yet efficient one, is to make up these drawers as a tray, with the front a separate piece glued or screwed on from inside the drawer. The front can then project ¼″ as a margin on the four sides. This makes a neat and a positive stop for the drawer. The main thing is to have two slides either under the bottom edge of the large drawer or two rabbitted grooves as shown for the hard wood slides to work very freely in. If these are well paraffined, they will slide very smoothly.

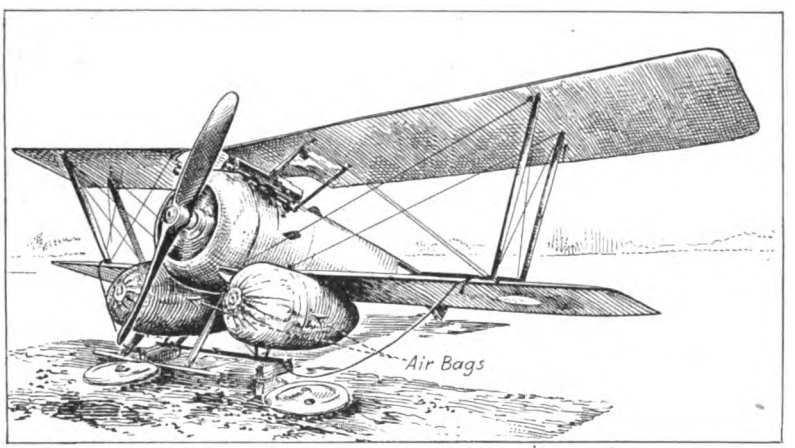
The stool is very simple and requires no further description. Follow the design as you choose. There is surely great room for elaboration; simply keep the overall dimension near the size. The sand papering and wood finishing is practically the same as the No. 1 project and offers no difficulties.

Digitized by Google

AVIATION BRIEFS

SECURITY OF AIRPLANES IN FLYING OVER THE SEA

THIS article deals with the provision of collapsible floats which can be instantaneously filled with compressed air at the desired moment. The idea is due to Colonel Busteed, and has been developed both by him at Grain, and by Lieutenant Bonnet-Labranche in France. The air floats have been filled on some hundreds of British and French airplanes patrolling the North Sea, the Channel and the Mediterranean, and many aviators owe their lives to them.



Airplane provided with air filled floats to permit landing on water

Airplanes fitted with these floats have been largely employed on airplane carrier ships in place of seaplanes, which are, of course, much less efficient.

Two or more floats of rubberized fabric are rolled up and stowed under the wings or under the fuselage, and these can be filled by means of a compressed air outfit in 30 secs. The number of bottles of compressed air required is reduced considerably by the addition of an injector with three concentric cones, inserted in the pipe leading from the compressed air bottle or bottles to the float bags. A jet of the compressed air issues from a fine nozzle, whose walls are divergent toward the orifice, and by its expansion draws a large quantity of the external air through the triple opening between the three cones.

Several reservoirs of air in rubber bags are symmetrically arranged in the fuselage framework, and connected by tubing provided with taps by which the pilot can partially deflate them at altitudes. A hand-pump allows loss of air pressure due to leaks during long flights to be made up. The wheels of the chassis may in some cases be dropped off before alighting on the sea. In addition a hydrovane is fitted in front of the chassis to prevent too great a shock to the inflated floats on alighting. A machine weighing 1,000 kg. requires floats of an aggregate volume of 2,000 litres.

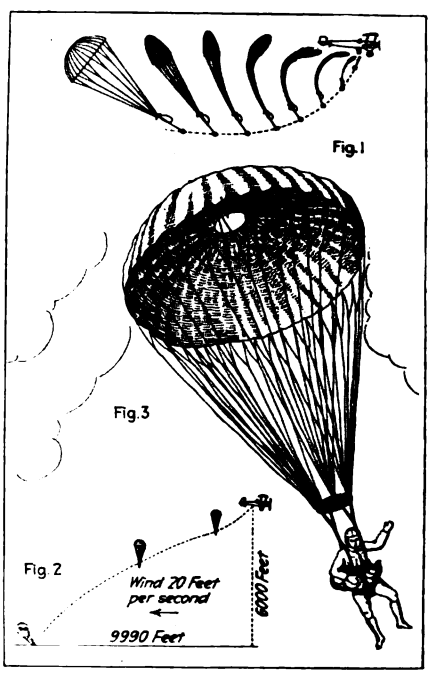
NOTES ON PARACHUTES

FOR many years one of the thrills at a country fair was a balloon ascension and the jump of the intrepid aeronaut from a great height with a parachute. During the war, aerial observers, both allied and enemy, made their escape from observation balloons when these were set afire or shot down by this means. Dirigible airships have parachutes as life preservers much as ocean liners carry life boats and rafts. Parachutes are easily launched from either free, captive or dirigible balloons, but the problem is a more difficult one when they are used as a life-saving auxiliary to airplanes.

In the early days some inventors figured out schemes of having a parachute large enough to sustain the weight of the entire airplane, but if this was difficult of practical achievement in the days when airplanes weighed but 650 to 700 pounds, it surely cannot be very easily accomplished in these days with aircraft weighing from 2,000 pounds to several tons. To check the fall of an airplane of modern design would require a spread of fabric about 8,800 square feet in area. The inventors, therefore, have confined their efforts to the design of parachutes suitable for the individual and even at that, it takes a good-sized parachute to keep an average man from falling too fast.

An empirical figure is 4 square feet area per pound supported so as to obtain a safe rate of fall. This is estimated to be about 10 feet per second. As a parachute would require about 3.5 minutes to fall 2,000 feet and about 10 minutes to drop 6,000 feet in still air, the latter figure is the usual height considered safe for normal flying. Recent tests have demonstrated that parachutes of latest pattern will open and check the fall of the pilot from heights ranging from 200 to 500 feet. The greater the area of canvas available for supporting a given weight, the slower the rate of fall. An area of 5 sq. feet per pound will allow a drop of about 8 feet per second—while allowing 3 sq. ft. per pound, will result in a drop of nearly 14 feet per second.

The important points to secure in parachute design are to have as rapid opening as can be obtained, this to be absolutely automatic and have a means of suspending the individual using it so there will be as little shock as possible when the parachute does open and checks the fall. The pilot of an airplane catching fire, for instance, must



How parachute opens and falls

be able to make a quick getaway, therefore the "Parachute pack" in which the aviator carries the entire safety apparatus canvas attached by straps and belt to his back, is favored by some authorities. A modern parachute will open in a distance ranging from 50 to 100 feet. Special efforts are made in the design to avoid tangling the supporting cables and to secure positive opening by

Digitized by Google

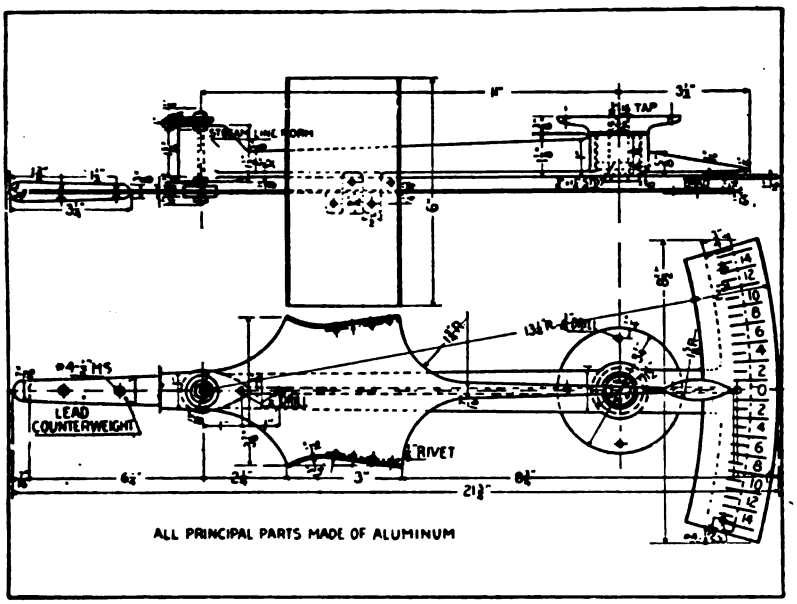
having some air in the chute, as a partial vacuum would cause the folds of cloth to stick together.

In descending a parachute goes through three phases. During the first, as it is still folded it does not support the aviator, who falls very fast, at the beginning of the second phase the canvas spreads and checks the speed of the fall; in the third phase, the device balances itself and continues to approach the ground at the reduced speed of 10 to 15 feet per second, depending on the weight supported.

AIRCRAFT INCIDENCE METER

THE construction of an aircraft incidence meter is described in the *Franklin Journal* by A. D. Zahm, Ph. D., of the Navy Department, Bureau of Construction and Repair.

To enable the air pilot to read at a glance the direction of flow of the air past his airship or airplane, a balanced weather-vane, indicating promptly small changes of incidence, has been developed and tried under regular working conditions. The scale drawings and test of the device herein described were



Figs. 1 and 2. Aircraft incidence meter experimented with by U. S. Navy Department

In the second period the aviator is subject to a very considerable amount of strain, because of the sudden "braking" produced by the spreading of the canvas. To prevent this from being dangerous the aforesaid strain is distributed over the entire body of the aviator by a system of wide webbing straps and belts. The parachute is also provided with a rubber shock absorber which seems to be quite effective.

The lateral movement of the parachute is at first equal in speed to that of the aircraft from which it was launched and becomes gradually less until it entirely disappears, provided there is no wind. Strong gusts of wind, however, cause landing to be comparatively dangerous, since the parachute retains the horizontal speed of the wind, and for this reason it is important for the aviator to be able to free himself from the apparatus as soon as he reaches the ground, since otherwise he may be dragged into various obstructions with considerable force and injured to a greater or lesser extent.

A new German optical glass is colorless, yet cuts off the ultra-violet rays; it can be used for goggles instead of the usual colored glass. It is said that the rare earths, such as thoria are the characteristic constituent.

made respectively by L. H. Crook and S. S. Rathbun, members of the aeronautics staff at the Washington Navy Yard.

Model.—Figs. 1 and 2 give the general appearance and dimensions of this instrument. It consists of a two-blade weather-vane supported from a horizontal pivot at the end of a bracket arm protruding forward from an airplane strut and adjustable in pitch by means of a clamping nut at its base. The vane has a forward counter-weight to insure static balance and a pointer playing on a graduated arc of 14 in. radius, indicating even degrees and readable to fractions of a degree from the pilot's seat. The blades have the sectional shape of an Eiffel Wing No. 5, which at zero incidence possesses very slight drag and a large increase of lift with slight increase of incidence.

Test in Flight.—The instrument was finally mounted midway between planes on the nearest right-hand strut of Flying Boat HS-2 No. 1840, and carried through very still air at three different fixed speeds. The following table indicates its behavior under these circumstances.

Wind Tunnel Test.—When the instrument was given its preliminary test in the 8 x 8 ft. tunnel, its pointer remained steadily fixed in the wind direction until forcibly displaced. It then promptly returned to zero incidence without lag or indication of friction.

OBSERVATIONS WITH C. & R. INCIDENCE METER IN FLIGHT

Speed of Flight in Knots	55	65	75
Normal variation...	±0.6°	±0.4°	±0.4°
Precision of reading possible	±0.3°	±0.2°	±0.2°
Occasional variation.	±2.°	±1.°	±1.°

Conclusion.—If this instrument is to be put into use, it may be lightened somewhat and provided with a strap to lash its flange to the airplane strut. So finished, it would weigh about 1.5 lb.

AN ALL-METAL BIPLANE

THE Austin "Whippet" is a biplane of English design and its dimensions have been reduced so it can be accommodated in the ordinary garage. From nose to tail it measures 16 feet while the wing span is 21½ feet. But by the introduction of wing-folding facilities the over-all width of the machine is so reduced as to permit storage within a building measuring 18 feet in length by 9 feet wide and 8 feet high. The folding arrangement is simple, it only being necessary to unlock four bolts holding the wings securely and rigidly in position for flight to permit the wings to be folded back to the side of the fuselage. Folding and spreading the wings is a simple operation and can be carried out in two or three minutes. The fuselage and landing chassis are constructed of steel and streamlined steel tubes take the place of the usual bracing wires, so that the necessity to undertake re-rigging from time to time is obviated.

It is powered with a six-cylinder, air-cooled radial Anzani engine developing 45-50 horsepower. Its climbing capacity is moderate, it being possible to attain 5,000 feet in 8 minutes and 10,000 feet in 18 minutes. Its flying speed is 85 miles per hour, but the landing speed is only 30 miles an hour which is a very desirable feature. The builders have had considerable experience in airplane design and construction, having built 2,000 machines of various types including the S.E-5, single seater fighting scout which was popular among the American airmen and over 2,500 engines. The "Whippet" is marketed at about $2,500 and the flights which have been made have demonstrated that the machine is a very able one and that it possesses considerable inherent stability.

It has been found that the sun gives more heat from its central parts than from its edges. The distribution is quite irregular. It is thought that the irregularity may be due to refraction by the gaseous layers.

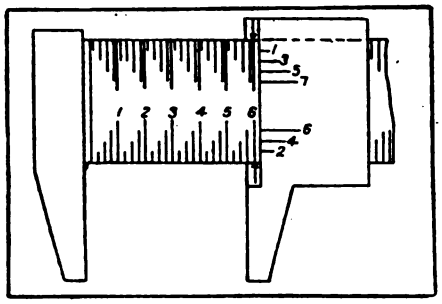
Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

EASILY READ CALIPERS

A VERY simple and clever way of marking calipers, so as to make them easy to read, is shown in the cut. It is of the ordinary slide construction. The stem is marked in two scales. The upper scale is marked in inches, each of the longest lines indicating an inch, and on this same scale the shorter lines indicate the odd eighths, 1/8, 3/8, 5/8 and 7/8. The lower scale is laid out on the same system except that here it is the even eighths that are marked. All this refers to the scales



of vertical lines. On the slide of the instrument there are two scales of horizontal lines, each coinciding in position with the end of the line of the other scale corresponding to the number of eighths marked on it. When the calipers are opened to any given extent, the inches are read directly, and the fractions are given by the horizontal line coinciding in position with the nearest vertical line's end. It will be noticed that the lines of the upper scale are unevenly spaced; this is because they start with a single eighth and end within a single eighth of the inch line, while the intermediate lines are spaced two eighths apart.

A concrete arch, 95 feet high and 300 feet span, has been erected in Sweden, the longest span of reinforced concrete in the world. It is in three pieces with hinge joints between the sections. A year of settling and seasoning was allowed before it was put into service. Under its working test it received a permanent set of only 1/16 inch.

As a breakwater, a horizontal pipe laid under the water and perforated with holes through which air is blown has been successfully applied. It is said to form an "air reef." It has been used in salvaging a ship and a pier in California has been kept in use by means of such an appliance.

Impressive figures of what may be done in the saving of coal have been published. In Silesia by saving twenty per cent of the waste heat in zinc furnaces an economy of 800,000 tons of coal per annum is represented. It is held that by other simple and inexpensive changes Germany could save 25,000,000 tons per annum. The fact, that there would be so large a number of individual cases each requiring treatment of its own operates to prevent the fullest application of such methods. The point has been made that in the case of wet coal it is not only the loss of heating power that is to be considered, but also the increased cost of transportation, and the longer the distance the greater is the loss due to the weight of the water to be carried.

In St. Louis trouble has been experienced with the electrolysis of lead-covered electric cables. The lead sheathing was injured, so that water got at the insulation and heating ensued.

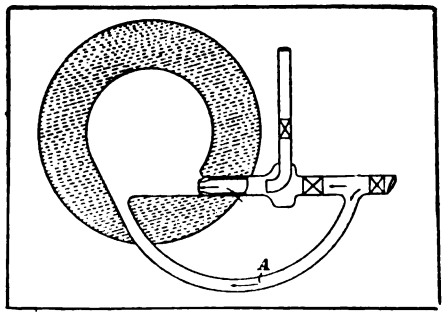
A system of stereo-photography from two aeroplanes, taking parallel courses, and whose distances apart is determined also by photographic methods, gives a series of photographs with stereoscopic effect. Each plane has its own camera, adjusted for the distance between the planes. They may also be in tandem instead of parallel. It is even possible to get a result with a single machine in two successive flights.

Slag from furnaces, such as gas works but not from blast furnaces because of the sulphur and other characteristic constituents, is recommended for concrete. It must be well wetted down in the mixing, and it is quite essential, that it is weathered a long while before use. One part of cement to eight parts of cinder is a typical proportion.

Some interesting work in the intensive hydration of concrete has been reported. The mix is rotated in a bowl at high velocity of rotation; the bowl was open at top. A curved arm continuously cut off a ribbon of the concrete from the outer edge, and the ribbon was returned to the center of the whirling material. The process brings about a very rapid and thorough mingling of the ingredients and was quite rapid in effecting the result.

TANGENTIAL BLAST GAS FURNACE

THE illustration of this furnace is self-explanatory. The object is to avoid the destructive impingement of flame upon a small area of the fire chamber. The principal blast enters by the upper jet. If this were

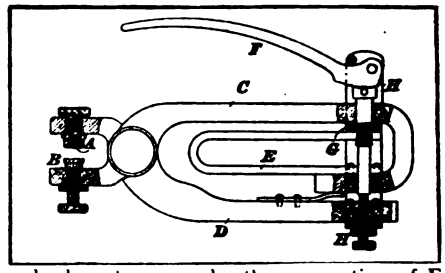


the only jet, the blast would strike the opposite wall of the chamber and would soon injure it by the concentrated heat. To avoid this action there is a supplemental lower blast of air, entering tangentially, which sweeps around the chamber and carries with it the horizontal upper blast. Thus the heat is distributed, and destructive localized heating is avoided.

The deterioration of calcium carbide brought about by the moisture of the air can be prevented entirely by immersing the carbide in kerosene oil. The oil may be poured into the receptacle holding the carbide and then at once is poured off. The treatment preserves it indefinitely, and has been rigorously tested.

BRINNEL HARDNESS TESTER

THE Brinnel test for the hardness of steel or other material is based on the depth to which a hardened steel ball is forced into the metal under definite pressure. As the test is comparative it is essential that the pressure is always the same. In the apparatus shown, which is a species of tongs, the ball is held in the socket, A, and the sample of metal is held in contact with it by the screw, B. Pressure is brought to bear by the handle, F, acting as a cam. H H is a stirrup,



and when drawn up by the cam action of F it presses the ball into the test piece, by compressing the spring E. The arms of the apparatus, C and D, are thus drawn together by the force of the spring, so that the pressure brought to bear on the ball is always identical, as it is due to a practically identical compression of the U-shaped spring, E.

Considerable interest is now shown in the electrolytic purification of iron. For many years copper has been thus purified. In both cases the process is simplicity itself. Anodes of the metal to be purified are suspended in an electrolytic bath, and by the action of the current are dissolved, and by the further action all the metal with the impurities eliminated is deposited on the cathode. To purify iron the bath contains various solutions; double oxalates or sulphates are employed; organic salts, such as the sulphocresylate is one that has been used. The cathode is rotated mechanically; it may be made of various metals, copper and lead working very well as regards the ease of separating the sheet of pure iron deposited on it. The cathodes are treated with alkali solution to dispose of any grease and are then put directly into the bath. Carbon almost inevitably accumulates in the electrolyte, and this is very objectionable, and it has to be filtered out periodically. The color of the solution is a guide for judging of its purity. The iron deposited contains a little hydrogen, nitrogen, carbon monoxide and carbon dioxide, all of which are expelled by heat treatment. It is so pure that it is nearly as soft as copper.

The toxic effects on vegetation of salts of the alkalies in soils has been investigated with the result that the effect of the salts is not in proportion to the salts which have been added, but to the salts which can be extracted by leaching from the soil.

A floating mill has been tried with some success on the Mersey off Liverpool. It consisted of two or more parallel endless chains working on two drums or wheels, and floats are carried at regular spaces on the chain. The construction is simple in all respects, and it would seem applicable to many small installations where limited power only is needed.

Digitized by Google

Aluminum maintained at a temperature of 1000° C. for seventy-three hours evaporates until there is but three per cent of the original weight left. The residue is supposed to be an allotropic form of aluminum, and oxidizes spontaneously in the air.

It is calculated that in the great Witwatersrand mining district of Africa three hundred and sixty million tons of rock have been hoisted in the last fourteen years. The deaths by accident, largely by falling of rock in the mines, have been 10,600 with 22,400 wounded and hurt.

The Wheatstone telegraph apparatus using the perforated tape system of transmission has been tried with success in England on a wireless circuit. One hundred words a minute could be transmitted and it is believed that much better can be done.

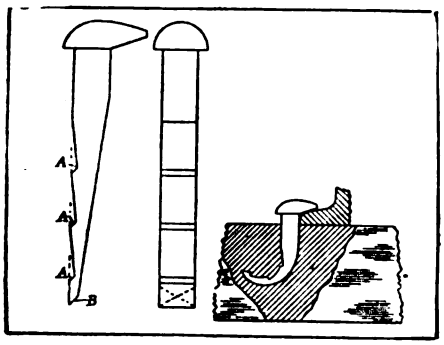
It is proposed to send power from England to France by a power line under the waters of the Channel. Sweden and Denmark are connected by a power line, carrying 50,000 kilowatts at a voltage of 25,000. This would represent many shiploads of coal.

An ingenious way of measuring the velocity of projectiles is based on firing them through coils of wire on closed circuits, so that the currents induced can be made to record the passage of the steel body through them. One of the coils may surround the barrel of the gun so as to give a record for the shell before it has left the piece.

The experiments with oil borings in Derbyshire, England, have produced one well, which delivers oil steadily; one well has been abandoned on account of water troubles, and other borings are proceeding satisfactorily. England is much exercised over the rising price of gasoline, and the subject of motor car fuel is receiving much attention.

RAILROAD SPIKE

THE object of this spike is to hold rails on the sleepers and to be to an extent locked in position. The effect of the three



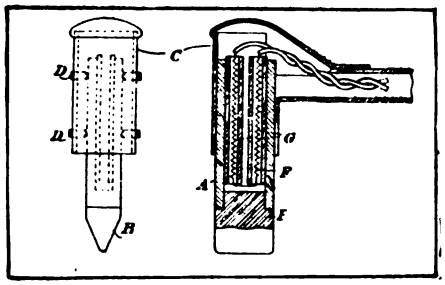
notches, A, A, A, and of the inclined face or edge, B, is to cause the spike when driven to bend around as shown and thus to get a good hold on the sleeper.

To have water for power stations at all seasons arrangements have to be made for impounding a sufficient quantity to carry over the dry season. It has been brought out that this is easier in the case of high falls rather than in low ones. Obvious as this is, it has only recently been commented on. In Switzerland it is proposed to transmit power at 120,000 to 150,000 volts, generating in the plant at 45,000 to 50,000 volts.

Low temperature carbonization of coal is advocated from some standpoints. It gives a smokeless fuel residue, produces gas and as by-products oil and ammonia are given. The oil is adapted for internal combustion engines.

ELECTRIC SOLDERING IRON

THIS tool comprises a tubular section, A, into whose lower end the soldering bit, E B, fits. Outside of the tubular part is a jacket, C, and set-screws, D D, hold all the



parts together. In the upper part of the bit, E, are holes containing quartz tubes, F, which receive resistance coils to effect the heating. In one form of construction the end of the bit, B, is made detachable so as to be readily renewable.

Several propositions to reform the calendar have recently been made. The simplest and to that extent the most rational one provides for the division of the year into quarters, each quarter to comprise two months of thirty days each and one month of thirty-one days. This gives 364 days. Then there is to be one day each year additional, which day is to be outside the week, and there are to be two such days in leap year. One effect of this would be that week days would repeat themselves every year; any week day would always come on the same day of the month. The extra or leap days would come at the end of the year. If the year began in March it would give meaning to the names of the last four months; September, for instance, is now the ninth month, yet its name means seventh month. If the year began with March, then September would be the seventh month; October, which means eighth month, would be the eighth in reality, where it is now the tenth, and the same applies to November and December, the eleventh and twelfth months in their order, and in name the ninth and tenth.

Electric iron ore reduction furnaces in Sweden use electrodes of carbon 24 inches in diameter and four or five feet long. Provision is made for attaching new sections to the old pieces as they grow short. The electrodes cost 4 cents a pound and 16 to 20 pounds are used per ton of iron reduced. A 3,000-kilowatt furnace will have six electrodes.

The treatment of the water in swimming pools has become a problem to be dealt with. One college is cited, where the water is changed only once a year. It is repeatedly filtered and purified with chloride of lime (bleaching powder). The standard temperatur is 76° F. except for swimming matches, when it is reduced to 72° F. In another prominent university ultra-violet light is the purifying agent; elsewhere ozone or copper sulphate is employed.

It is officially stated that England is five years behind on her proper building program, and half a million of additional houses are said to be needed. Steel frame houses with bolted fastenings are in use there now. A light concrete wall filling is used for the houses in question.

By combining the water gas process with the old distillatory process complete gassification of the coal is brought about. The coke is the basis for the water gas, so that there is no residue or by-product, except the ash of the coal. The gas is of 425 British thermal units heat value.

The Ford radiator is coming into its own. It has been promoted to the service of cooling the oil in transformers. The oil is circulated, exactly on the lines of the water in an automobile, and an electric fan, of the office type, is used to accelerate the cooling if necessary. This is reported from a railroad in the Southern States.

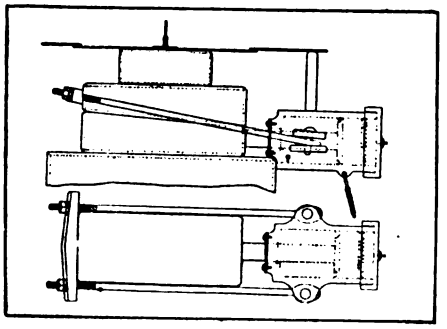
In France a wireless alarm system is being installed on the railways. The block stations use an antenna about 46 feet long, operated by an 8-volt battery coil with an inch and a quarter spark. One pole of the battery is earthed, the other connects through the primary of the induction coil to an insulated rail, which is grounded by the passing train. The locomotive carries its own local battery, coherer and antenna. The grounding of the insulated rail causes a whistle to blow upon the passing of the signal station.

The peat beds of Manitoba are calculated at 12,000 square miles area, with an average depth of six feet. This gives over nine billions of tons of peat, equivalent to over five million tons of good quality coal. A number of peat deposits or bogs are in the neighborhood of Montreal and Toronto not as extensive as the Manitoba fields, but representing fifty million tons, about equally divided between the two localities.

As a means of increasing the vacuum in a liquid gas container in the outer space, charcoal has been found to be useful; it absorbs under the reduction of temperature, incident to the filling of the bottle, any gas in the vacuous space. But this is believed to be a cause of explosions; if there is any leakage of oxygen from the container into the outer compartment containing the charcoal, an explosion may result, on account of the reaction between the oxygen and the charcoal impregnated, it may be, with combustible gas in addition to its own combustibility.

NEW KEEL BLOCKS

IN dry-docks and on launching ways ships are carried, as regards greater part of their weight, on blocks placed under their keels.



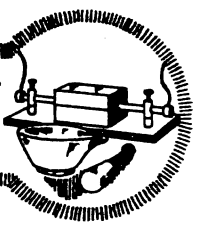
In the system of launching employed in this country and in England, the weight of the ship at the last moment is transferred to parallel ways at each side of the keel, and the keey-blocks have to be removed. In the construction shown in the cut, each block consists of two opposed wedges. When they are to be removed, before the ship goes down the ways into the water, hydraulic rams applied as shown pull one of the blocks, in this case the upper one, in such direction as to reduce the height of the pair, which releases them so that they can be removed. In this arrangement there is a possibility of various other applications.

A recent report on helium for balloons states that the helium to inflate a balloon would cost more than the balloon itself. Efforts are to be made to cheapen the production of the gas in question.

Digitized by Google



EXPERIMENTAL CHEMISTRY



The Chemistry of the Common Metals

Part III—Calcium

By Henry L. Havens

THE metal calcium, which belongs to the alkaline group, was first prepared by Sir Humphrey Davy in the year 1808. The calcium prepared by Davy was in a very impure state, and it was not until the year 1898 that the metal was obtained in a perfectly pure condition by Prof. Moissan. In this instance it was obtained by the electrolysis of the fused iodide and by the reduction of this salt with sodium.

Calcium is a very abundant element and occurs in the form of silicates, carbonates, sulfates, fluorides, phosphates, borates, etc. The human body contains a considerable amount of the element, the teeth being largely made up of calcium carbonate.

Today calcium is prepared by the electrolysis of the fused chloride. This is carried out with a carbon anode and an iron cathode. The liberated calcium clings to the iron cathode which is in the form of a rod. The temperature of the bath is kept as low as possible. To accomplish this calcium fluoride is added to the bath, which, since it dissolves, lowers the melting point of the chloride.

Calcium melts at 800 degrees and will voltalize below this point under reduced pressure. It has a density of 1.55 and is extremely malleable. It decomposes water forming calcium hydroxide or lime water Ca (OH_2). Calcium acts vigorously with acids and burns brilliantly in air. Combines at higher temperatures with nitrogen, chlorine, sulphur, silicon and phosphorous. When heated in a closed vessel, both the oxygen and nitrogen present are almost entirely removed if a sufficient amount of the metal is heated. A very high vacuum will result.

Calcium hydride (CaH_2) is a white crystalline substance that reacts with water, forming the hydroxide and hydrogen. Calcium combines directly with hydrogen to form the hydride.

Calcium oxide (CaO) is one of the most important compounds of calcium. It is commonly called lime and finds a multitude of uses in the workaday world. This important substance does not occur in nature but is prepared by heating marble or limestone in a high temperature. The following reaction takes place:

$$CaCO_3 \leftrightarrows CaO + CO_2$$

This reaction is carried out in what has become known as a lime kiln.

Calcium hydroxide $(Ca(OH)_2$ is made by the action of calcium oxide on water. The following reaction is carried out:

$$CaO + H_2O = Ca(OH)_2$$

This action is very slow in starting, but once started the heat gradually rises, the rapidity of the reaction increasing with it.

Calcium carbonate $(CaCO_3)$ occurs very freely in nature as limestone, marble and chalk.

Calcium chloride (CaCl) occurs very abundantly in nature and the oceans contain great quantities of it. This important compound finds great use in the industries. It is extremely soluable in water and crystallizes out with varying amounts of water. It is possible to prepare it in the laboratory by dissolving pure calcium carbonate in hydrochloric acid. The compound is very diliquescent and melts at exactly thirty degrees.

Calcium hypochlorite $(CaCl_2O)$ is prepared by the reaction resulting when chlorine is allowed to come in contact with slacked lime:

$$Ca(OH)_2 + Cl_2 = CaCl_2O + H_2O$$

This compound is sometimes called bleaching powder. It is partially soluable in water and yields calcium, chlorine and hydrochlorite ions. It is capable of reacting with all the acids. The following is an example:

$$Ca\ Cl_2O + H_2SO_4 = CaSO_4 + HCl + HClO$$

Calcium fluoride (CaF_2) is found to a considerable extent in nature. This substance is commonly called fluorspar. It melts at 1330 degrees and is quite insoluble in water. It has the peculiar property of becoming luminous at temperatures below redness. It is used as the source of most all other fluorine compounds and especially for the production of hydrofluoric acid.

Calcium nitrate $Ca(NO_3)_2$ is produced by the action of nitric acid on calcium carbonate. The compound occurs in nature and is found in all fertile soil. When calcium nitrate is heated it gives calcium oxide, nitrogen peroxide and free oxygen. The substance is very soluable in water and forms a number of hydrates.

Calcium phosphate $(Ca_3(PO_4)_2)$ occurs in nature as part of the mineral $Ca_5(PO_4)_3F$. This substance is found widely distributed in but small quantities in practically all rocks and soils.

Calcium sulfide (CaS) can be readily produced by heating the sulfate with charcoal. It is produced commercially as a by-product in the Le Blanc process for the production of soda. It is insoluble in water but can be slowly hydrolyzed forming hydroxide and the hydrosulfide. The following equation represents this:

$$2CaS + 2H_2O = Ca(OH)_2 + Ca(HS)_2$$

Calcium sulfide has the property of phosphorescence when the compound is mixed with impurities but the pure substance does not exhibit this property.

Calcium sulfate $(CaSO_4)$ takes two forms in its occurrence in nature, the mineral anhydrite $(CaSO_4)$ and gypsum $(CaSO_4 2H_2O)$. The latter is by far the most important of the two, as it is used largely in plaster of Paris and cement plaster.

Calcium carbide (CaC_2) is formed in the electric furnace by the reaction produced when carbon is brought into contact with lime at the high temperature of the furnace. The following equation represents the reaction which takes place:

$$CaO_2 + C = CaC_2 + CO_2$$

The calcium carbide thus prepared reacts vigorously with water for the production of the inflammable gas acetylene. Calcium carbide is produced in enormous quantities at Niagara Falls, where electric power is cheap.

Calcium cyanamide $(CaCN_2)$ is produced in the electric furnace. This substance, which is used as a fertilizer, is formed when nitrogen gas is brought in contact with calcium carbide at the proper temperature. The reaction follows: $CaC_2 + N_2 = CaCN_2 + C$.

Calcium silicate is contained in almost all of the natural silicates. Artificial and very complex silicates in the form of glass are produced in great quantities and the following equation shows how the production of one of these is carried out:

$$Na_2CO_3 + CaCO_3 + 6SiO_2 = Na_2CaSi_6O_{14} + 2CO_2$$

Digitized by Google

Experimental Physics

Ultra-Violet Rays—Part 1.

By James L. Clifford

THE twentieth century was ushered in by a series of epoch-making discoveries. With each new advance, the mind of the scientist reached further into the mysteries of the unknown. Modern physical science is one of the most fertile fields for study and experimentation. The study of the various types of radiations, Roentgen, radioactive, ultra-violet, and infra-red, aside from being intensely interesting, is instructive as well. It is the purpose, then, of this series of articles to outline a few experiments in physics, suitable for amateur investigation. The field of radioactivity has been omitted, as it has been covered by the author in previous numbers of this magazine.

Light is one of our most familiar entities. We all recognize light and appreciate its many simple properties. It is defined as the sense impression formed by the eye. This definition would have been accepted generally for light 30 years ago, but now we know that there is light which it is impossible for the human eye to detect. To say, then, that light is what we see, is an obvious absurdity. We had better speak of light as a transverse wave in the all-pervading ether. This wave has a constant velocity of 186,000 miles per second, but may vary greatly in the wave length and the frequency.

The ether can probably transmit waves of any wave length. The shortest waves detected by Shuman, and later accurately measured by Lyman, have a wave length of but .0001 mm., while the waves of radio-telegraphy, also ether disturbances, sometimes reach a wave length up to 20 kilometers. Thus we see that the ether is probably overflowing with vibrations of all wave lengths and frequencies. The human eye can only recognize vibrations of from .0004 mm. (violet) to .0007 mm. (red) wave length, this being the range of the colors of the rainbow. Wave lengths greater or less than these cannot be detected by the eye. It was long thought that this 3/10,000 of a millimeter variation of wave length constituted all of the radiation known as light.

By the action on a photographic plate, and the phosphosescence caused in certain substances, waves of but .0002 mm. wave length were detected.

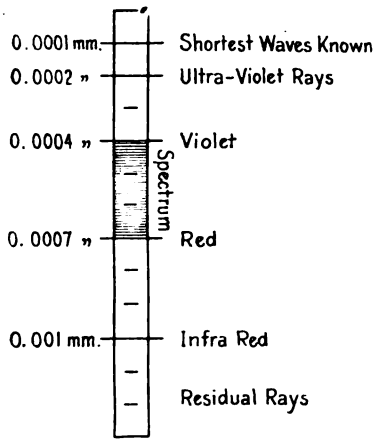


Fig. 1. The wavelength scale of the spectrum

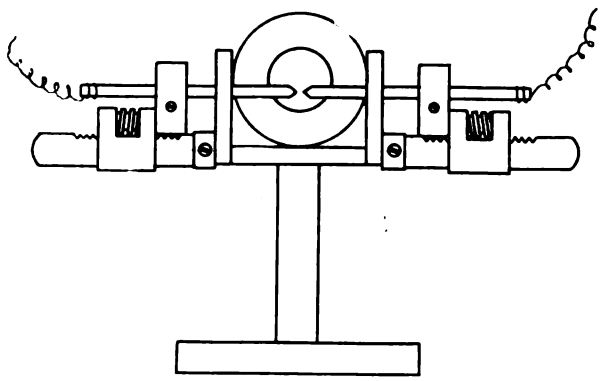


Fig. 2

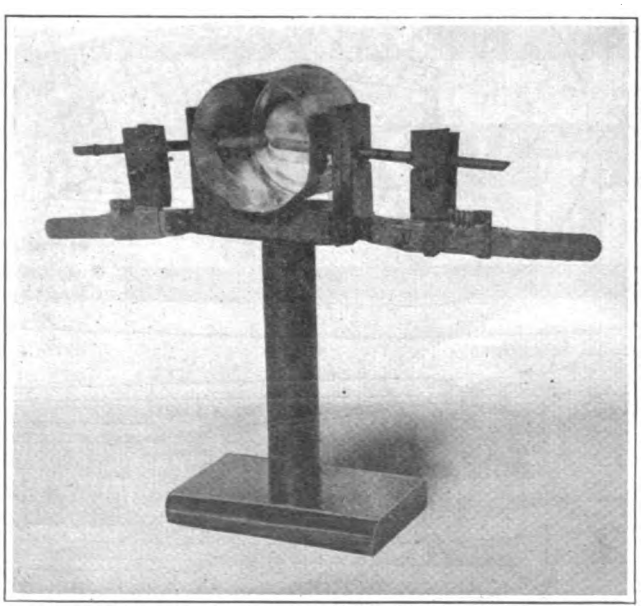


Fig. 3. A simple arc light used for the production of ultra-violet rays

These were called the ultra-violet. On the other end of the spectrum, heat light waves were discovered with a wave length of .001 mm., and were called the infra-red. By repeated reflections from quartz, flourite, and sylvite residual rays were isolated having wave lengths up to .06 mm. In Fig. 1 is shown the relationship of these various types of light rays. In this article we shall confine ourselves to a discussion of the ultra-violet rays.

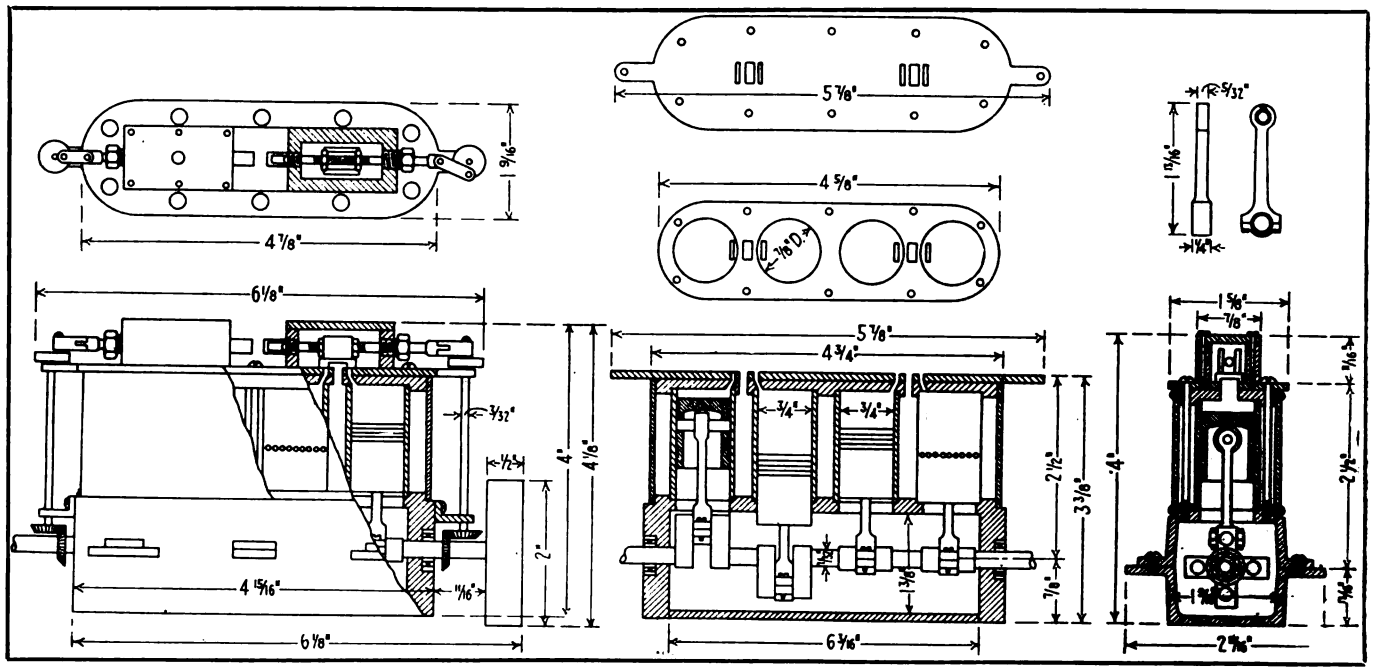
It has long been known that in light there is a peculiar ray having the property of producing chemical action. If a ray of light is broken up into a wide spectrum by a diffraction grating, or a prism, all the colors can be obtained. If a small volume of equal portions of chlorine and hydrogen is first placed under the red portion of the spectrum, and then successively moved under the orange, yellow, green, blue, violet, it will be found that the gas will be unaffected until after passing the violet, when it will explode. This action is the combining of the chlorine and the hydrogen to form HCl due to the ultra-violet rays.

The rays have also a distinct physiological action. It is these rays that produce sunburn and sun-stroke. Everyone knows that it is dangerous to look long at a bright artificial light, but few understand that this is because of the ultra-violet rays emitted by the light which affect the eyes, often causing total blindness. Some time ago an experiment was tired to find the action of these rays on life. A beam of sun light was separated into its component colors by a diffraction grating or other device of this kind. Small cages containing ants were placed under each successive color from beyond the red to the ultra-violet. The actions of the ants were then observed. The ants everywhere except under the ultra-violet acted normally, but under the ultra-violet they were very much disturbed. They seemed to try to get away from the radiation. If kept long enough under the light the ants died. Ultra-violet light isn't good for healthy life cells.

Ultra-violet light, unlike ordinary light, does not pass

(*Continued on page* 166)

Digitized by Google



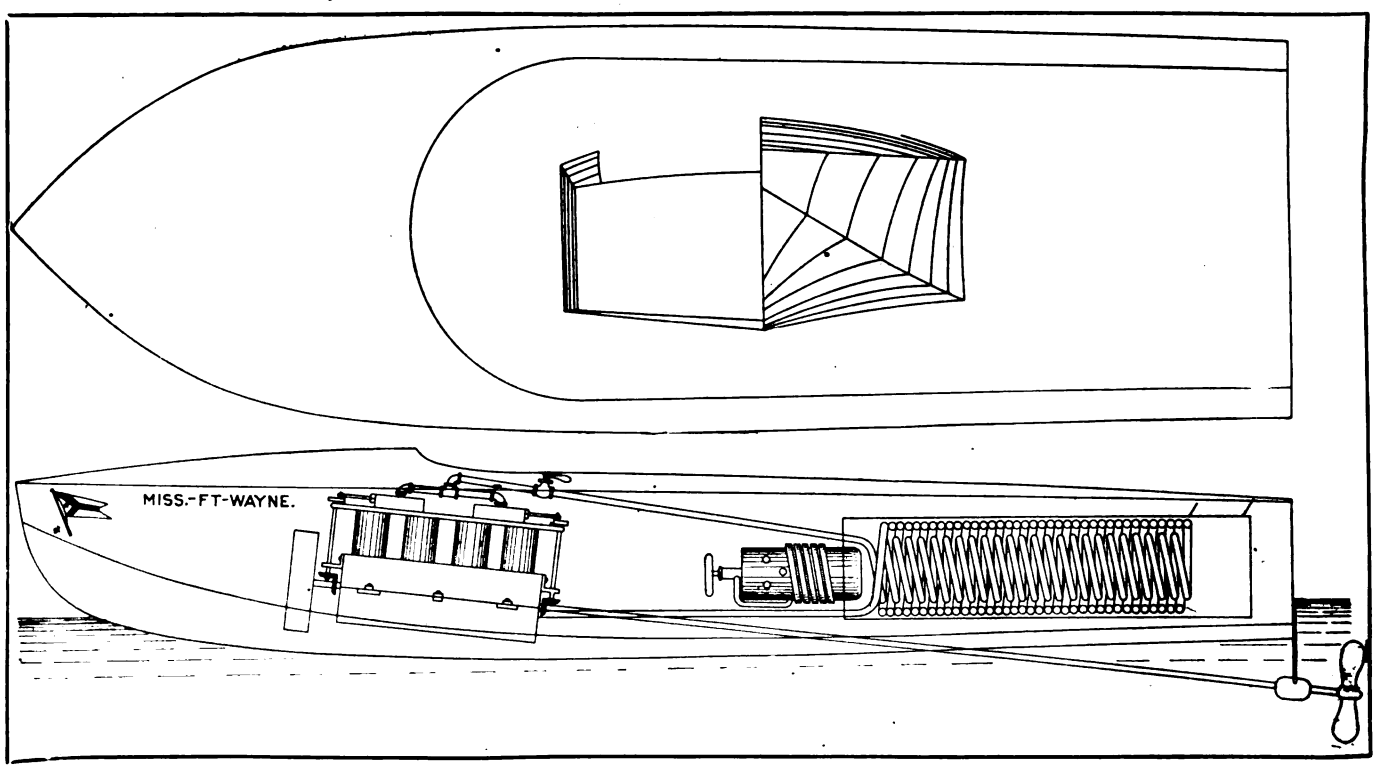
A Model Record Breaker Under Construction

MISS FORT WAYNE is the name of a new model speed boat being constructed by Mr. E. J. Stroud, of Fort Wayne, Ind. The new craft is to be motored with a four-cylinder engine similar in general design to the Westinghouse type of engine described in the September, 1918, number of EVERYDAY ENGINEERING MAGAZINE. This engine has a three-quarter bore and three-quarter stroke. An extra large blow torch and boiler supply the four cylinder engine with steam. The valve design is in general the same as that of the Westinghouse engine previously mentioned.

The hull of Miss Fort Wayne is designed along lines that have not been employed in model work heretofore and great interest will be shown in the trials of this craft. Of course, this type of hull is not as easily constructed as the common single step hydroplane hulls and therefore it may never become quite so popular even though it may be more efficient.

The model power enthusiasts at Central Park may well feel concerned over this newcomer as it is very apt to set new records that will be difficult to beat. Mr. Stroud, the builder and owner of the new boat, has great expectations, and if these are fulfilled someone will have to leave New York before the summer is over and go out to Fort Wayne with a boat under their arm to prove to that part of the country that model speed boats of the real fast variety are really made only in New York. It is certainly gratifying to those who are following the sport to see new designs making their appearance from different parts of the country.

The Editor has one suggestion to make: He would advise Mr. Stroud to take the stop cock off the steam line. If this is closed when the boiler is in operation something is going to happen between that point and the water end of the boiler.



Digitized by Google

Construction of a Long Distance Indicator

By George Leslie

IF you were asked to devise an apparatus which would indicate and record the temperature of one corner of a thousand acre orange grove at the opposite corner, or the gas pressure of a large feed pipe at the main works, it would seem quite a difficult task. Yet such systems are in operation. The principle on which the apparatus works, the Bard induction balance, was patented several years ago, but has been applied to this use a comparatively short time.

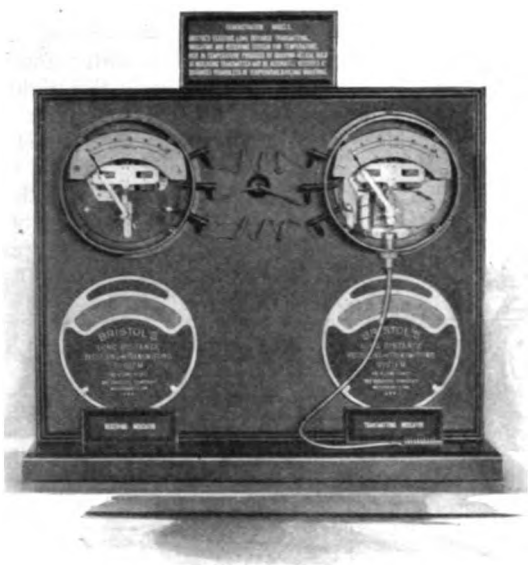


Fig. 1. Complete set for indicating temperatures at a distance

Fig. 1 shows the interior of the transmitter, while Fig. 2 explains the working of the instrument. This particular instrument is for recording gas, water or steam pressure, although a change in the measuring device makes it applicable to the measurement of water-level, temperature or mechanical movements. This is composed of two soft iron cores with two coils turning horizontally between them. Jewelled bearings support the moving element. Since alternating current is used to energize the coils, it will be seen that any change in the relation between the cores and coils will change the current, allowing more current to pass in the coil which moves away from the core, and less in the other one.

At the receiving instrument, perhaps many miles away, a pair of solenoids, mechanically balanced and free to take any position, are connected to the transmitter coils. As the current increases in one coil of the transmitter, the corresponding solenoid of the receiver will attract its core with more force, while the opposite is true of the other set. If it is desired to make a permanent record of these changes, the solenoids are connected by a frictionless multiplying lever to an arm which moves over a circular chart. This chart is continuously revolved by clock-work, so that it gives an indication of the pressure at any time during the day. A new chart is put on every twenty-four hours.

Three wires are required to connect the two stations, as indicated in Fig. 1. One end of each magnet, at both transmitter and receiver, is joined to the common wire, or the center lead shown in Fig. 1. The other ends of the transmitter coils go to the corresponding connections on the receiver. The batteries or source of current is inserted in a break in the common wire. Thus two circuits are formed, each with the battery, one transmitter magnet, and one receiver magnet.

If 110 volts, alternating current, is used, and the wires are of number 14 gauge, the stations can be thirty miles apart, or if number 12 wires are employed, the transmitter and receiver can be separated by forty miles. The transmitter is mounted in a moisture-proof case, so that it may be set up out of doors, on the bank of a reservoir or irrigating system if it is desired to record the level of the water.

There are many applications for this apparatus. Now that such care is used to get the greatest efficiency from heating and power plants, these instruments are being used to show in the chief engineer's office the performance of the boilers. In heat-treating rooms the recorder is used that the results of different treatments can be compared. This is particularly true in factories where rubber is vulcanized.

One practical use of this apparatus is the installation of a steam-pressure indicator to show on the first floor of a house the condition of the furnace in the cellar. The transmitter can be attached to the steam gauge, to move the solenoids. A simple pointer on the receiver solenoids will make indications corresponding to those of the gauge. 110 volt, 60 cycle current can be used, though a higher frequency will give better results. A small light must be put in series with the apparatus, or the coils wound to a sufficient resistance to keep the current down to the carrying capacity of the wire. The greater the number of turns on the transmitter coil, the larger the range of variation in resistance.

The principle of the system is one which can be applied to other instruments. Perhaps some of our experimenters can work out a new use for this type of induction balance.

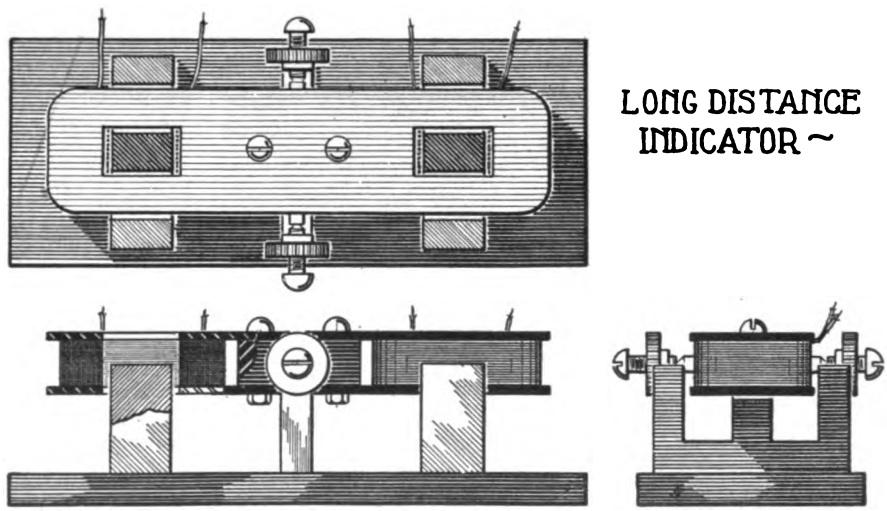


Fig. 2. A model of the long distance indicator which will find various uses in the experimental laboratory

The experimenter who keeps in mind the practical application of his work is the one who finds some material reward aside from the pleasure of the work he performs. Moreover, there are always new applications of old principles which the student inventors are rapidly bringing out as commercial products.

Digitized by Google

Compressed Air Driven Monoplane

By H. C. Ellis

BEFORE attempting the construction of this model study the drawings carefully. Use the scale for measuring in laying out full size components. Two main planes are required, one left and one right. The wing spar is of spruce 3/16" x ¼" and tapered as shown to a stream line form. The leading and trailing edges of the main planes are of flat steel wire, 28 gauge is used for the leading edge and 26 gauge for the trailing edge. The ribs are constructed of the same material. Be certain to have the same curve on all ribs.

To assemble the wings make a full size lay out on a piece of board and place small nails or brads along the edges. These will aid in holding the wire in place. If any difficulty is experienced in shaping the wings heat the wire at the point where the bends are to be made. All joints are to be wrapped with 30 gauge wire and carefully soldered. The wing spar is bound to the ribs at the points shown with linen thread and glued. After the main planes are completely assembled cover with a good grade of silk, glue same to the ribs on the bottom side. After the glue is thoroughly dry apply three coats of dope, being sure to apply one and allow it to dry before applying the remainder.

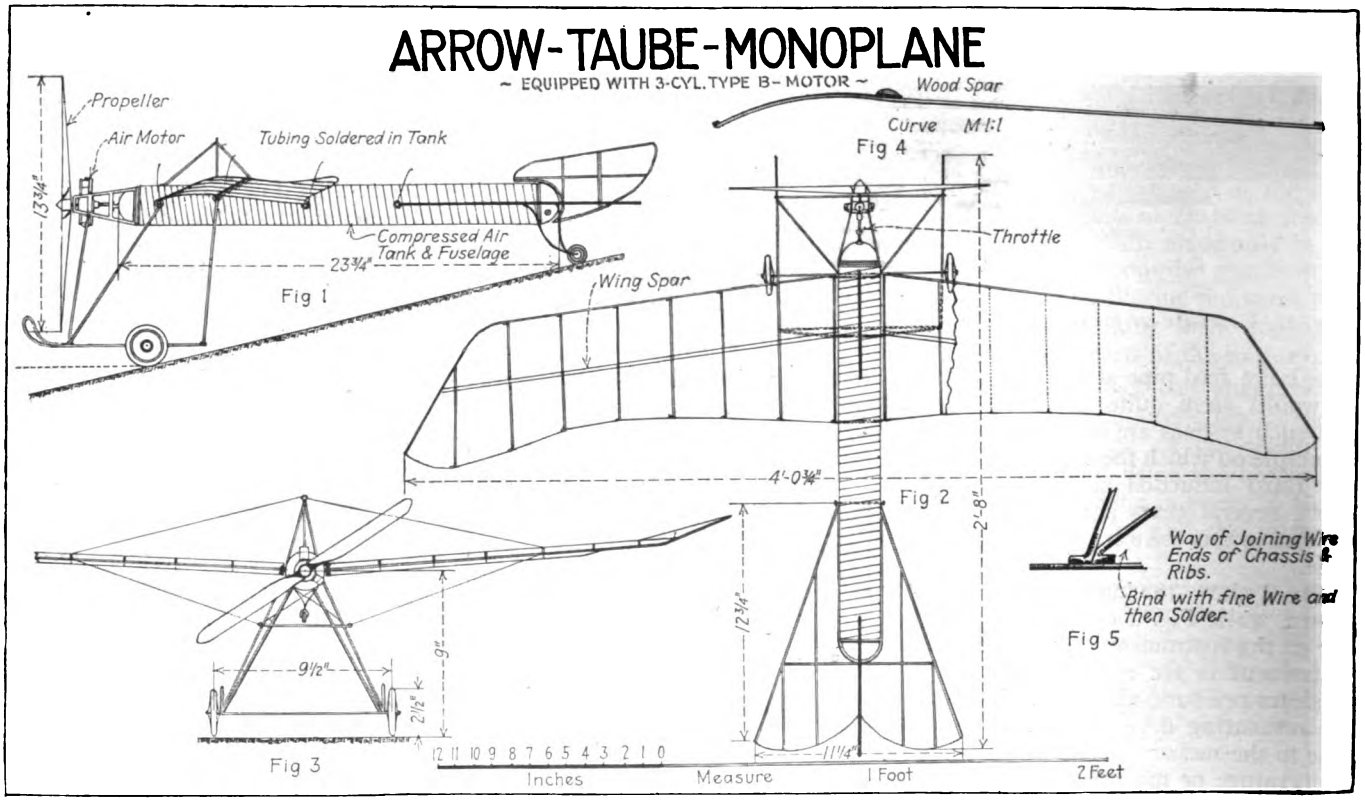
The tail is built up the same way as the main planes. "A" is a long bolt which passes through the tubing soldered in the tank and through the loops at the front edge of the tail. This provides for the connection of the tail to the fuselage. "B" is a small sleeve on the tank cap. This receives the wire running length wise through the tail just at the end of the tank. The rudder and rear wheel chassis is soldered to the tail.

Landing Chassis

The landing chassis is built up from 18 gauge piano wire and bound with 30 gauge wire, then soldered. The upper ends of the struts are bent into small loops, the wing spars passing through same. The lower ends which join the skids are bent parallel to same. The strut at A measures 9¾ in.; B, 11 in.; C, 10 in. One-half inch is allowed for bending the loop on each side. The skids are 13 in. long, 5 in. being required for shock absorber. The chassis measures 9 in. in width. The spreader D is 9 in. long and has two loops at the ends to receive the guy wires. The wheels used on this model are 2½ in. in diameter, or larger. They are the rubber stream line disc form that can be secured from dealers in model supplies. The axle is of ⅛-in. steel rod, 10½ in. long, threaded and fitted with nuts. It is bound to the landing gear with 30 gauge wire and soldered. The tank and motor used for this model are the same as the one described in the March issue of the EVERYDAY ENGINEERING MAGAZINE.

Flying Instructions

In flying the model charge the tank with 75 lbs. pressure with a foot pump. Grasp the tank with the right hand just to the rear of the main planes. Open the throttle with the left hand and launch the model gently forward at a slight upward angle, with the wind. The maximum pressure capacity of the tank is 150 lbs., and with this pressure, the model should fly from 600 to 800 feet. When the tank is pumped up to its capacity, the model will rise from the ground under its own power.



The temperature of ignition of liquid combustibles has been determined with a simple apparatus as below. A steel block, three inches high and four inches across has deep grooves turned to make it easily heated. It is bored out so as to receive a crucible. Oxygen is admitted through holes in the block, so that it is heated when it reaches the crucible. The oil to be tested is dropped in and the temperature is taken by a thermo-couple. The combustion of the oil produces a slight explosion and the temperature of combustion is thus determined.

It is reported that two tons of tin are smelted each day in Canada at Brantford, Ont., by electrically heated furnaces.

Digitized by Google

CHEMICAL COMPOSITION OF MAN

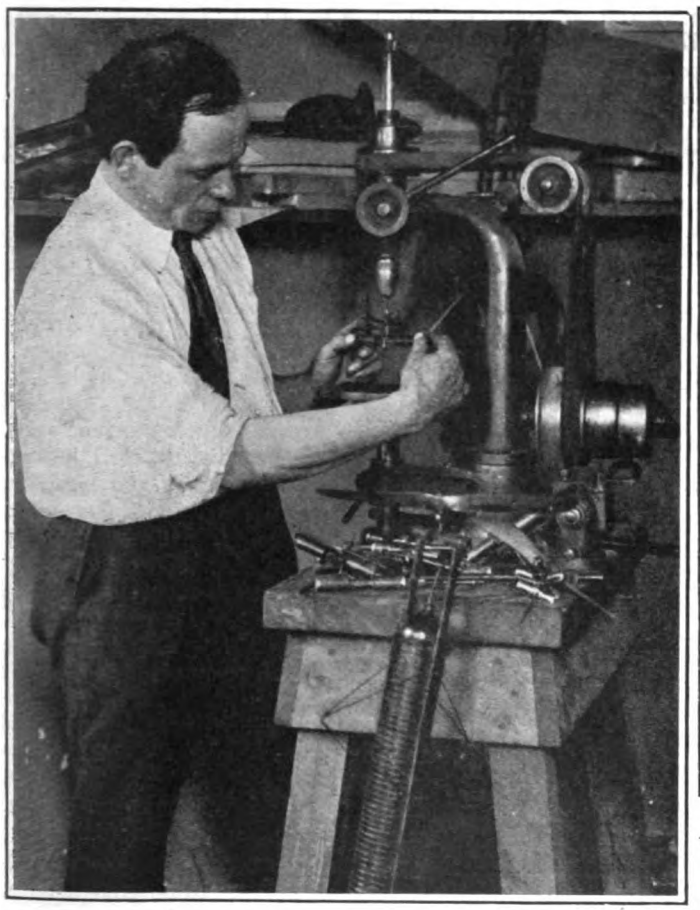
CHEMISTS and scientists have whiled away many a long day by delving into the mystery of the substance of mankind. They have brought many interesting things to light. One French scientist discovered, for example, that the stuff of which a 150-pound man is composed equals a thousand ordinary hens' eggs. An experimenter, with nothing of more practical value to do, busied himself with discovering, that in every one of us is 3,500 cubic feet of oxygen, hydrogen and nitrogen, sufficient gas to inflate a balloon with a lifting power of 200 pounds, or to illuminate a street a quarter of a mile long for several hours: for the humbliest of us contains, without suspecting it, $3.75 worth of illuminating gas. And if the 22 1/6 pounds of carbon in the average body were reduced to graphite, there would be enough leads for 780 pencils. Another chemist found out that enough iron is stored in the human system to make seven large nails. And as for phosphorus—there is enough in each of us to tip 820,000 matches or, improperly administered, to poison 500 people. It has been estimated that we are worth, if we could be separated into our respective chemical elements, $18,300, which is considerably more than most of us have of the world's goods.

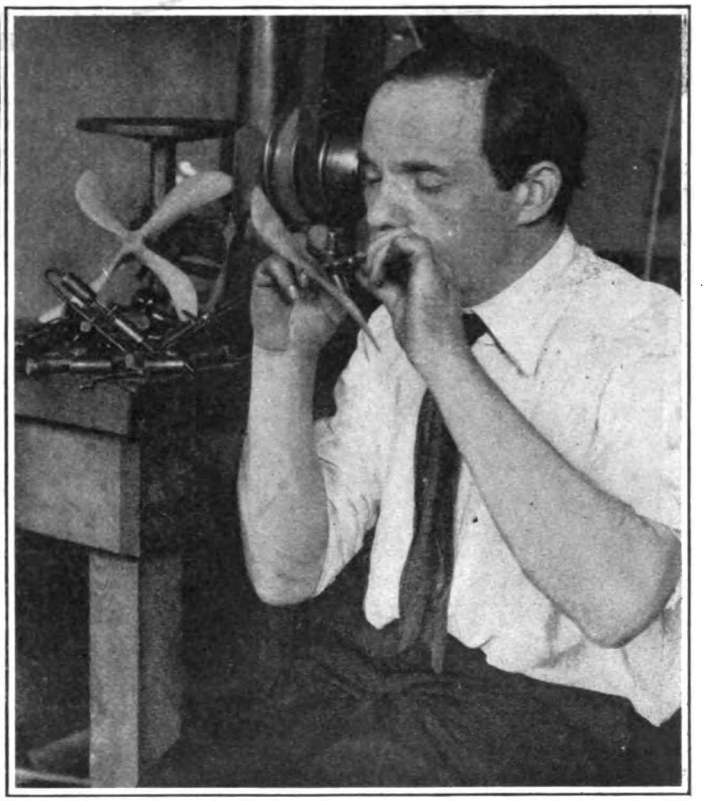
NEW MOTOR BOAT RECORD

A SUNBEAM motor of the same construction as that used in the British dirigible R-34 is said to have broken the World's speed record for motor boats during a recent trial on the Seine river, near Paris. The trials were carried out on a 500-meter course where the current is slight, and the official chronometers recorded that this was covered in from 14 to 16 seconds at different trials. The general speed may be set down as 120 kilometers, or 75 miles an hour. The Sunbeam motor used in making this record is 450 hp. Naval constructors have held that a propeller turning more than 1800 revolutions a minute would produce a vacuum about itself and in consequence fail to secure speed. The inventors of the new record-breaker, however, have disproved this theory and used a multiplicator which produced 3000 revolutions a minute.

LARGE CAPACITY AIRPLANES

A STRIKING development noted in European aviation is the great increase in size and power of the large airplanes suited for bombing in war and for passenger carrying in times of peace. The Carproni triplane which made a flight from Villacoublay, France, to London with a number of passengers, has been remodeled for passenger service and carries eight passengers, with three additional seats for pilot and mechanicians and is the same type in essentials that was used in bombing. The largest Caproni but recently developed is a triplane which, fully loaded, weighs about 25,000 pounds and is driven by five 200 horsepower engines. This has a double-deck cabin and accommodation for 22 passengers. The Vickers-Vimy has been remodeled and is carrying ten passengers. The Farman "Goliath," which is making regular passenger trips between Paris and Brussels, carries ten passengers at a time, and with this load aboard has attained a height of 10,000 feet. The Handley-Page four-engined biplane has been fitted for passenger accommodation and is credited with having accommodation for thirty persons. Another huge machine is the Bleriot four-engined machine, with accommodation for twenty-eight passengers. Commercial flying in Europe is well established and showing rapid development.





A sensitive drill press can be used to "run in" a compressed air motor. At the right one method of testing for free running is shown

The presence of nitrogen in iron may affect its qualities to a considerable degree. Some investigations of the contents of the bubbles often found in the metal have shown that they contain nitrogen with a little carbon dioxide and hydrogen. The latter is derived from the moisture of the air which has been used as a blast in the manufacturing processes. Red hot iron can bring about the combination of nitrogen and hydrogen to form ammoniacal gas (NH_3), so if this is formed conditions of heat may determine the combination of the nitrogen, in the nascent state with the iron.

Digitized by Google

Who's Who in the American Society of Experimental Engineers

C. Vey Holman, LL.M.

C. VEY HOLMAN is a resident of Maine, in which State he has served as State Geologist and State Assayer. Mr. Holman was born at Poughkeepsie, New York, January 23, 1861, of parentage running back on both sides to early colonial and pre-Revolutionary New England stock.

He was educated in the common schools of Maine, Rhode Island and



C. Vey Holman, LL.M.

Massachusetts, becoming a graduate of the Boston Public Latin School, the oldest school in America. Studied four years as a member of the class of 1882 at Harvard College, where he received honors in the classics and prizes for excellence in reading and declamation. Matriculant of Boston University Law School and graduate of the Law School of the University of Maine, receiving from the latter the degrees of Bachelor of Laws and Master of Laws. Founder of daily journalism at Harvard College where, as a sophomore he established the *Harvard Daily Echo,* published in Boston and other Massachusetts cities. Member of the bars of the Supreme Courts of Massachusetts and Maine and of the Courts of the United States. Member of many technical and scientific bodies, including the American Institute of Mining and Metallurgical Engineers, The American Mining Congress, of which he is a Vice-President, the American Association for the Advancement of Science, The American Electrochemical Society, life member of the Association of Harvard Engineers and a charter member of the American Society of Experimental Engineers. An owner and developer of mining properties in Maine, Alaska, Pennsylvania and Nova Scotia. Member of the Boston Veteran Journalists' Association and of the Navy League of the United States.

Mr. Holman very interestingly sets forth his experiences in life in the following lines:

"I was first attracted to the little magazine, then called *Everyday Mechanics,* by the casual purchase of a copy on a railroad train. My interest was excited by the plucky and straightforward way in which the Editor was appealing to his constituency of readers for support in his fight to retain the use of that title in which I believe he would have received universal public support had he been able to contest it to the bitter end. I immediately subscribed, mailing my subscription from the train.

"The cleverness of his editorship, the brightness and aptness of the little publication so won my admiration that when the proposition to consolidate the amateur engineering talent of young America in our Society was broached, I was happy to yield instant and enthusiastic support. I am only regretful that I have not been able to do more, but as the years advance, duties accumulate rather than lessen, and the desire to do all that I should frequently succumbs to the necessity of doing merely what I can.

"I have always been interested in boys—bright boys—bad boys (who are usually only over-bright boys lacking opportunity to express natural aptitudes of the highest order) and, of course, good boys, not preternaturally good, but well-dispositioned and teachable lads of spirit and principle.

"Looking back to a boyhood now nearly half a century behind me, I am as young as ever in my love of all outdoor sports, boating, hunting, fishing, tramping in the forest and in the open, studying always and everywhere the lessons which in imperishable characters God has written in the massive rocks in glacial-cut river valleys and glacier-deposited moraines, rames or "horse-backs" as they are termed in the vernacular, in forest, field and mountain, for the guidance and government of us, His children, who, after all, are only boys of a larger growth and elder stature, and pitifully small boys at our best and greatest, in His great scale of creation.

"With many years of pupillage in the school of experience, as journalist, publicist, lawyer, miner and mining geologist, I am continually being more and more impressed with the duty we owe the young of this great, free America, happily still possessed of our unrifled Constitutional character of liberty regulated by law, to impart to them the wisdom we may have been so fortunate as to steal or borrow from the great book of Nature and of Nature's God. So from me, as one whom a Connecticut Pegnot Indian taught to swim, and a Maine Penobscot Indian taught to paddle a canoe; who in my youth knew by sight and by name every native bird with its nesting habits and tricks of flight; who understood how to set dead-fall and figure-four traps, and to prepare the pelts of the small animals, grey and red squirrels, weasels and minks they caught; who knew the Rhode Island hillsides where grew the hickory and chestnut trees, and when to gather the nuts the early frosts dislodged from their hold upon the branches; who knew the Maine Hardwood ridges where the beech and oaks scattered their mast in brown profusion in the golden autumn days, convey to our brethren of the American Society of Experimental Engineers my salutations and best wishes.

"I hope the time may come when every American boy may know more than I ever learned of these wondrous lessons; may see in every angleworm a chemical engineer fertilizing more efficiently than ever any farmer did the soil he continually works over, in the wasp the original pulp wood paper-maker, in the beaver the earliest and most indefatigable hydraulic engineer, in the bee, nature's greatest conservationist of food supply, in the ant, the mole and the rat, mining engineers surpassing in ingenuity, fertility of resource, and untiring application, the graduates of the technical schools which have distinguished the names of Freiberg, Columbia, Cawborne, Harvard and the Massachusetts Institute of Technology among the many of the world's polytechnic schools.

"And may it be the mission of our Society to encourage, foster and develop, in American youth, enthusiastic love of scientific research along all lines of mechanical, electrical, chemical and geologic science."

TESTING METALS

FILE, or grind, the pieces to be tested and polish them smooth, then place them in a dilute nitric or sulphuric-acid solution for a day. Wash and dry the pieces, and if they are of the best steel, the surface will have a frosty appearance. Ordinary steel will have a honeycomb surface, and iron will present a fibrous structure running parallel with the direction in which the metal was worked.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

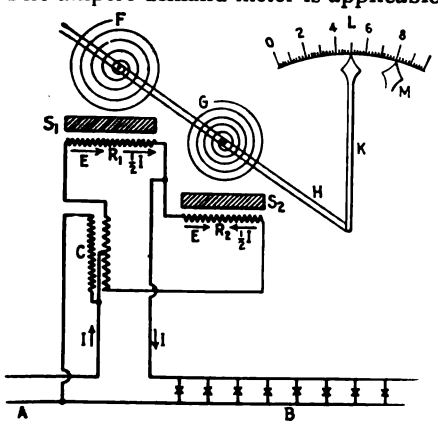
A New Thermal Demand Meter

RUGGEDNESS, compactness and simplicity of construction are the distinctive mechanical features of a new type of demand meter now being manufactured by the Westinghouse Electric & Manufacturing Company. The instrument employs the principle of thermal storage and indicates what has been termed the logarithmic average demand. The new line of instru-



ments consists of indicating watt demand meters for alternating current circuits, and ampere demand meters for alternating and direct current circuits.

The watt demand meter can be used to measure the watt demand in all types of alternating current circuits where it is desired to measure the load with an indicating type of demand instrument. The ampere demand meter is applicable



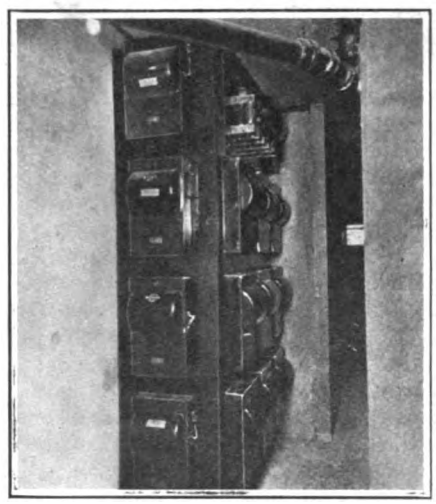
to installations where it is desired to measure the current demand; this type of ampere demand meter is espeically applicable in determining the average current in steel mill and railway work where a motor load varies through a wide range within a very short time.

The moving element of the instrument consists of a shaft connected to two bi-metallic spiral springs. The springs are attached to the shaft at their inner ends, and to a cylindrical case at their outer ends. The springs are wound in opposite directions so that an equal change in the temperature of both springs does not produce any rotation of the shaft. The instrument is, therefore, independent of atmospheric temperature changes. However, if one spring is raised to a higher temperature than the other, it will deflect through a greater angle than the other, and the shaft will move through an angle which is proportional to the difference in temperature of the two bi-metallic springs. Each of the cylindrical cases mentioned above contains a heating element which is connected to the electrical circuit in such a way that one spiral spring is raised to a higher temperature than the other, which results in the shaft deflecting through an angle proportional to the load on the meter.

In the wattmeter, the difference in the temperature of the two spiral springs, and hence the deflection of the shaft is made proportional to the watts by causing the load current to pass through the heating elements in such a way that in one heater it is additive to a current which is proportional to the voltage, and subtractive from the same current in the other heating element. In other words, if E is a current which is proportional to the line voltage, and I is the load current in each element, then the total current in one heating element will be $E + I$ and the other $E - I$. The losses, and hence the heating in the elements, are proportional to the squares of these currents, and it is readily seen that the difference in the heating is the difference between the squares of $(E + I)$ and $(E - I)$, which is proportional to the product EI or watts. Due to the thermal storage of the cylindrical cases surrounding the bi-metallic springs, the wattmeter does not respond instantly to a change in load, but always indicates the logarithmic average load for the time period immediately preceding the instant of observation. The thermal storage capacity of the cases is so designed that the wattmeter gives a deflection equal to 90 per cent of the final deflection in the rated time interval of the meter. This means that a 30 min. meter will give an indication equal to 90 per cent of final indication in 30 min.

PRESENT TENDENCIES IN CONSTRUCTION OF SWITCHBOARDS

OWING to the increasing labor shortage which necessitates the employment by industrial plants of men and women having no electrical experience, the question of protecting the "green employee" from electrical hazards is of paramount importance. Industrials, cognizant of this new responsibility created not only by a realization of the humanitarian aspects of the problem but by the tremendous expense entailed by accidents, are rapidly reconstructing their electrical equipment in such a manner that the element of danger is reduced to a minimum. Exposed portions of current-carrying parts are being protected so as to insure safety to life, reduction of fire hazards and simplicity of operation.



Dead front switchboards have already found a broad range of application as they protect the inexperienced operator by providing a centralized control for starting motors and miscellaneous power circuits.

The accompanying illustration shows fourteen modern type safety switches mounted on steel panel boards in the Sperry Flour Company plant at Spokane, Washington. The safety switches made by the Square D Company of Detroit, control 2300, 440, 220 and 110 volt circuits.

Such a board has a great many advantages. It can be constructed by any responsible electrical contractor, as the material used consists chiefly of pipe or angle irons, pipe clamps, conduit, steel plates used for panels and the safety switches themselves. An unusual

Digitized by Google

feature is its flexibility. Switches that are already individually installed on motors are easily convertible to a central power panel, and panels already mounted can easily be changed for individual drives.

MONSTER ELECTRIC PASSENGER LOCOMOTIVES

THE Chicago, Milwaukee & St. Paul Railroad is one of the trunk lines which bridge the gap from Chicago through to the coast. Building the road in itself was a pretty big feat of engineering, and the railroad operators had their problems when it came to hauling trains successfully over the steep inclines. For there are several steep grades, many short radius curves, and numerous tunnels. A sample of what they have to negotiate is a 21-mile, 2-per-cent grade between Piedmont and Donald, Montana. And another climb is a 49-mile, one-per-cent grade on the west slope of the Big Belt Mountains.

Two sections of the lines are electrified. One, the longer, and more important, comprises a division 440 miles in length extending from Harlowton, Montana, to Avery, Idaho. The distance is approximately equal to that from New York to Buffalo or from Boston to Washington.

The success resulting from the use of electric power on the division just described led the company to electrify another section further west, extending from Seattle to Othello, Wash., a distance by railroad of 211 miles.

Each locomotive is equipped with six electric motors capable of developing in the aggregate four thousand two hundred horsepower. The driving wheels of the giant engines are 12 in number, six on each side. Their diameter is 5 feet 8 inches, or equal to the height of a man of average stature. The diameter of the so-called "bogie" and trailer wheels is 3 feet. The height of the engine from rail to top of cab is 14½ feet. The overall length is nearly ninety feet.

Electrification of railroads goes a long way in solving the coal problem which confronts the United States today. The energy used for driving these trains over the mountains is obtained from the great waterfalls of the Montana Power Company, thereby utilizing the "White Coal" which otherwise might be wasted.

The electric locomotive described makes use of a feature known, as regenerative braking. That is to say, when the engine is running down hill, the motors become generators which deliver power back into the line, and in so doing they resist the impelling force of the train and act in a retarding or braking capacity. This is a big factor when one considers the pushing force brought to bear on the locomotive, by a heavy train. This tremendous energy, which would otherwise be lost by friction braking, is in part saved and used for moving other trains. It were as though a train going down one side of a mountain were helping to pull another up the other side. Power is saved and the down moving train is effectively braked as well. This form of braking has increased the safety of operation on grades and has greatly reduced the wear on wheels and tracks, to say nothing of the saving on brake shoes, which, under the friction braking method, wear down quickly, the friction often becoming so intense as to heat the brake shoes red hot.

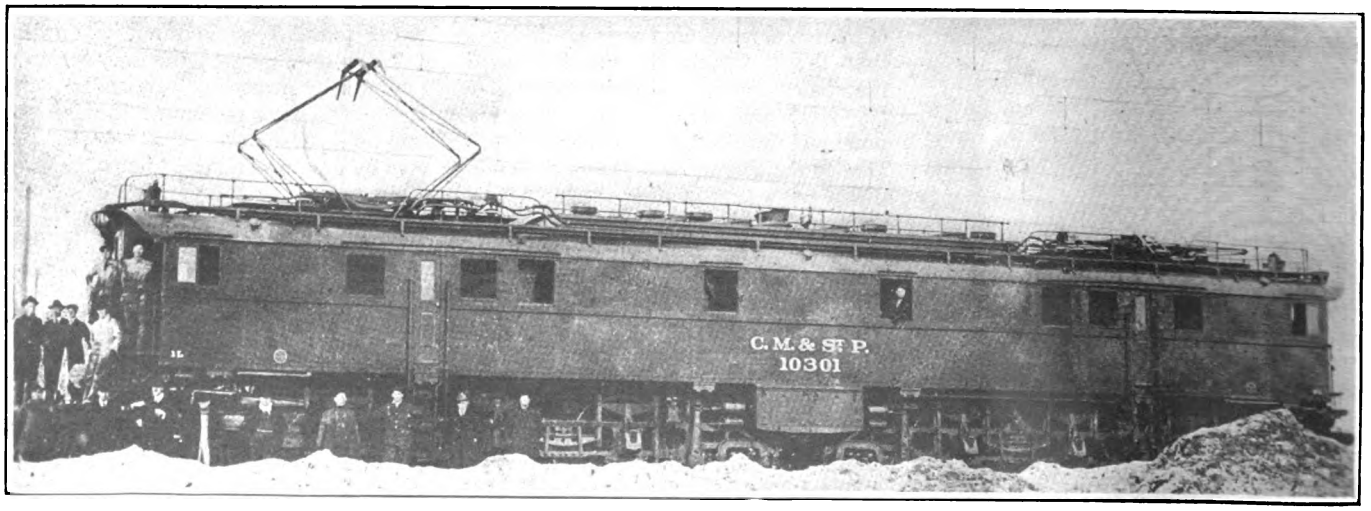
Anyone who has traveled through a tunnel behind a steam locomotive will at once recognize the advantage secured by electric operation through the elimination of noxious coal gas. This is an important item out on that mountain line with its 36 tunnels to be negotiated.

BAKING BY ELECTRICITY

THE extraordinary rise in the prices of fuel caused by the war has considerably furthered baking by electricity, although a great many electric bake ovens existed in Norway, Sweden and Switzerland before the outbreak of hostilities. The cheapness of coal at that time was not conducive to the bakeries taking up electric baking, in spite of the fact that in those countries which possess water power, baking by electricity is of considerable economic importance, as the employment of electric ovens permits the utilization of superfluous energy which usually cannot be made use of during the night. The night energy can be supplied by hydroelectric power stations at such cheap rates as to make the use of electric ovens much more economical than those heated by coal or steam.

AUTOMATIC TELEPHONES IN NEW YORK

THE telephone company operating in New York City has recently announced that, following exhaustive experiments, it has developed a machine switching central office system that has proved so satisfactory in a number of practical trials as to warrant its use in several places within its territory. Installations are now being made in Dunkirk, Ithaca and Geneva and the work is expected to be completed about the first of the year, in the three new exchanges, but none of these installations can be completed, according to present estimates, much before the end of 1920. The latter changes are expected to help meet the abnormal demand for telephone service in that city. The new system has been carefully worked out and the means of co-ordinating it with the other types of switchboards have been so perfected that the different types of equipment will interconnect without difficulty. In fact, a subscriber connected with one of the new switchboards will not need to know whether the called party is connected to a machine-switching or a manually-operated switchboard and vice versa.



The new giant electric locomotive built to haul trains over the Rocky Mountains

Digitized by Google

Detecting Flaws in Mica With X-Rays

By Brewster S. Beach

THE difficulty of detecting flaws and the presence of foreign bodies, of a metallic or other nature, in built up mica which is used for insulating purposes, has caused the General Electric Company to install an X-ray testing outfit for this purpose. As will be shown, the detection of such flaws before the mica is actually used for insulation purposes is highly important, as much damage, and loss of time and money, due to faulty mica are averted.

Mica, a substance which has a very high dielectric strength, is extensively used in the electrical industry as an insulator, especially in building commutators for direct current generators and motors. In this construction the copper segments of the commutators are separated by sheets of mica, to prevent short circuits between the copper segments. Mica is best for this purpose because of its high insulating properties even when it is in the form of a comparatively thin sheet and also on account of its heat resistance.

When it is received at the factory it comes in the form of flakes varying in size, but none very large, and with a thickness of one-one-thousandth of an inch. These flakes are given various treatments and built up into sheets, which are cut to any desired size. These sheets are pressed in a hydraulic press.

Since at best the bars are not very thick—about one-thirty-second of an inch—it is important that they have a uniform cross section, and be free from all foreign substances, because a thin spot in the bar, or the presence of some small metal object would weaken its resistance and probably cause considerable damage to the machines in whose commutator it was. A good many of the processes involved in building up these sheets are done by girls, and it has been found that, in spite of all precautions, pins, bits of chewing gum, tinfoil wrappers, small pieces of wire and other foreign substances are sometimes built up in the mica.

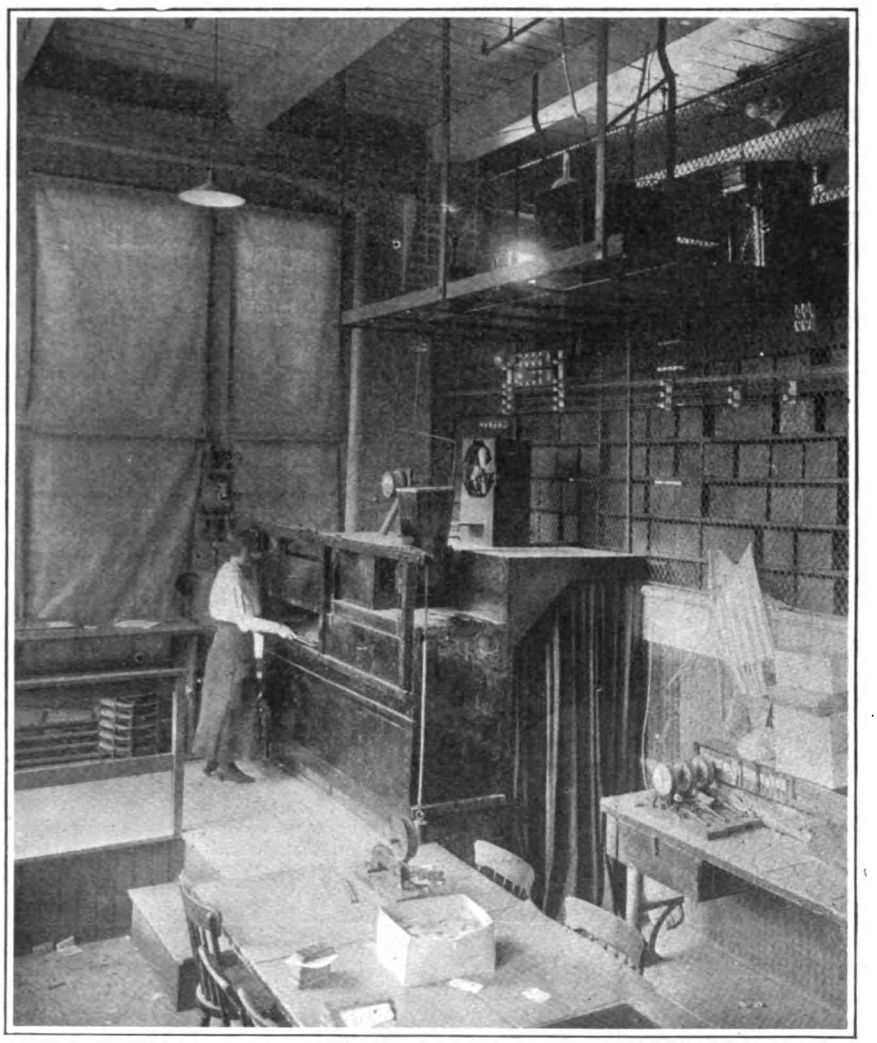
Since objects like these, as well as unevenness in the density of the structure are invisible from the outside of the sheet, the X-ray method of testing is about the only one that will reveal these faults with any degree of certainty. The installation itself has features that are well worth description.

The testing is done in a light-proof cabinet, which is equipped with protection in the form of lead sheeting so that neither the observer or any one outside can be burned by the rays. The section where the observer sits is merely a cabinet, painted black throughout and having a light-proof curtain over the door. Directly in front of the observer's face is a lead glass window through which she can see the reflection of the mica under test.

On the front of the observing cabinet is another smaller cabinet, which is divided into two sections, laterally. The upper of these sections contain the X-ray tube, in a lead-covered case, with a fan at one end and an exit at the other, for ventilation. There is a hole in the bottom of this section, directly under the tube, which permits the rays to fall directly upon the mica under test. The lower section contains a track and truck with a fluorescent screen upon which the trays of mica are set, same being about two feet long and a foot wide, consisting of a light wooden frame stretched with white cloth.

This arrangement is necessary so that the observer can move the trays from her cabinet without moving from her seat. There is a lead shutter, which is connected to the end of the truck, and which closes when the tray is moved over, shutting off the rays from above, which would otherwise discolor the glass of the mirror. The mirror in question is set at a 45-degree angle, about a foot under the tray, and so placed that it reflects the image of the mica directly through the glass in front of the observer.

The mica to be tested is placed on the trays, which are put on their track through a lead-covered door in the front of the section beneath the tube, which closes by means of counterweights. The aperature between the tube and the trays is then opened and the observer has before her the X-ray reflection of the mica. This reflection has the general appearance of an X-ray photograph. The solid parts of the mica strips appear light gray, the spots of lesser density being of a lighter shade. The absence of comparatively few mils of mica will show up in the form of light spots, which increase in brightness in proportion to the decrease in the density of the mica object. Foreign objects, such as pins, bits of wire—no matter how fine



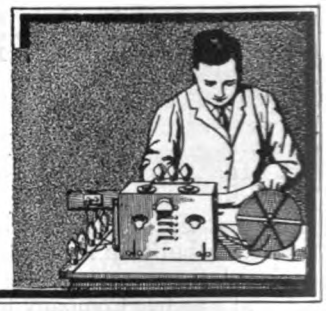
Complete apparatus for X-ray examination of side mica to locate flaws

(*Continued on page* 184)

Digitized by Google



RADIO TELEPHONE AND TELEGRAPH APPARATUS



Ideas for the Radio Laboratory

An Oscillating Audion Circuit, Use of a Milliammeter, Winding and Tapping Banked Coils, and Other Ideas for the Experimenter.

By M. B. Sleeper

A SMALL laboratory oscillion is a very useful as well as interesting instrument. It can be employed for undamped wave reception, as a transmitter for testing receiving sets, a wavemeter, and a short distance transmitter, when the industance coil is replaced by a loop antenna.

The instruments are illustrated in Figs. 1 and 2. The panels carry a milliammeter, rheostat, tube mounting, and variable condenser. There is a grid condenser on the tube panel, but this is short circuited. This is the simplest type of oscillator, and a very efficient one, too. Wave-length control is effected by means of the variable condenser, while the strength of the oscillations is regulated by the rheostat which controls the brilliancy of the filament.

The Oscillator Circuit

In this type of set, the inductance is connected in shunt with the condenser, and the condenser is put across the grid and plate of the audion. The B battery, milliammeter, and telephones are all put in the lead from the condenser to the plate. The filament is in series with two small storage cells and a rheostat. A lead is taken from the negative side of the filament to a tap at the center of the inductance. This completes the wiring.

The condenser, audion, and rheostat panels have been fully described in previous issues of Everyday. Fig. 3 shows the Weston milliammeter. A 0 to 1 milliampere type was selected because, in this type of oscillion, the plate current seldom exceeds 1 milliampere, and readings as low as 0.01 milliampere or 10 microamperes can be taken.

Mounting the meter is an easy matter. A hole can be turned out in the panel, or a series of small holes can be drilled in a circle, and the work completed with a file. Three small screws hold the instrument in place. One of the binding posts on the meter is marked +. This side goes to the plate of the audion; the + lead from the B battery is joined to the other post.

A ¼ inch panel was used to carry the meter, while the other panels were of ⅛ inch bakelite. When the panels were linked together, the discrepancy in thickness was made up by putting washers at the back of the thinner panel, under the links. Thus the fronts were made flush. Small angle brackets at each end supported the panels.

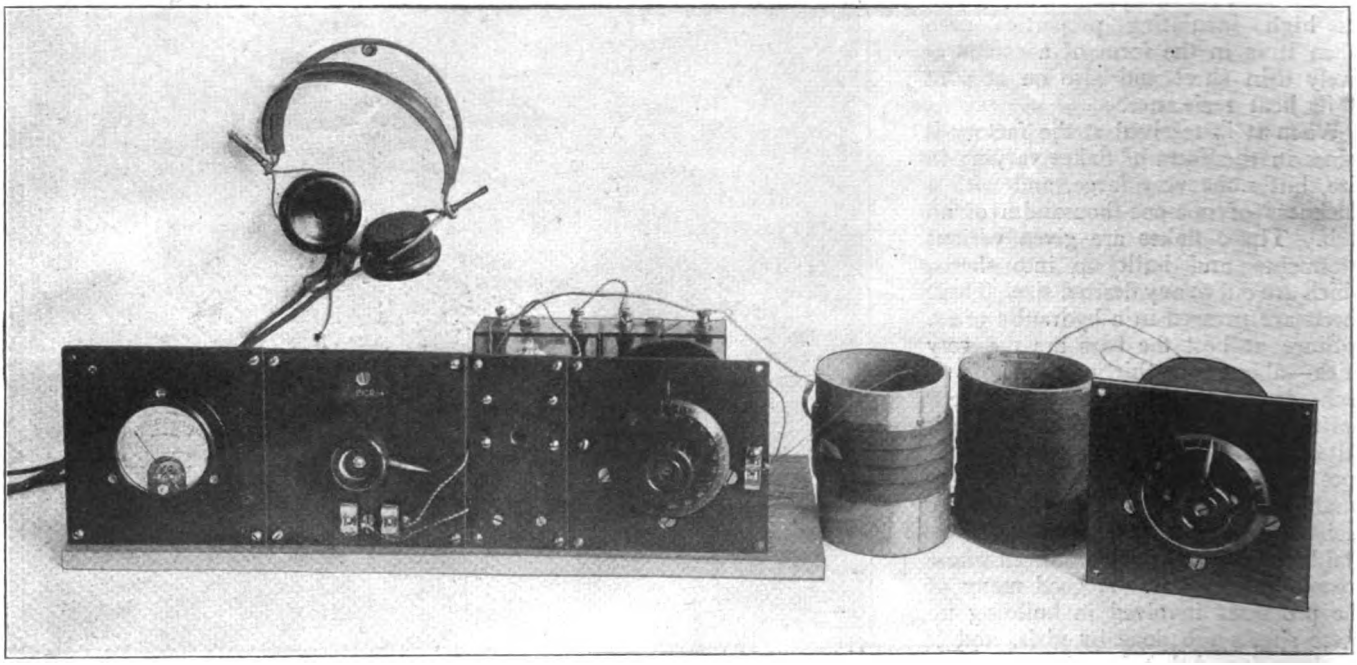


Fig. 1. A front view of the oscillator used as a wavemeter

Calibrating the Oscillator

Several coils of different sizes were made up, so that the oscillator could be used as a wavemeter. A wavemeter was set up with rather close coupling between meter inductance and the oscillator coil. The buzzer and detector circuit were not used with the wavemeter, the milliammeter and telephones in the oscillator plate circuit serving as the indicators. As the capacity of the oscillator condenser was increased, the plate current increased, and, when the point of resonance with the wavemeter was passed, the milliammeter dropped back slightly, then moved up again.

When, however, the oscillator condenser was left stationary, and the wavemeter varied near the resonance

Digitized by Google

point, the plate current increased up to a point at which it dropped back again. The telephones were used for a more accurate determination of resonance. The method was as follows:

For example, when the capacity of the wavemeter was increased, a click was heard in the telephones when the pointer passed 88°. Reducing the capacity of the wavemeter condenser, a click occurred at 80°. The coupling between the oscillator and wavemeter coils was reduced. Then, on the increase, a click occurred at 85°, and on the decrease, at 83°. This indicated that the resonance point was at 84°, half-way between the clicks. Reference to the wavemeter calibration curve gave the wavelength of the adjustment at 84° on the condenser scale, which was also the wavelength of the oscillator.

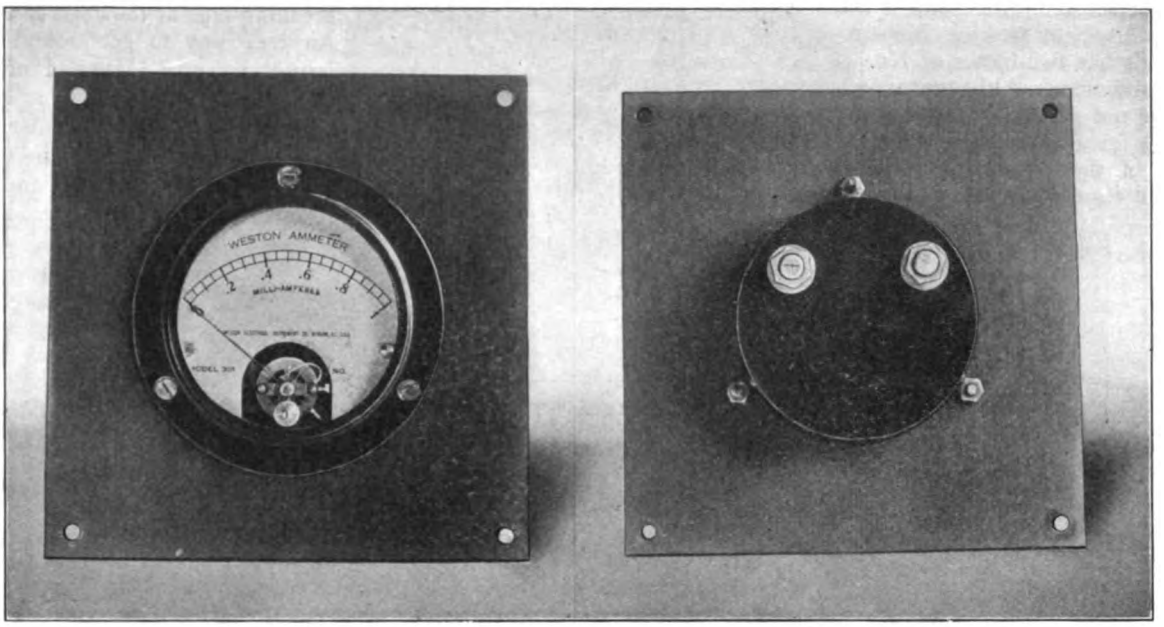


Fig. 3. A low-reading milliammeter is a very useful instrument for the radio laboratory

Calibration of a Receiving Set

To calibrate a receiver, it is generally sufficient to measure only the secondary, particularly when it is to be used on various antennas. The primary has, of course, the same wavelength as that of the secondary circuit, when they are tuned to an incoming signal.

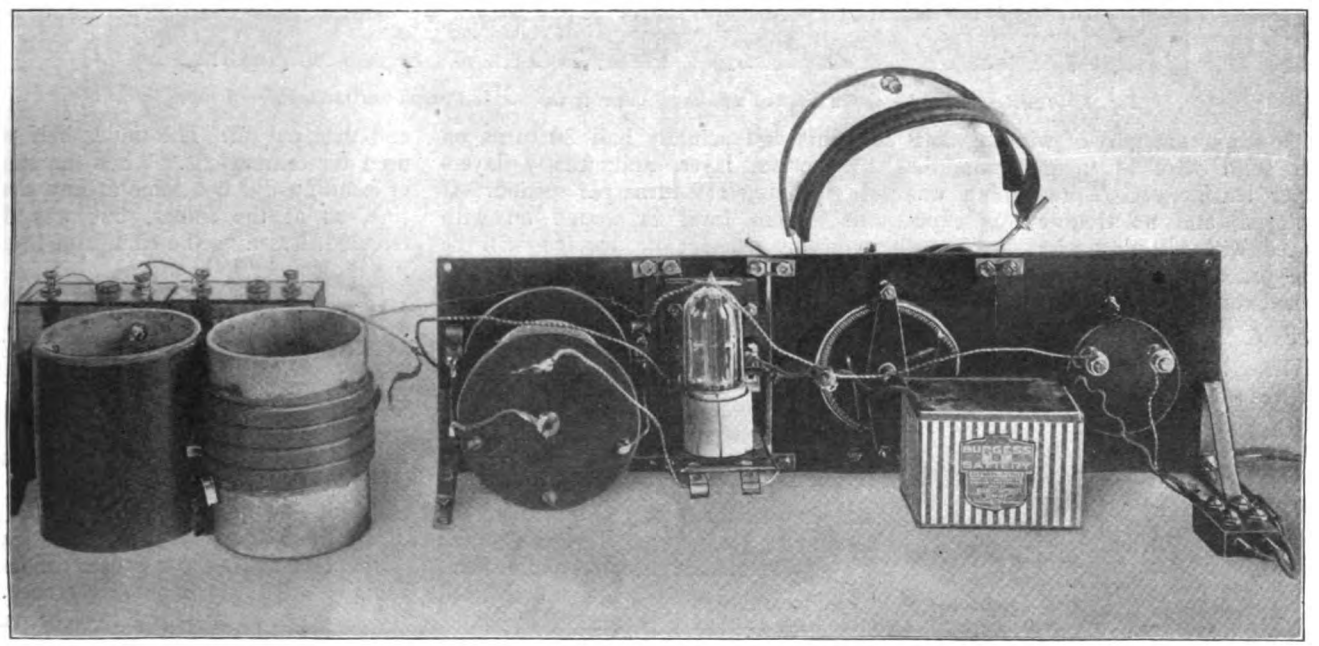


Fig. 2. A rear view of the set, showing how the panels are assembled to make an oscillating audion circuit

The primary should be moved away from the secondary coil, and the oscillator coupled to the latter. Then, by setting the oscillator for a given wavelength, the secondary circuit can be tuned to it, using the click method described above.

Undamped wave receivers can be tested by means of the oscillator. The receiver is set up at one end of the laboratory, and the oscillator at the other. Then leads are run from the antenna and ground posts to a small coupling coil placed beside the oscillator. A condenser of about 0.0003 mfd. is inserted in one of the leads, to replace the antenna capacity.

With the oscillator to supply the undamped waves, the characteristics of the receiver can be readily determined.

Undamped Wave Reception

The use of a separate oscillator for receiving undamped waves has been discussed in previous issues of Everyday Engineering. A set of this sort is well adapted to such work.

Digitized by Google

An ordinary damped wave receiver is employed, with a small coil of twenty turns connected in the ground lead. This is coupled to the oscillator. Beats are set up with the incoming oscillations, producing audible signals.

Continuous Banked Windings

Fig. 4, at the left, illustrates a coil which was used in making measurements. This has two banks of No. 24 S. S. C. solid wire. Although experimenters are not generally aware of the fact, this is excellent wire for banked windings, in that it is very easy to handle, and can be tapped readily.

Grouped Banked Windings

The problem of producing an efficient coil of high inductance in a small space is a difficult one for the man who makes his own apparatus. Probably the easiest method is that shown at the right of Fig. 4. The turns are wound on in the following manner:

46 47 48 49
45 44 43 42 41
35 36 37 38 39 40
34 33 32 31 30 29 28
20 21 22 23 24 25 26 27
19 18 17 16 15 14 13 12 11
1 2 3 4 5 6 7 8 9 10

This coil actually had 20 turns on the bottom layer, and was 7 layers deep, giving 119 turns per section. If the bottom layer is wound on with sufficient tension, no trouble will be experienced from slipping. To make doubly sure, after the first layer was wound, a thin film of beeswax was run around the tube at the starting end of the coil. A soldering iron was used to melt the wax.

No difficulty should be experienced in bringing the wire from the end of the top layer down to the tube to start the next section. Any slipping can be eliminated by bending the wire, at the top, to the side at a sharp angle, then, holding the bend with the thumb nail, bringing the wire down on the tube. A drop of beeswax should be put on each of these jumps after the coil has been completed.

Four of these sections, wound with No. 24 S. S. C. solid wire on a tube 3½ in. in diameter, gave an inductance of 22.35 millihenries, 8 sections, 40.4 mh., and 12 sections, 107.2 mh. These coils, measuring at the bottom, were 1.8 in., 3.6 in., and 5.4 in. long respectively.

It is not practical to attempt to tap this type of coil in the center of the section, but a tap can be taken off easily at the end, as in Fig. 4. Here a piece of paper was put under the wire, and a strip of copper foil soldered to the wire.

Some difficulty was experienced with breaking taps at the edge of the solder. An easy way to get around this was found, however. Instead of using a single copper foil strip, a long strip was bent double at the center, and this end of the foil put under the wire. The upper half was soldered to the wire, and then cut off. The under half was used for connections. Thus the strain of bending did not come at any sharp line, as at the solder, but was distributed, lessening the chance of breaking the copper foil strip.

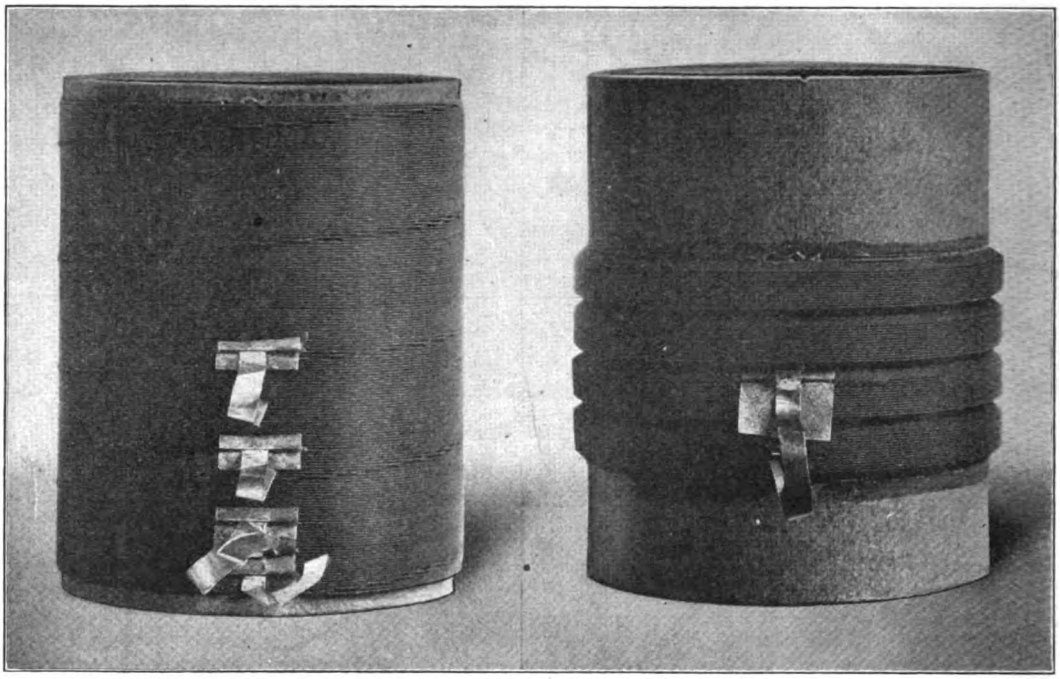


Fig. 4. Continuous and grouped banked windings, showing the method employed for taking off tops

The important part of winding coils with solid wire is to maintain the proper tension. G-A-lite tubing was employed, and no trouble was experienced with slipping wires. After a little practice, it is possible to wind banked coils of this heavy wire without stopping at the crossovers.

Where taps were made, the insulation was scraped away for ¼ in. Then a strip of paper ⅜ in. by 1 in. was put under the wire. After a piece of copper foil had been placed over the paper and under the bare section of the wire, the winding was continued one turn. Next, a second piece of paper was put on the coil, with one end over the tapping point. Subsequent turns were wound over the paper.

The result, as can be seen from the illustration, was the complete segregation of the tapped wire from the other turns. When the coil was completed, each tap was soldered, making a perfect joint. Copper foil 0.0002 to 0.005 in. thick is the best material for tapping, as it is so thin that it does not distort the winding.

THE RADIO REGISTRY

All kinds of opportunities are coming up in radio work, not only in the United States but in foreign countries as well. Men to fill these positions cannot be located readily, but they will be found through the Radio Register. Is your name among the others?

The following information, clearly written, is needed for proper registration.

Don't put it off—send in your name at once.

Name.
Address.
Engineer or Experimenter.
Age.
Experience.
Special qualifications.
Radio station owned, if any.

Address your letters to the Radio Department, Everyday Engineering.

Digitized by Google

A Two-Stage Amplifier

This Instrument, From the Wireless Improvement Company, Illustrates Some Features of Standard Navy Practice

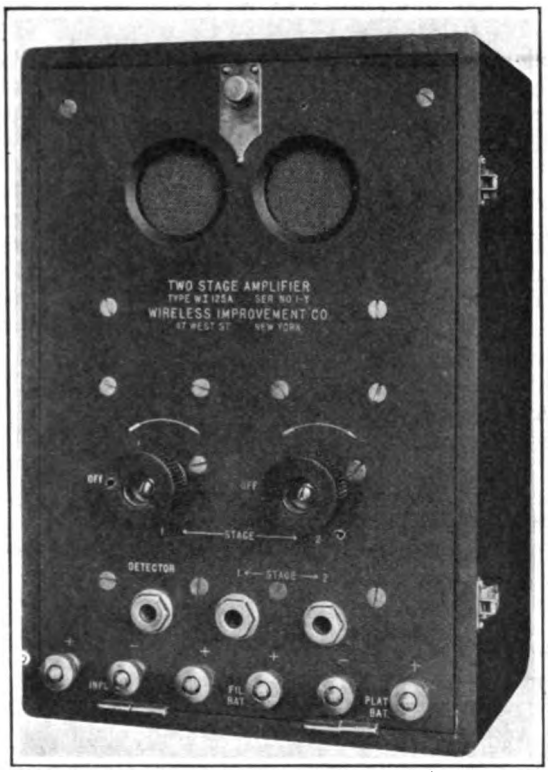
ALTHOUGH, from the point of view of the experimenter, construction following what has become known as standard Navy design is expensive, it gives to purchased or home-made equipment a dependability which inspires a consistent faith and pride in the instruments.

The amplifier illustrated here is carried in a case 9½ ins. high, 4½ ins. deep, and 6½ ins. wide. All the instruments are carried on the removable panel.

At the front are the tube observation windows, closed to dust by a fine mesh screen, filament rheostats, telephone jacks, and binding posts. Connections from the detector are run to the posts marked INPUT. When signals are of such strength that no amplification is required, the telephone plug is simply inserted at the jack marked DETECTOR.

For one or two stages, the filaments are lighted by turning up the rheostats, and the phone plug put in the one- or two-stage jacks.

The rear views, with the panel removed from the case, show the very compact arrangement of the apparatus.



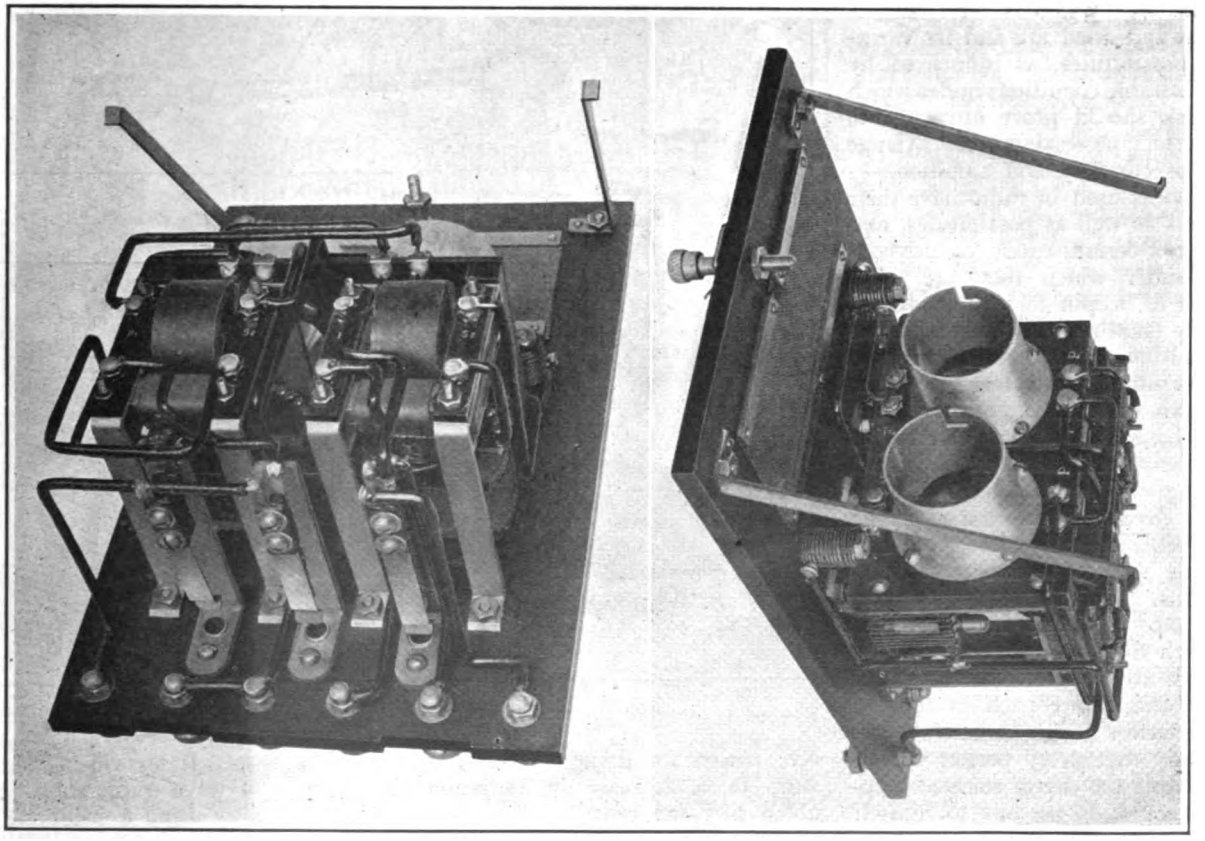
Four U-shaped brackets hold the transformers and tube sockets. This type of mounting has not been used extensively by experimenters, although it is readily adaptable to the compact design of all kinds of instruments. A bakelite plate on the upper legs of the brackets carry the sockets.

Between the upright parts are two Navy type rheostats, just visible in the side view. A dead point is left on each rheostat so that the corresponding tube circuit can be opened. This is accomplished by connecting the tubes in parallel, with a rheostat in series with each tube.

Small biasing resistances, to give negative grid potentials, are mounted just above the socket plate.

The phone jacks are clearly shown. The first is of the open circuit type. Therefore, as long as the plug is not inserted, the plate circuit of the detector goes directly to the grid or input circuit of the first stage. The second and third, however, are of the closed circuit type. The plate circuits are closed through the jacks, when the plug is removed, or the telephones placed in series with the plate when the jack is inserted.

(Continued on page 158)



A close examination of these illustrations will reveal a number of ideas which experimenters can incorporate in their own equipment

Digitized by Google

Quenched Gap Operation

An Explanation of the Construction and Use of the Amrad Gap for 200-meter Transmitters

By H. J. Tyzzer

THE writer was once questioned by a puzzled father as to why radio should hold such a fascination for his son as to occupy all his spare time.

The question was certainly a sticker for, while the writer could readily sympathize with the youthful enthusiast, being in a similar state himself, he had not, at that time, analyzed his own feelings sufficiently to give a satisfactory answer.

There is but one thing that will keep the human mind concentrated on a single subject and that is to have that subject constantly presenting new problems or novelties which demand thought and attention. Radio is far from being a cut-and-dried art and its variation of possibilities, as influenced by the innumerable conditions under which it is used, should prove attractive to any person possessing an average amount of curiosity and ambition.

All devices used in radio have their limitations as well as possibilities, and depend to a certain extent on the conditions under which they are used. Each one to be put to best advantage must be studied, its requirements noted, and favored as much as possible. To show the importance of this, imagine an enterprising amateur who has purchased an audion detector to replace the crystal formerly employed. Not being well acquainted with the operating characteristics of the vacuum tube, possibly he fails to supply sufficient plate voltage to obtain satisfactory results. Were it not for the fact that perhaps a friend has a similar tube which does remarkable work, he would, in all probability, regret his purchase and revert back to the old crystal detector. Such instances prove conclusively that every person who is contemplating the use of some new apparatus should, to be fair to himself and to the new device, extend every effort to obtain facts concerning it.

In these days of QRM, anything which tends to lead to selectivity of reception or transmission is certainly welcome to the average amateur. Receivers of the loose coupled and regenerative types have assisted considerably in solving this problem but when several stations within a few miles' radius persist in using transmitters having a decrement of ——— (no decrometer manufactured reads high enough to obtain this value), these are of little avail. In vain we attempt to persuade them to loosen up the coupling of their transmitters but it is more or less difficult to give a comprehensive reason for doing so when it results in a decrease in radiation of about fifty per cent.

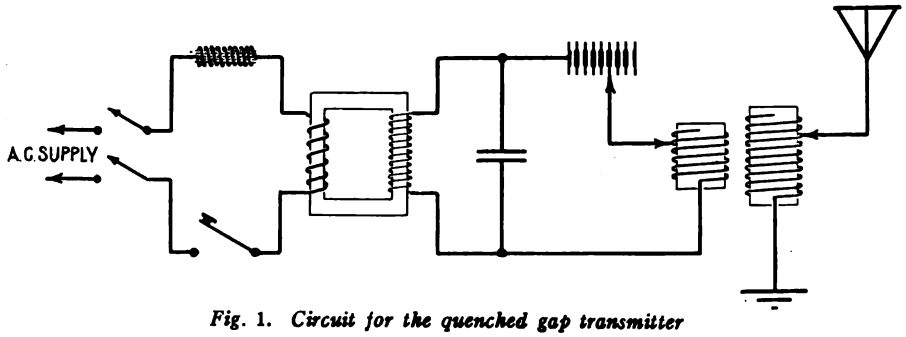


Fig. 1. Circuit for the quenched gap transmitter

For some time rotary gap transmitters have proved most effective for amateur use but that does not necessarily mean that they could not be replaced by something better. For instance, there are comparatively few rotary gap installations in commercial service at the present time, because Radio Inspectors have enforced the government regulation limiting the decrement to 0.2. This low value can only be obtained in case of a rotary or plain gap by employing exceedingly loose coupling which results in low radiation and efficiency. There is no question as to the merits of employing a low decrement as it results in greater selectivity together with longer distance transmission with a given power.

The association of 500 cycles with the quenched gap has led many people to believe that they are inseparable and hence the employment of a lower frequency has led to considerable skepticism on their part. However, 500-cycle transmitters were only adopted because their signals might be easily read and not because they were specially adapted to the quenched gap.

In such a transmitter there are 1,000-wave trains emitted from the antenna per second corresponding to a 1,000-spark note. It is evident that if the number of wave trains were decreased to 500 as by using a 250-cycle supply the energy per wave train will be doubled and, as the audibility at the re-

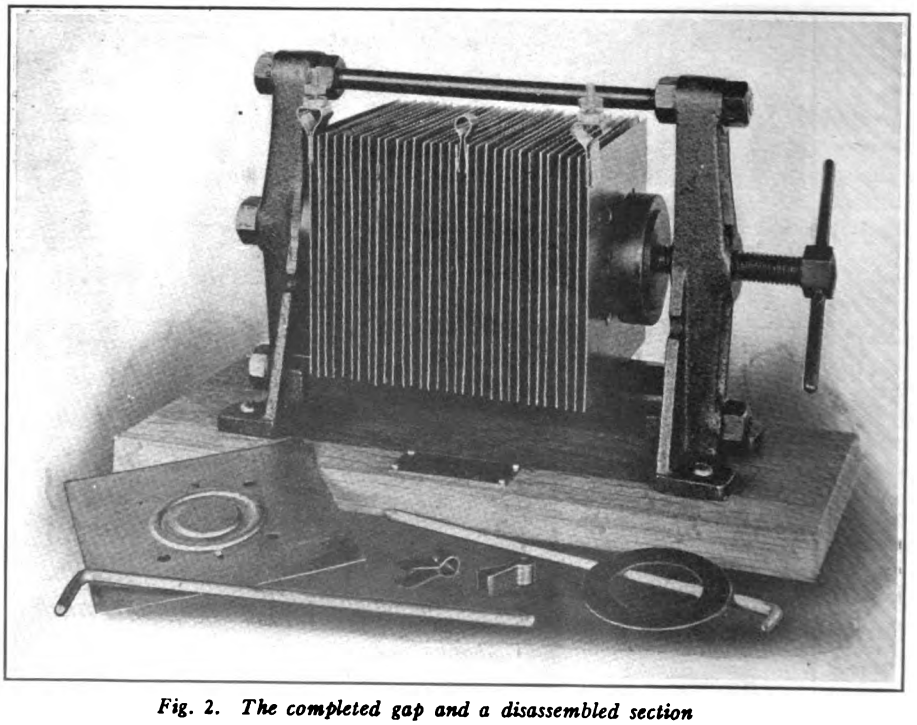


Fig. 2. The completed gap and a disassembled section

Digitized by Google

ceiver is dependent upon the amplitude of the wave train, the signals will be greatly increased. This shows the advantages of employing a 60-cycle rather than 500-cycle supply for long distance transmission, although in some cases this may be partially compensated by the fact that the receiving telephone diaphragms might operate more efficiently at the higher frequency.

There are certain requirements which must be met in successful operation of quenched gap transmitters, and it is desired to explain these in detail in order that the Amrad Quenched Gap, shown in the accompanying photographs, will meet with the success which it deserves.

Commercial transmitters make use of the phenomena of resonance to obtain satisfactory and efficient quenched gap operation.

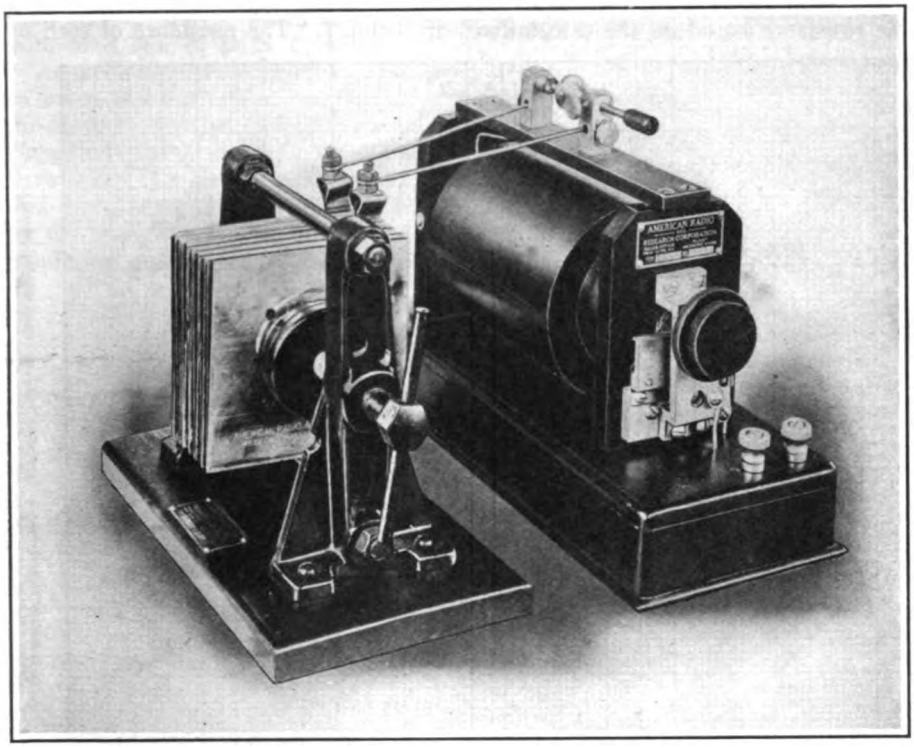


Fig. 3. A quenched spark gap for use with an induction coil

Reference to Figure 1 will demonstrate clearly what is meant by this term. In alternating current circuits the current may lead the voltage or lag behind it, depending upon whether the capacity or inductive reactance predominates. It is desirable from the standpoint of best efficiency to have these values equal. If the step-up transformer shown in Fig. 1 is of the non-leakage type, a condenser shunted across the secondary leads will have the same effect upon the supply line as a much larger capacity, depending upon the primary and secondary turn ratio, replacing the transformer.

It may readily be seen then that by inserting a variable inductive reactance in series with the primary of the transformer a condition of resonance may be secured. This not only results in greater efficiency but reduces the possibility of an arc when the gap is broken down by acting as a high impedance choke, thus decreasing the secondary voltage. The power in watts consumed in such an equipment, neglecting transformer losses, is equal to CV^2N where C is the capacity employed, V the maximum or peak value of the secondary voltage and N the frequency of the A. C. supply. This is figured on the basis of one spark per alternation or two sparks per cycle, such as is ordinarily made use of in quenched spark transmitters. From this the amateur may readily figure the average value of the transformer secondary voltage necessary, which is

$$\sqrt{\frac{\frac{W}{CN}}{1.41}}$$

The result will probably be much higher than the voltage rating of some of the radio transformers now on the market, many of which were constructed for rotary gap use where the number of sparks is much greater than two per cycle. With such low voltage transformers the power consumed will be small when properly resonated and the primary inductance necessary for resonance must be much greater. In the event of insufficient primary inductance being present, there will be a tendency to crowd in several sparks per alternation, which results in an exceedingly mushy and uneven note, although the power consumed may be increased. This shows conclusively the necessity for the highest voltage transformers manufactured for radio purposes and now on the market.

The major difficulty encountered by amateurs employing the Amrad quenched gap has been in obtaining resonance, due to the variety of transformers used. Because of the complications from the use of a primary inductive reactance, the manufacturers of this gap have recommended the use of a variable resistance as an alternative. Although this latter method is not as efficient as employing an inductive reactance, due to heat loss, it gives the necessary falling characteristic to the transformer and if a sufficient amount is used it prevents arcing. As in the case of the reactance the less the transformer voltage the more resistance is necessary and the lower the efficiency.

Amateurs familiar with alternating current circuits and having the necessary equipment may be able to operate their transformers successfully at resonance but unless this is true the use of a primary resistance is recommended, the value of which may best be determined experimentally as it varies with the type and voltage of the transformer employed.

The radio circuits are much the same with the quenched as with the rotary and plain gaps with the exception of the coupling which is sharply defined. An ammeter in the antenna circuit is quite sufficient for indicating when the primary and secondary circuits are in resonance, but if the effectiveness of the quenched gap is to be compared with some other it is urged that a sensitive meter, placed in a tuned circuit and coupled to the antenna, be used. This latter method is the true way of determining the effectiveness of the transmitter as it discriminates between a high and low decrement.

The quenched gap is particularly well adapted for use with induction coils which supply a peaked secondary voltage wave, thus eliminating the possibilities of arcing. The use, or rather misuse, of induction coils for transmitters, with the high decrement which has caused them to be such a source of Q R M, has caused much prejudice against their use. However, when used with an oscillation transformer and properly tuned, remarkable results may be obtained from them. For the amateur who has no A. C. supply and must use batteries, they offer the only solution to the transmitting problem.

The induction coil illustrated in Fig. 3 in similar to those supplied to the United States Army Signal Corps for trench warfare. These proved very effective for use on the European battlefields and often formed the only means of communication between advancing troops and headquarters.

It has been the custom of amateurs and manufacturers to rate induction

(*Continued on page* 158)

Digitized by Google

The Measurement of High Frequency Resistance

Part I. The Effects of High Frequency Resistance, and a Comparison of Different Types of Windings.

By L. M. Clement

THE resistance of the coils and condensers which make up the radio frequency circuits of transmitting and receiving radio apparatus plays an important part in the operation of the apparatus as a whole. The resonance curve of a circuit was taken, Fig. 1, with various values of series resistance in order to show what effect this resistance has on the operation of the circuit. The tuning of the circuit is made less sharp by the addition of resistance and the circulating current is reduced for the same total amount of energy in the circuit. In radio apparatus, therefore, where it is desired to obtain sharp tuning, the resistance of the circuit should be kept low. In radio transmitters it is essential that the resistance be kept low in order to keep the losses in the circuit to a minimum. If this is to be done we must know something about the resistance of the component parts of our radio frequency circuits.

It is the purpose of this article, therefore, to describe some means for obtaining the values of the radio frequency resistances of coils and condensers and particularly a method which almost every experiment can use.

Many attempts have been made to calculate the effective resistance of straight conductors at radio frequencies with a considerable degree of success. Unfortunately, however, when this wire is wound in the form of a coil, the resistance based on the calculation for a straight wire is useless so that it is necessary to go to some method of measurement.

The total resistance of a coil is the sum of a number of component resistances which result from the following causes:

1. D.C. resistance of the wire.
2. Skin effect at High Frequencies.
3. Eddy current losses in the conductors.
4. Eddy current losses in material in the magnetic field of the winding.
5. Loss due to the effect of distributed capacity of the coil. This is maximum at the natural period of the coil.
6. Losses in dielectrics in the electrostatic field of the coil.

In order to illustrate the effect of different types of coil construction on the resistance of the wire at radio frequencies seven coils were made up having the dimensions and constants shown in Table 1. The resistance of each of these coils for wave lengths between four hundred and two thousand meters was measured. The results of these measurements are plotted on curves which show the radio frequency resistance and the ratio of radio to direct current resistance for various wave lengths, Figs. 2 and 3.

It is evident that at the lower wave lengths the single layer or double banked wound coil using ten strands of No. 38 B.E.C. wire is the best. (Coils

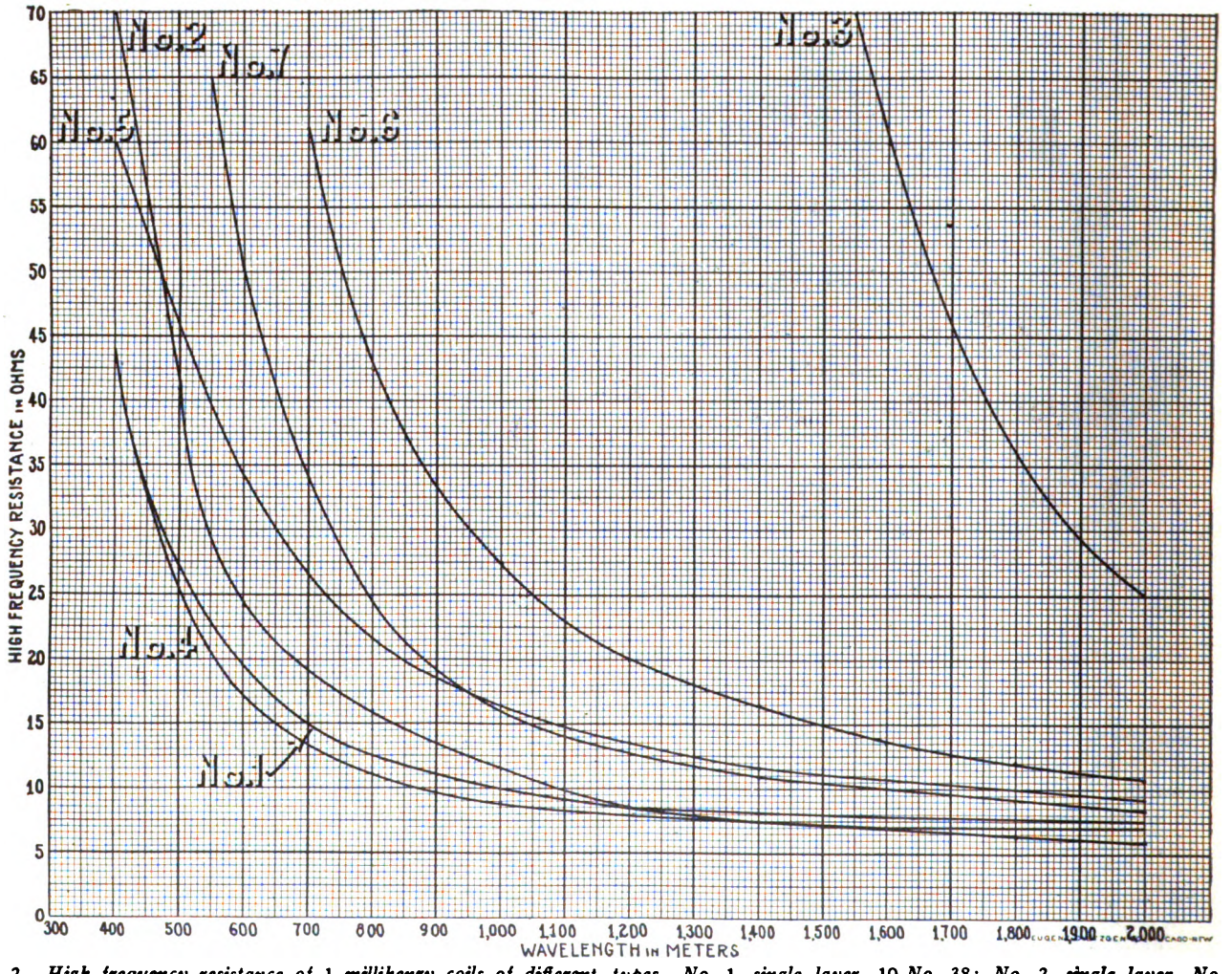


Fig. 2. High frequency resistance of 1 millihenry coils of different types. No. 1, single layer, 10-No. 38; No. 2, single layer, No. 26 D.S.C.; No. 3, double layer, 10-No. 38; No. 4, two-bank winding, 10-No. 38; No. 5, two-bank winding, No. 26 D.S.C.; No. 6, concentrated coil, 10-No. 38; No. 7, basket weave, 10-No. 38

Digitized by Google

No. 1 and No. 4). The two-layer coil, because of the high capacity between layers, has a higher natural period than any of the others measured and should never be used in radio frequency circuits. The effective resistance of this coil is by far the highest of the coils measured.

The increase of the high frequency resistance due to skin effect or the tendency of the radio frequency currents to travel in a thin layer on the surface of the conductor is illustrated strikingly by the results obtained on coils 1 and 4 and 2 and 5.

Coils 1 and 4 are wound with 10 strands of No. 38 B.E.C. wire and have a smaller cross section of copper, as shown by the higher D.C. resistance, than coils 2 and 5, which are wound with solid No. 26 D. S. C. wire.

At the longer wave lengths coil 2 is of lower resistance than coil 1, but at the shorter wave lengths, due to eddy currents in the conductor, coils 1 and 4 have much less resistance than coils 2 and 5. The eddy currents are reduced by the stranding of the conductor and insulating each of the strands from the

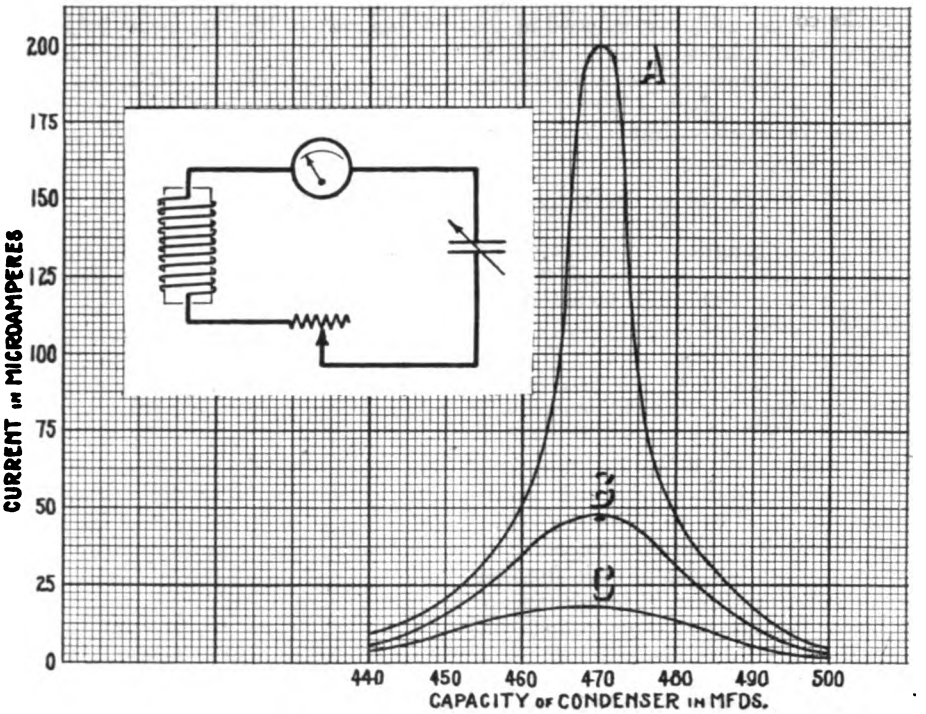


Fig. 1. At A, 4 ohms resistance are inserted; B, 8 ohms; C, 15 ohms

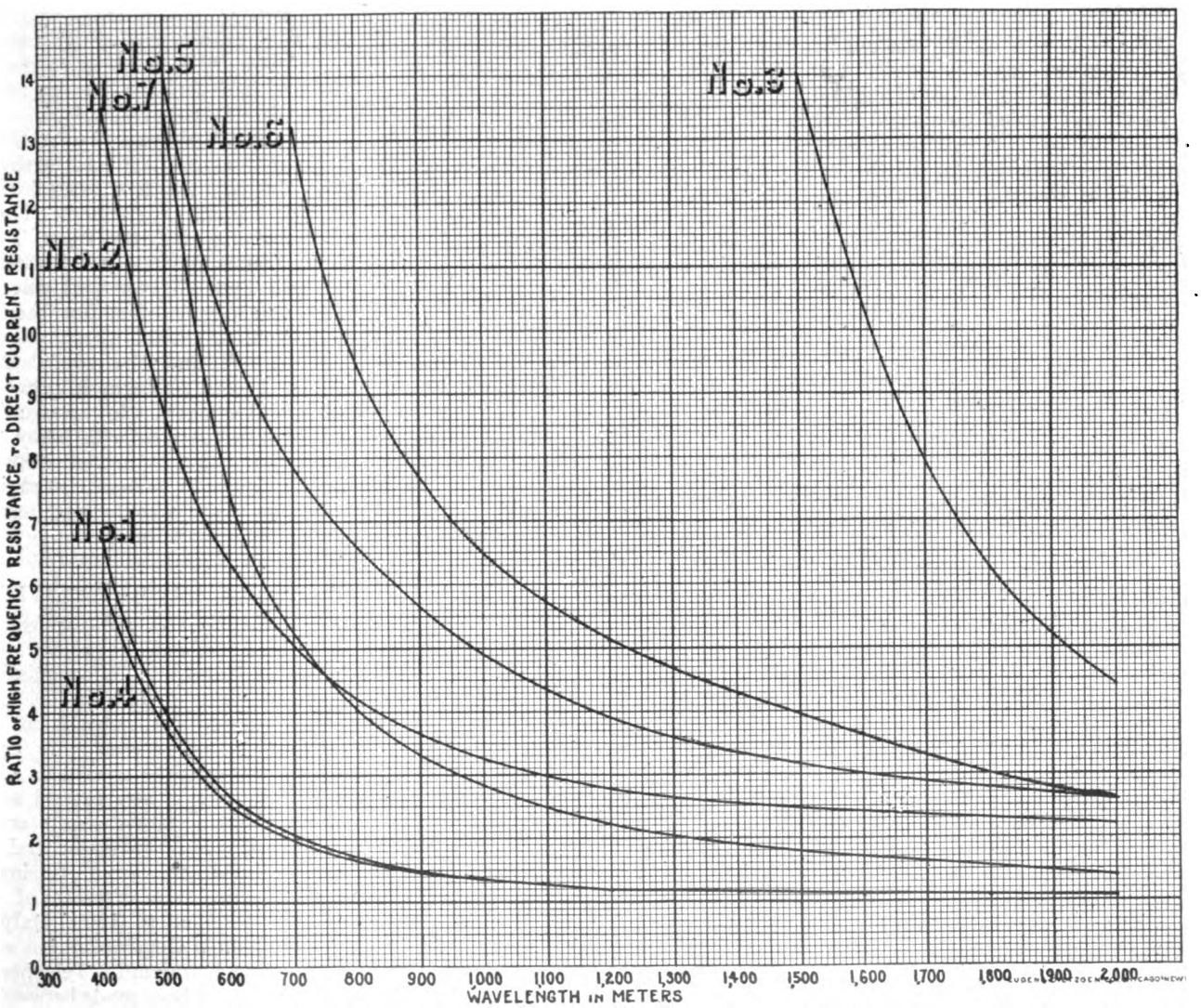


Fig. 3. These curves show how much greater is the resistance of a coil to high frequencies than to direct current. At frequencies greater than 2,000 meters, which corresponds to 150,000 cycles, the high frequency resistance drops still lower, approaching the direct current resistance. The results shown here and in Fig. 1 are convincing arguments in favor of stranded conductors

Digitized by Google

others. The 1 m.h. concentrated and pancake coils, while not as good as the single layer solenoids, can be used in special cases more or less satisfactorily at wave lengths above 1200 meters.

The conclusions drawn from these results should not be applied to coils of other electrical or geometrical dimensions, as in all probability they would not hold. It is therefore necessary to investigate each series of coils from actual measurements and tests made on them under the actual operating conditions. In general that coil is the best whose ratio of high frequency resistance to D.C. resistance approaches nearest to unity. See coils 1 and 4, Fig. 5.

The continuation of this article will take up some of the available methods for measuring the resistance of coils and condensers at radio frequencies, and in particular a method by which the amateur can make measurements with apparatus generally found in an amateur laboratory.

(To be concluded)

TABLE 1

TABLE GIVING THE DIMENSIONS OF THE COILS USED IN THE TESTS

Type and Number of Coil	Wire Used	Length of Winding	Depth of Winding	Mean Dia.	Total No. of Turns	Direct Current Resistance
1. Single Layer Coil	10 Strands No. 38..	2¼		3⅝"	106	7.23
2. Single Layer Coil	No. 26 D. S. C.....	2¼		3⅝"	106	4.20
3. Double Layer Coil	10 Strands No. 38..	⅞"		3⅝"	86	3.81
4. Double Banked Coil	10 Strands No. 38..	⅞"		3⅝"	86	6.53
5. Double Banked Coil	No. 26 D. S. C....	⅞"		3⅝"	86	3.42
6. Concentrated Winding	10 Strands No. 38..	.5	.3	.6	300	4.1
7. Basket Weave Coil	10 Strands No. 38..		.6	3.52	64	6.0

Determination of Distributed Capacity and Inductance of A Coil

ALL coils have a certain amount of distributed capacity which will resonate with the inductance of the coil at a wave length called the natural wave length of the coil. At all other wave lengths this capacity adds to the capacity of the condenser which is connected around the coil when resonance is obtained. L_u is the true inductance of the coil, C_u is the distributed capacity of the winding and C_v is the capacity of the shunt condenser to obtain resonance at the various wave lengths.

The wave length of the circuit at wave length λ is expressed by

$$\lambda = 59.6 \sqrt{L_u (C_u + C_v)} \quad (1)$$

At a wave length λ_1 the condenser reading will differ from C_v if L_u and C_u remain constant. Call this value of capacity C_{v1}

$$\lambda_1 = 59.6 \sqrt{L_u (C_u + C_{v1})} \quad (2)$$

From these two equations in two unknowns, L_u and C_u, we can obtain the solutions for the inductance and the distributed capacity of the coil as follows:

Dividing 1 by 2 eliminating L_u, we have

$$\frac{\lambda_1^2}{\lambda^2} = \frac{C_u + C_{v1}}{C_u + C_v} \quad (3)$$

Solving for C_u

$$\lambda^2 C_u + \lambda^2 C_{v1} = \lambda^2_1 C_u + \lambda^2_1 C_v$$

from which

$$\lambda^2 C_u - \lambda^2_1 C_u = \lambda^2_1 C_v - \lambda^2 C_{v1}$$

$$C_u = \frac{\lambda^2_1 C_v - \lambda^2 C_{v1}}{\lambda^2 - \lambda_1^2} \quad (4)$$

Substituting the value of C_u in either equation (1) or (2) and solving for L_u, we find

$$L_u = \frac{\lambda^2 - \lambda_1^2}{3552 (C_u + C_v)}$$

The following table indicates one of the many ways in which data of this sort can be tabulated and shows a typical example of a calculation of distributed capacity and inductance of a coil from two of the observations.

TABLE 2

TYPICAL SET OF DATA AND CALCULATION OF L_u AND C_u

Observation Number	Wave Length in Meters	Capacity Necessary for Resonance Mfds.	Resistance in Ohms
1	600	.00091	5
2	800	.000170	4.2
3	1000	.000271	4.1
4	1200	.000395	4.0

Distributed Capacity of Coil

Let $\lambda = 600$ $C_v = .000091$

$\lambda_1 = 1200$ $C_{v1} = .000395$

then $C_u =$

$$\frac{(1200^2 \times .000091) - (600^2 \times .000395)}{600^2 - 1{,}200^2}$$

$$= \frac{-.001114}{-1.08}$$

$= .0000103$ Mfd. distributed capacity.

From this it can be seen that the inductance of a coil cannot be measured accurately by the wavemeter method. Readings taken in this way are high, because no account is made of the capacity of the coil.

A TWO-STAGE AMPLIFIER

(Continued from page 153)

All the wiring is done with heavy solid copper wire, covered with Empire cloth tubing. The neatness of the soldered joints can be observed from the illustrations. Experimenters who have difficulty in making smooth and regular joints where wires are fastened around screws will find that, if they file or sandpaper both parts, and make the soldering iron very hot, this difficulty will be overcome. A soft, long-haired brush is excellent for removing filings or soldering paste which may collect in the corners of the parts.

QUENCHED GAP OPERATION

(Continued from page 155)

coils by the length of the secondary spark, not watts input, and under this category it may be classed as a two-inch coil. The frequency, approximately 100 cycles, while not high, is easily readable. A study of the engineering problems encountered in spark coil design will reveal the reason for this when it is realized that a high frequency two-inch coil necessitates a low inductance primary. Such a primary would consist of but few turns, which means so high an input current as to make its use prohibitive to the average amateur employing a battery supply.

An exceedingly rugged vibrator with large and ample contacts is supplied with the coil which ensures long life and permanent satisfaction. The coil is manufactured in two types, Type C being wound for a six volt battery supply and Type C-1 for a 32 volt D. C. source such as is often furnished with farm lighting outfits.

This coil and the quenched gap shown in the photograph provide an admirable equipment for amateurs. Its range is comparable with many transformer transmitters and it is particularly adapted to motor car, camp, and other use where a course of alternating current is not available.

FOREIGN RADIO ACTIVITIES

COMMERCIAL radio systems have been expanding rapidly in the European countries. A commission of Danish experts is now in the United States, making arrangements for direct communication between this country and a station to be erected at Copenhagen. Traffic is now carried on with the Norwegian station near Stavanger.

Successful radio telephone trials have been carried out from Chelmsford, England, up to a distance of 1,000 miles at sea, and to Rome, Italy.

The German Government has erected a station at Dortmund. Telephone experiments have been made between Berlin and Karlsborg, Sweden, and between Berlin and Moscow, with the view of maintaining regular service.

Digitized by Google

High Inductance Variometers

A Method for Making Variometer Windings of Very Slight Clearance

THE variation of inductance in a variometer composed of two coupled coils in series is due to the change of the mutual inductance between them, according to the formula

$$L = L_1 + L_2 + 2M$$

or $$L = L_1 + L_2 - 2M$$

where L = total inductance,
L_1 – inductance of one coil,
L_2 = inductance of other coil,
and M = mutual inductance, all measured in the same units.

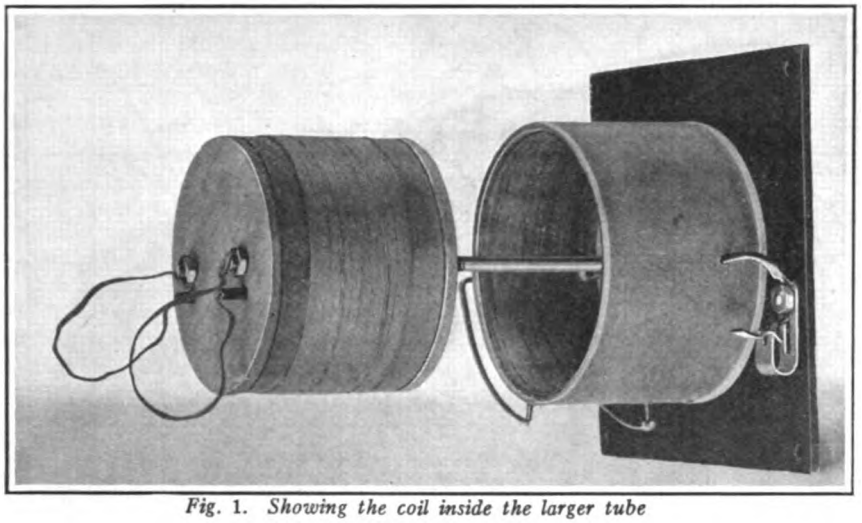


Fig. 1. Showing the coil inside the larger tube

To obtain the largest maximum value of M, the coils must be very close together. For this reason, the ball type of variometer is widely used, since at maximum, the coils can be made quite near each other.

This method of constructing a varometer, has limitations, however, in that only a small amount of inductance can be used in each coil, unless the windings are made of very large diameter. The type shown in Figs. 1 and 2 is adaptable for coils of high inductance, and the windings can be made as close as with the ball method. Moreover, the design is simple and inexpensive.

The only disadvantage is that the coils cannot be changed from opposing to aiding as is the case with the ball type. A switch is needed for the variometer described here, to reverse the connections of one coil to give positive or negative values of 2M.

An outstanding feature of this instrument is that one coil is wound on a cardboard tube, while the other is on the inside of a tube. For this particular instrument, two-bank windings of No. 26 S. S. C. wire were employed.

It was was easy enough to wind the smaller coil and to fit wooden end pieces on the tubing. The larger coil was the real problem. Here is the method:

A 3-in. tube was used for the smaller coil. To wind the other, a piece of 3-in. tubing was cut to a length slightly greater than that of the proposed coil. First, the tubing was slitted down its length with a sharp knife. Then a piece of cardboard 1/16 inch thick was wrapped once around the tube. This was covered by one wrapping of thin paper. Several turns of threads were put around the paper to keep it in place.

All this accomplished, the coil was wound on. The cardboard acted as a spacer to make the inside of this coil slightly larger than the outside of the other.

When the coil was done, a pot of beeswax was heated to the boiling point, and, with a paint brush, a very thin coating of wax was brushed over the coil. After cooling, the inside slitted tube was carefully removed, then the cardboard, and, finally, the thin paper was drawn out, leaving a self-supporting winding held together with wax.

This was by no means the end of the work. Attempts to push the coil inside another tube failed, for the wires were loosened. Ultimately a tube 3½ ins. in diameter was slotted and enough cut off, lengthwise, so that, when the tube was pressed around the coil, the tubing closed exactly.

To keep the tubing together, a wooden disc was turned up to fit inside the tube, and the tube was nailed to the disc with small brass escutcheon pins. As a finishing touch the completed coil was held in the heat of a gas burner just long enough to warm the beeswax, but not melt it, causing the wax to adhere to the tubing.

Figs. 1 and 2 show the variometer mounted on a 5x5 in. bakelite panel, ready for use. It can be seen that the movable coil slides on two brass rods, held to the panel by nuts. A third rod, carrying a handle, serves to move the smaller coil in and out.

This method of mounting is also good for any sort of coupling coils, tho, in the case of primary-secondary or secondary-tickler coupling, it is not necessary to have such a small clearance between the windings. A particular advantage is that this method of mounting takes up very little panel space for the large inductance obtained.

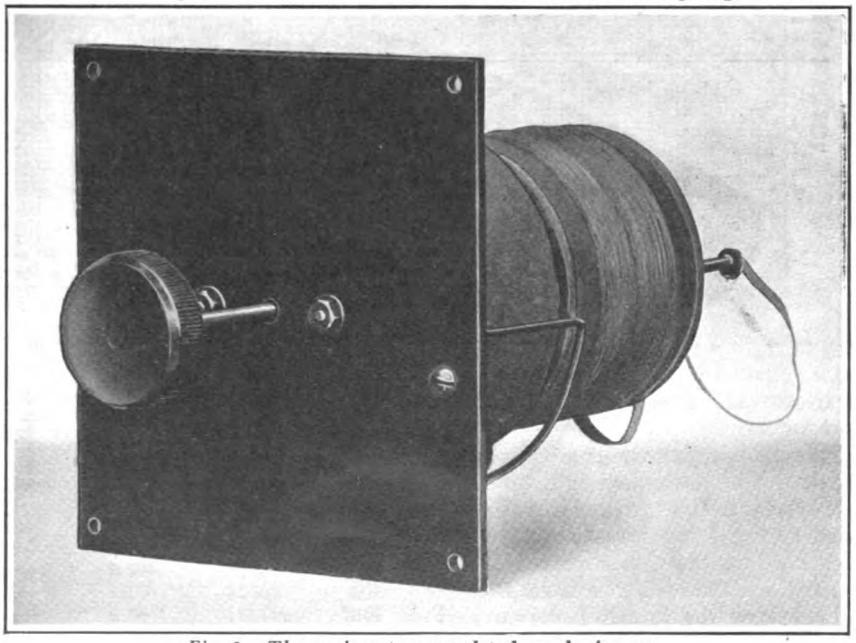


Fig. 2. The variometer completed, ready for use

Digitized by Google

Radio Tuning Circuits

The Radio Man Thinks in Terms of Wavelengh; the Electrical Man, in Reactance. This Article Discusses Radio Circuits From the Latter Aspect

NEARLY all radio experimenters take up wireless work because it is interesting and gives them something to do. And most of them stop with wireless, thinking that the electrical considerations are too dry and uninteresting.

Since electrical engineering forms the basis of all radio work, the experimenter must have some knowledge of the former to be proffi cient in the latter. Moreover, an understanding of the electrical side makes radio problems more interesting.

This is particularly true of tuning circuits. The radio man says, "Resonance is obtained when two circuits are tuned to the same wavelength." The electrical man says, "Resonance is obtained when the reactance is zero."

Thereupon the former looks puzzled and asks, "what do you mean by reactance?"

Let us start at the beginning. In all radio tuning circuits, only alternating currents and voltages are considered. Fig. 1 shows an alternating current, I, and a voltage, E, changing at the rate of one complete cycle per second. The current and voltage are said to be in phase, because they reach the zero and maximum points simultaneously.

A cycle can be divided into so many parts of a second, or, as is more usual, 360 degrees, as is a circle.

The values of the current and voltage, during the complete cycle, are given by the table below:

Degrees	Seconds	Current	Voltage
0	0	0.0	0.0
30	2/24	+1.0	+2.0
60	4/24	+1.7	+3.5
90	6/24	+2.0	+4.0
120	8/24	+1.7	+3.5
150	10/24	+1.0	+2.0
180	12/24	0.0	0.0
210	14/24	—1.0	—2.0
240	16/24	—1.7	—3.5
270	18/24	—2.0	—4.0
300	20/24	—1.7	—3.5
330	22/24	—1.0	—2.0
360	24/24	0.0	0.0

The power in Watts is given by

$$W = E\,I \qquad (1)$$

where E = potential in volts,
W = power in watts,
and I = current in amperes,

whether direct or alternating current is employed. Since the alternating current is varying continuously, the watts at any instant are as shown below. It should be noted that, in multiplying the amperage by the voltage, the product of two negative quantities is a positive quantity.

Degrees	E		I		W
0.....	0.0	x	0.0	=	0.0
30.....	+2.0	x	+1.0	=	+2.0
60.....	+3.5	x	+1.7	=	+5.9
90.....	+4.0	x	+2.0	=	+8.0
120.....	+3.5	x	+1.7	=	+5.9
150.....	+2.0	x	+1.0	=	+2.0
180.....	0.0	x	0.0	=	0.0
210.....	—2.0	x	—1.0	=	+2.0
240.....	—3.5	x	—1.7	=	+5.9
270.....	—4.0	x	—2.0	=	+8.0
300.....	—3.5	x	—1.7	=	+5.9
330.....	—2.0	x	—1.0	=	+2.0
360.....	0.0	x	0.0	=	0.0

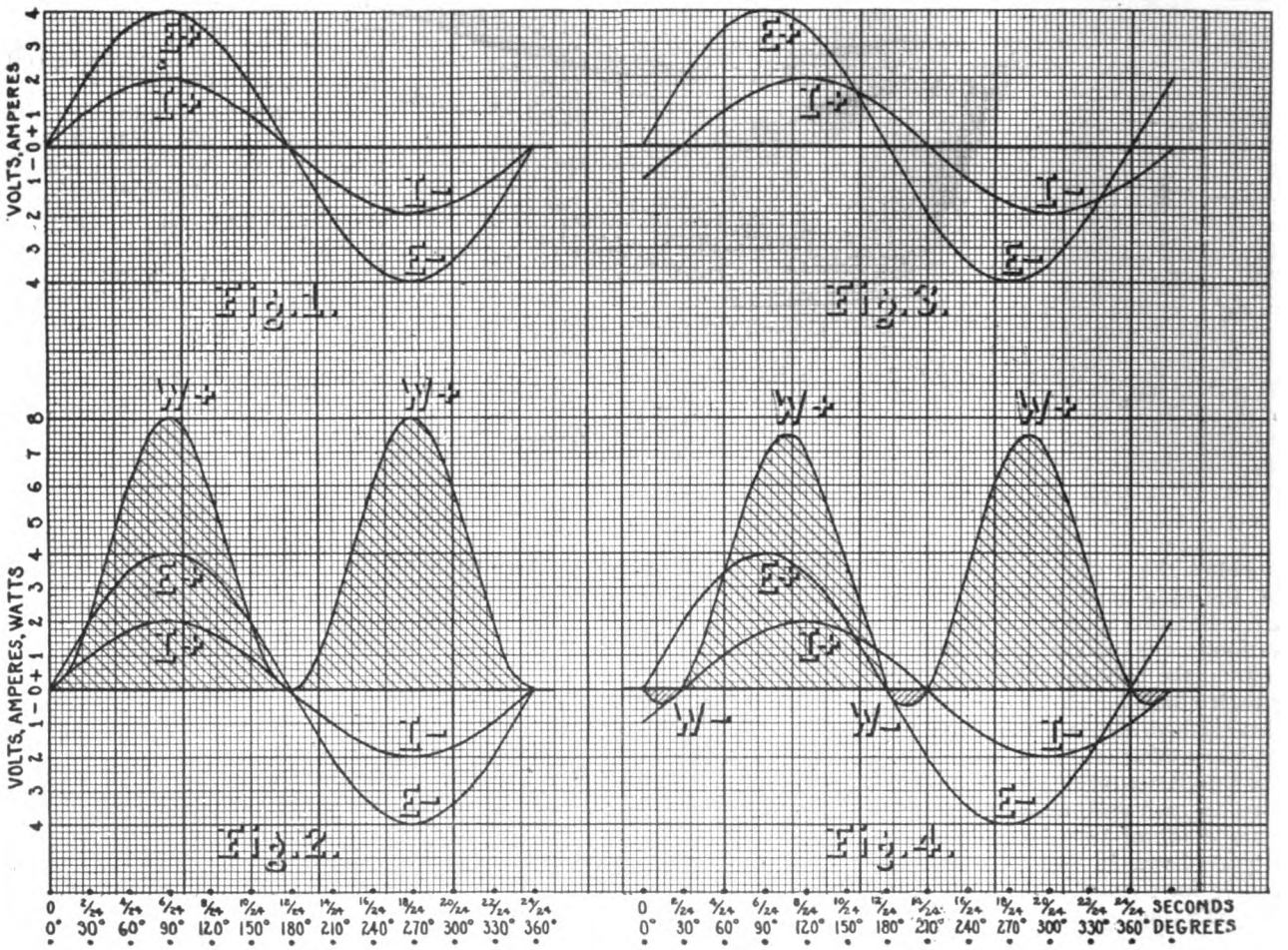
The effective value of the current and voltage, that is, the value indicated by an ammeter or volt meter, is

$$E_{eff.} = 0.707E \qquad (2)$$

where $E_{eff.}$ = effective voltage
and E = maximum value

or $$I_{eff.} = 0.707I \qquad (3)$$

where $I_{eff.}$ = effective current
and I = maximum value



Illustrating the loss of power when the current and voltage are not in phase, due to the unbalancing of inductive and capacity reactance

Digitized by Google

Therefore, the effective voltage in Fig. 1 is
$E_{eff.} = 0.707 \times 4 = 2.8$ volts effective, and the effective current is
$I_{eff.} = 0.707 \times 2 = 1.4$ amp. effective. The effective power, in watts, is

$$W_{eff.} = E_{eff.} \times I_{eff.} \quad (4)$$

or $W_{eff.} = 2.8 \times 1.4 = 3.9$ watts effective.

It may appear as if the foregoing has nothing to do with radio tuning circuits, but what is to follow is based on Figs. 1 and 2.

Fig. 3 presents a new problem. It will be seen that the current and voltage are not in phase, that is, at some instants, one is positive when the other is negative. This is one of the effects which we know occurs, even though we have not actually seen the electricity itself do that way.

If an alternating current, taken, perhaps, from a vacuum tube oscillator, is put through a carbon resistance rod it will obey Ohm's Law, which is

$$E_{eff.} = I_{eff.} \times R \quad (5)$$

where R = resistance in ohms.

In a radio circuit, however, there are, in addition to the resistance of the wires, inductance and capacity. These also act as resistances. Resistance due to inductance or capacity is spoken of as reactance. Resistance or reactance indicate an absorption of power, for work must be done in overcoming them.

Losses in pure resistance are dissipated in heat. Reactance losses are indicated in Figs. 3 and 4. When the current I is zero, the voltage E has passed through 30° of its cycle. In other words, the voltage is leading the current.

When the reactance due to capacity is greater than the inductive reactance, the voltage leads the current, or when the inductive reactance is greater, the current leads the voltage.

Let us make another table to determine the power when the current and voltage are not in phase, as in Fig. 3.

Degrees	E		I		W
0.....	0.0	x	—1.0	=	0.0
30.....	+2.0	x	0.0	=	0.0
60.....	+3.5	x	+1.0	=	+3.5
90.....	+4.0	x	+1.7	=	+6.8
120.....	+3.5	x	+2.0	=	+7.0
150.....	+2.0	x	+1.7	=	+3.4
180.....	0.0	x	+1.0	=	0.0
210.....	—2.0	x	0.0	=	0.0
240.....	—3.5	x	—1.0	=	+3.5
270.....	—4.0	x	—1.7	=	+6.8
300.....	—3.5	x	—2.0	=	+7.0
330.....	—2.0	x	—1.7	=	+3.4
360.....	0.0	x	—1.0	=	0.0

This table is plotted in Fig. 4, the shaded portion of which represents the watts. The area of the W+ sections are smaller than in Fig. 2, where the current and voltage are in phase. There is a small area, W—, in Fig. 4 which accounts for the lost power. This occurs when the current and voltage have opposite signs, for a positive quantity multiplied by a negative gives a negative quantity.

As the difference in phase is made greater, the power loss increase until the current and voltage are 180° apart. Then the watts at any instant have a negative value. This is called a wattless current, for, while a voltmeter and ammeter would show the passage of electricity, the current would perform no work.

The reactance due to inductance in a circuit is

$$X_l = 2\pi fL \quad (5)$$

where

X_l = inductive reactance, in ohms,
$\pi = 3.1416$,
f = frequency, in cycles,
and L = inductance in henries.
1 cm. = 0.000000001 henry.
1 mh. = 0.000001 henry.

Capacity reactance is given by the formula.

$$X_c = \frac{1}{2\pi fC} \quad (6)$$

where

X_c = capacity reactance, in ohms,
and C = capacity in farads,
1 mfd. = 0.000001 farad.

The formular for impedance, which includes the pure resistance and the reactance is

$$Z = \sqrt{R^2 + (X_l - X_c)^2} \quad (7)$$

where Z = impedance in ohms.

If the capacity reactance is greater than the inductive reactance, the latter is subtracted from the former.

Thus it will be seen that if the reactance is made zero by balancing X_l and X_c, then the only opposition to the flow of the alternating current is pure resistance, no power is lost in overcoming reactance, and the current and voltage are in phase.

This is shown by the formula

$$\text{Cos } \Phi = \frac{R}{Z} \quad (8)$$

where Φ = difference in phase of current and voltage, in degrees.

If there is no reactance in the circuit, from (7) it will be seen that Z = R. Then (8) will read

$$\text{Cos } \Phi = \frac{R}{R} = 1,$$

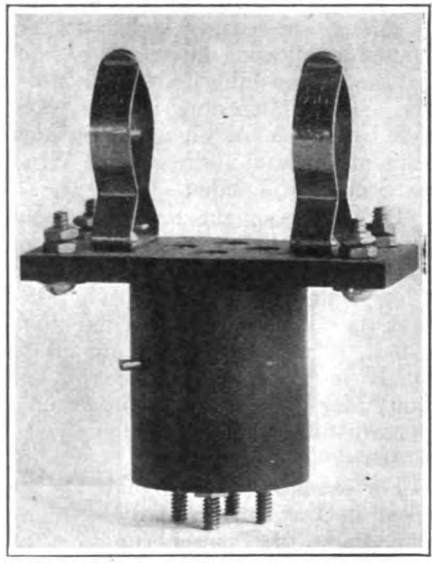
and, as shown by a cosine table, Cos 0° = 1. Therefore, there is no lag between the current and voltage.

(To be continued)

A TUBULAR AUDION ADAPTER

AN interesting socket adapter has been introduced by the International Electric Company. In contrast to other types, the arrangement is such that the axis of the tube is at right angles to that of the socket.

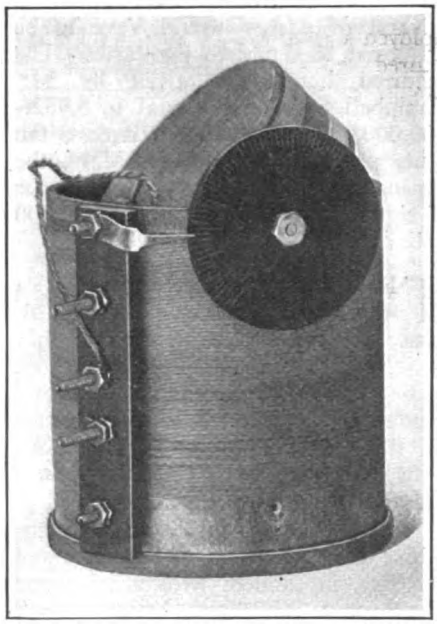
The fibre plate which carries the audion clips also has four binding posts to which connections are made from the tube. These posts are, in turn, joined to four pins which make contact with the springs in the socket. Thus a tubular bulb can be used with a regular VT socket.



Such an adapter is particularly good for apparatus where the tube protrudes from the panel, as is the case with International Radio and de Forest unit panel instruments.

OSCILLATOR COUPLING COIL

AN instrument such as is shown here is useful in oscillating circuits, as well as for other purposes. This coil was designed for coupling a test circuit, in series with the small coil, to an oscillator, of which the longer coil was the inductance.



The vertical bakelite strip has five binding posts, two of which are connected by flexible leads to the rotating coil. The others serve as connections to the ends and center tap of the large winding.

Digitized by Google

The Radio Department

IT may appear to be a reflection on the intelligence of radio men to bring up here the subject of Martian signals, the possibility of which has been brought to the attention of the public through newspaper statements attributed to Marconi, though he has denied the responsibility for them. However, some interesting points were made by Mr. A. A. Campbell Swinton in his presidential address to the Wireless Society of London.

"Perhaps is might be pointed out with advantage that the intensity of received signals varies inversely more or less as the square of the distance between the source and point of reception, so that, if we suppose the mysterious signals in question originate on the planet Mars, the power of the sending apparatus must be of prodigious dimensions.

"For example, if the signals are received in London as loudly as those from Paris, the power employed at Mars must be greater than that used at Paris, in the proportion of the square of 200, the rough distance of 49,000,000, the distance in miles to Mars.

"The power employed at Paris is about 200 horsepower, so that, unless the inhabitants of Mars have improved methods of directional sending greatly surpassing our own, the power used on Mars to give equal effects at London must be about 60,000,000,000 times greater than at Paris, or say 12,000,000,000,000 horsepower."

While the circumstances might be such that this power could be reduced greatly, it is obvious that an impossible amount of energy would have to be employed to signal to the earth. The required horsepower given by Mr. Campbell Swinton is equal to 8,952,000,000,000 kilowatts. If it costs ten cents per kilowatt-hour on Mars, the expense to the Martians for each hour of signaling would be 895,000,000,000 dollars.

THE vacuum tube situation, as was stated in the March, 1920, issue, is such a complex affair that is it almost impossible to pick out facts of importance to the experimenters. This is made doubly difficult by the legal definitions which have come to supplement and modify general technical understanding.

According to Judge Mayer, "An amplifier really consists of two or more detectors in tandem with a telephone transformer interposed between each element in series. The primary element of such an amplifier may be either an audion or any other form of a detector. ... In other words, an 'amplifier' is part of a detector."

In regard to the Oscillion, the following statement is from Judge Mayer:

"While the claim covers broadly the device (Fleming valves) when used in the radio art, yet when read with the context of the specification, it is plain that Fleming's disclosure was addressed to the use of the instrumentality as a detector only.

"It is, however, a principle of patent law—so well settled as not to call for citations of authority—that a patentee is entitled to all of the benefits of his invention whether or not known to or foreseen by him.

"The testimony of the experts and numerous demonstrations in the court room... proved beyond a peradventure that the two element valve possesses inherently the same capacity for generating radio waves as is possessed by defendant's (de Forest's) three-element device."

In a demonstration, "The valve was made to oscillate without a condenser although the action in this regard is not certain and reliable; but, this latter fact is immaterial."

It is not generally known that a Fleming valve has been made to oscillate. This was done with a special gas tube, but further information concerning the means employed is not known.

The statement in the March issue, concerning the purchase of vacuum tubes, may have been misleading. To make it more clear— "Tubes not licensed under the Fleming patents can be used only for other than radio work or non-communication purpose, and then only when licensed by the de Forest Company for the use of the grid."

RADIO men, whether concerned with the commercial or experimental aspect of radio work, will be greatly pleased at the announcement, made by Dr. Goldsmith at the May meeting of the Institute of Radio Engineers, that the Department of Commerce, in its decisions regarding radio regulation and legislation, will be guided by a committee of twenty-eight radio engineers, of whom twenty-seven are members of the Institute, while the twenty-eighth man is about to become a member.

This means that the future control of radio has been put, not in the hands of uniformed men or in the military, but in a representative body of engineers who are entirely familiar with the problems involved, and personally interested in their most useful solution.

It was notable that, in the discussions by this committee, almost unanimous agreement was reached on the various subjects discussed. The decision to put the radio problem in the hands of such a committee, and the promise of successful results, lifts from the art the gathering cloud of Government monopoly.

TWO papers by Dr. Austin, of the Bureau of Standards, were read at the May meeting. The first was on the quantitative predetermination of loop antenna transmission and reception. These were checked by actual measurements made at the Bureau on signals from Arlington.

A point brought out, of special interest to experimenters, was that loop transmission and reception is very much more efficient at short wavelengths, in the neighborhood of 200 meters, than at the long waves. This was shown clearly in one of the tables accompanying the paper.

The second paper summed up the results of observations on static, showing the variations in audibility on different wavelengths over periods of twenty-four hours.

A striking feature of the curves shown was that a receiving set tuned to 15,000 to 20,000 responds several hundred times more loudly to the static than when it is adjusted to 200 meters. This accounts for the static interference during transatlantic communication.

This led to a discussion of the characteristics of the static discharge. Mr. Pickard maintained that the static is a critically damped impulse, and showed several slides illustrating results which were obtained from an artificial static producer. These checked with Dr. Austin's curves on the audibility of static at a receiver tuned to different wavelengths.

It may be added, for the benefit of those who are not members of the Institute, that copies of the Proceedings can be purchased from the Secretary, Institute of Radio Engineers, College of the City of New York, New York City. Application blanks for membership can also be obtained by writing to this address.

NEXT month, a heterodyne wavemeter for 150 to 20,000 meters will be described, with full details and illustrations of the apparatus. The instrument, under construction in EVERYDAY'S laboratory, is nearly finished. An amplifying unit is also being made for the June issue. Both of these devices have much of interest for experimenters who make their own apparatus.

The article on the non-inductive resistance box has been postponed to accompany the conclusion of Mr. Clement's article on high frequency resistance measurements. In the June issue he will describe several circuits which can be used for this purpose, and one special method not disclosed before.

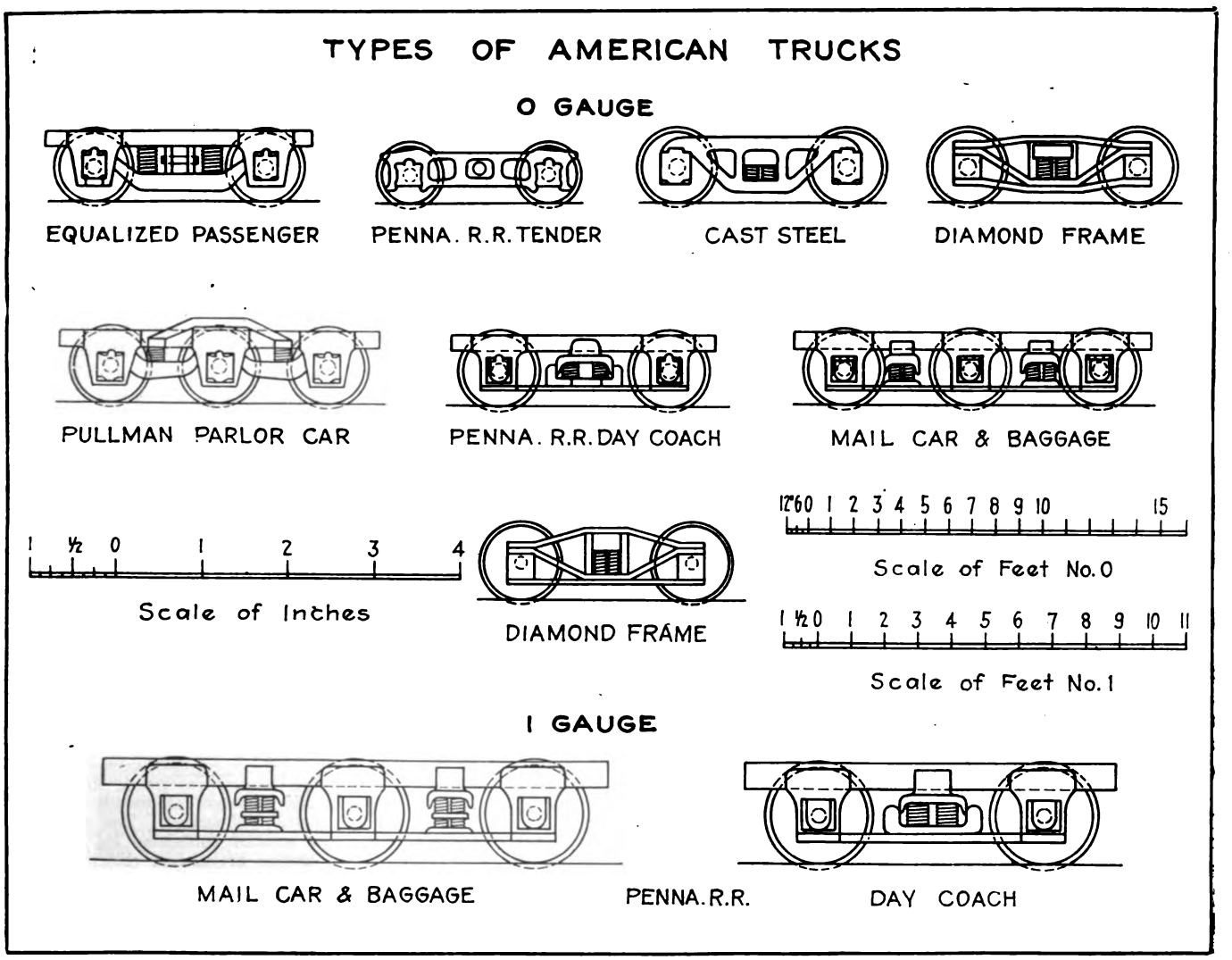
Several new instruments from the manufacturing companies will also be shown in the next number.

Digitized by Google

A Model Automobile

THE automobile shown in the illustration is one of the best pieces of model engineering that has come to our attention in some time. Not one of the constructional features of the little machine differs from those of its prototype. The characteristic lines of the body, which were designed after those of a well-known car, will be immediately recognized. Even the tires are included on the model and how the builder overcame this difficult problem is quite beyond the Editors of EVERYDAY unless he succeeded in inducing some of the large manufacturers to make them especially for his use, which seems somewhat doubtful. The steering gear, headlights, windshield, fuel tank, upholstering, radiator wheels and dash are carried out with amazing detail, to say nothing of the smaller fitments. As far as can be learned, the little machine is not equipped with a workable gasoline motor. It appears that the constructor of the machine (who appears in the photograph) made the device to demonstrate a new automobile top of which he is the inventor. It will be seen that the top is not similar to the conventional type.





This chart, which shows the different types of American car trucks, was prepared by Mr. George Bender. It will be of great assistance to model engineers engaged in the construction of model railways

Digitized by Google

A Home-Made Hygroscope

By L. B. Robbins

ONE of the earliest forms of barometers consisted of a long piece of "gut" hanging vertically and held straight by a weight. This was called a hygroscope, and foretold weather changes by recording changes in atmospheric moisture. As the gut absorbed moisture its length varied and these variations indicated certain changes in the weather.

The apparatus herein described makes use of this principle inasmuch as the gut is used, but is arranged in such a way as to be in a convenient form and readily accessible. Only simple things are needed in its construction which can be found or made at any work bench.

First procure nine deep grooved spools about 2 in. in diameter. There are certain brands of high grade fish line, which come wound upon spools admirably suited to this purpose. Five are used for stationary pulleys and four for weighted ones. Mount four of them near the top edge of a base board 3 ft. 6 in. long by 2 ft. wide, setting them in a straight line allowing considerable more space at the left of the row than at the right. A screw eye takes the place of a fifth pulley at the left. Use long slender screws for the pulleys to rotate on and provide washers if the heads are too small to retain the spools upon them. One more pulley is mounted in a similar manner at the lower right hand corner of the base.

The four remaining pulleys are then provided with hangers made of sheet tin bent in the form of a U as shown in detail. Holes through the top of each leg take the axle of the pulley, which consists of a small bolt. A hole in the center at the bottom is for a wire by which 4 oz. weights are attached to each hanger. These weights are made by pouring moulten lead into small sand moulds, letting them solidify about a wire through their centers. Make a fifth weight for the dial.

Next, take about 32 ft. of ⅛-in. rawhide "gut" or belt lacing and weave it back and forth through the stationary and weighted pulleys as indicated. One end attaches to the screw-eye; the other passing under the lower pulley.

Cut out a cardboard dial 19 in. in diameter, and mark it out in degrees as shown, from 25 to 31. This is in imitation of the common barometric readings. Three lugs on the back of dial serve to fasten it to the cover on the base.

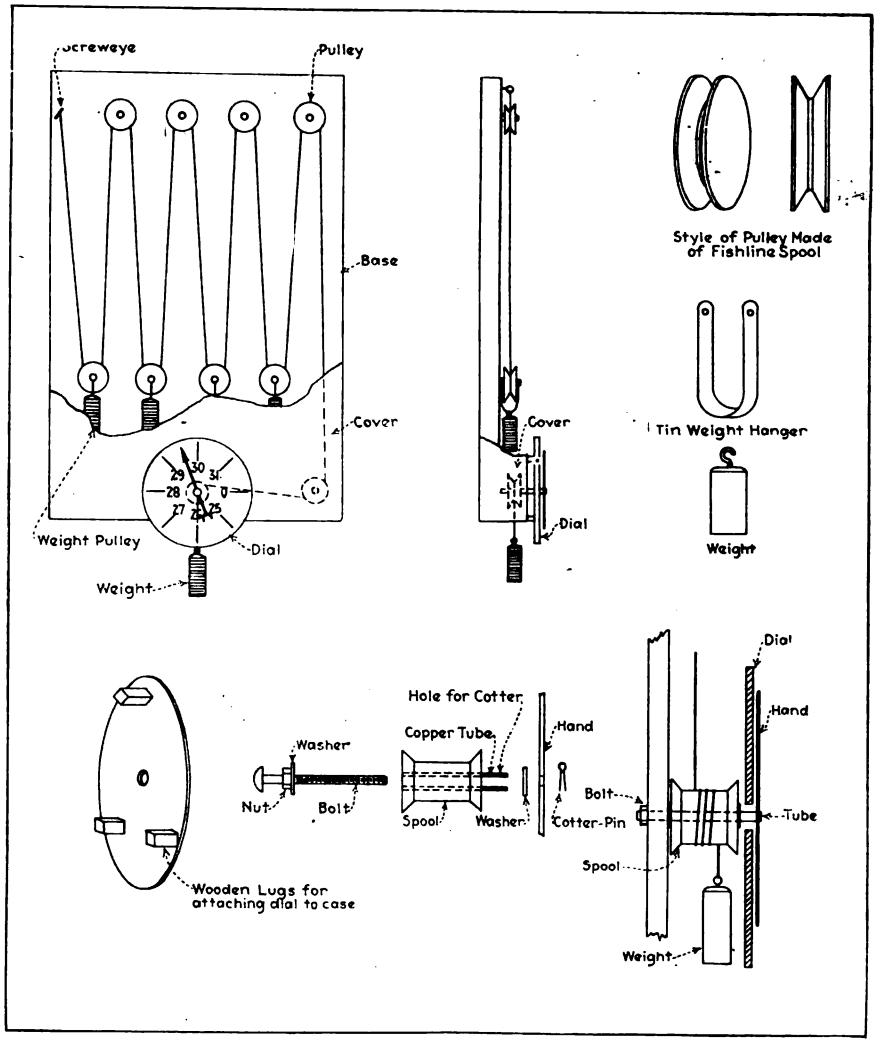
The dial drum is shown in detail and consists of a somewhat wider spool than the rest. A copper tube is driven through the hole and acts as a bearing which revolves upon a bolt projecting from the base. Wind several turns of the lower end of gut around this drum, hanging the extra weight from its end as shown.

When this is done and the gut is in place, fit a cover over the base to hide the entire workings. This can be held in place by screws or hooks so it can be easily removed if necessary. A hole should be provided in the cover to coincide with that in the center of the dial and allow the bearing of the drum to project through. Cut out a hand of thin metal and ream out a hole in the center to make a driving fit over the end of the bearing. A cotter pin can be used to hold the hand in place if desired.

Set the barometer on the wall in the desired location and allow it to remain there several days before placing on the cover in order that the weights may take up all slack in the raw hide and stretch it to its full length. Then set the hand on the bearing so it points to the same figure as a regular barometer would indicate at the same time and secure it finally to the bearing with a drop of solder. This is done, of course, after the cover is replaced.

While this instrument is not intended for a barometer in the strict sense of the word, it will, however, serve to indicate the relative and absolute humidity, the dew point and approach of frosts and rains. Numbers on the dial can be marked as such after it has had a few tests.

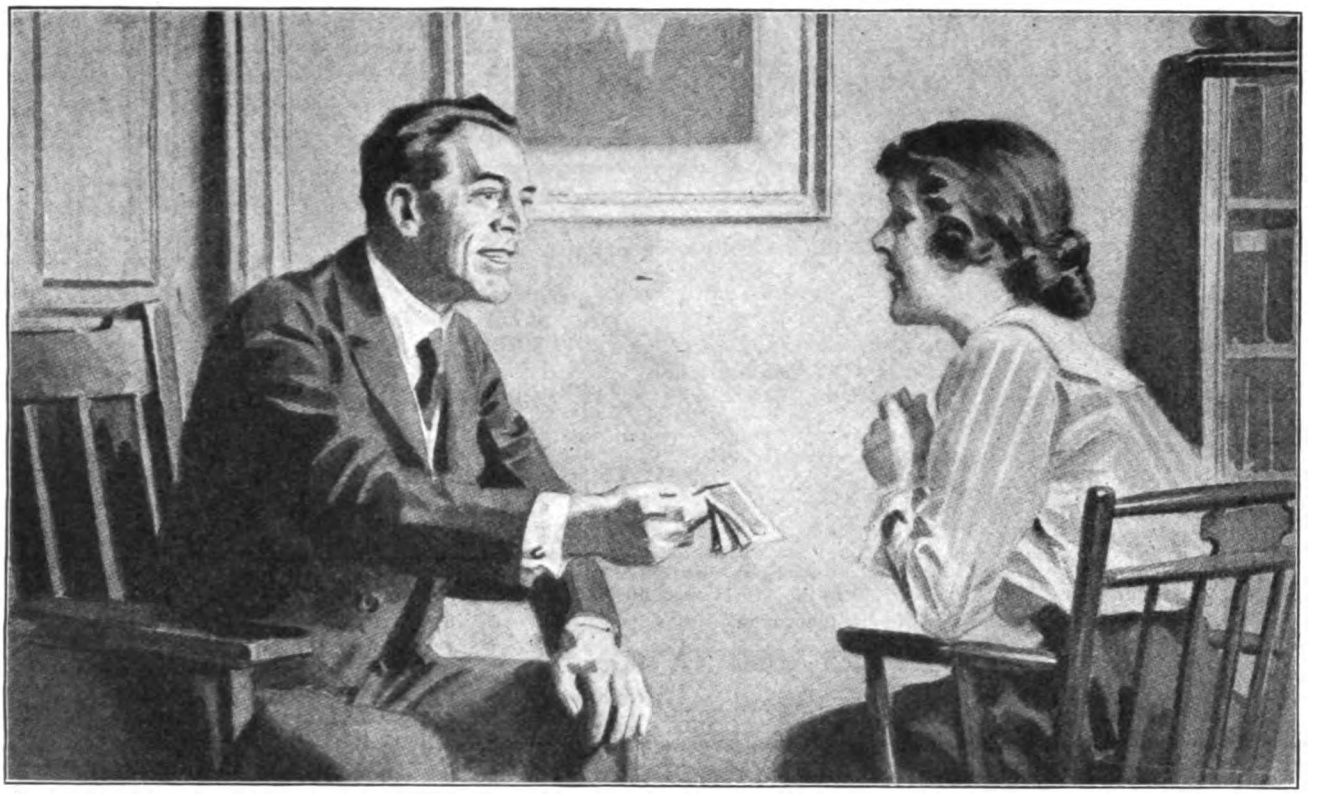
It also will assist in determining a healthful degree of humidity in the house while the heating apparatus is being operated.



The six-hour day in factories has been investigated in England. It was found that, for work requiring heavy muscular exertion, it was advantageous, but the contrary was the case for light work. It is said that the noise in a factory is a serious element in fatiguing the workers. One advantage for the six-hour day is that if two shifts are used, it gives twelve hours of production for the expensive machinery.

An electric treatment of seeds is described in an English publication. The seeds are put into a solution containing 2½%-5% of sodium chloride or calcium chloride. Five gallons of the solution suffice for a bushel of seed. Eight watts of electric power are taken for each gallon. Remarkable results are claimed in the way of increased yield, although the same favorable results have not always been attained by others than the originator. The seed must be used soon after the treatment, as the effects of the electricity last only a month.

Digitized by Google



"Here's an Extra $50, Grace —I'm making real money now!"

"Yes, I've been keeping it a secret until pay day came. I've been promoted with an increase of $50 a month. And the first extra money is yours. Just a little reward for urging me to study at home. The boss says my spare time training has made me a valuable man to the firm and there's more money coming soon. We're starting up easy street, Grace, thanks to you and the I. C. S.!"

Today more than ever before, money is what counts. The cost of living is mounting month by month. You can't get along on what you have been making. Somehow, you've simply got to increase your earnings.

Fortunately for you hundreds of thousands of other men have proved there is an unfailing way to do it. Train yourself for bigger work, learn to do some one thing well and employers will be glad to pay you real money for your special knowledge.

You can get the training that will prepare you for the position you want in the work you like best, whatever it may be. You can get it without sacrificing a day or a dollar from your present occupation. You can get it at home, in spare time, through the International Correspondence Schools.

It is the *business* of the I. C. S. to prepare men in just your circumstances for better positions at better pay. They have been doing it for 28 years. They have helped two million other men and women. They are training over 100,000 now. Every day many students write to tell of advancements and increased salaries already won.

You have the same chance they had. What are you going to do with it? Can you afford to let a single priceless hour pass without at least finding out what the I. C. S. can do for you? Here is all we ask —without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6078-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ADVERTISING	☐ ELECTRICAL ENGINEER	☐ MECHANICAL ENGINEER
☐ SALESMANSHIP	☐ Electrician	☐ Mechanical Draftsman
☐ Traffic Management	☐ Electric Wiring	☐ Machine Designer
☐ BUSINESS MANAGEMENT	☐ Electric Lighting	☐ achine Shop Practice
☐ Private Secretary	☐ Electric Car Running	☐ Boilermaker or Designer
☐ Commercial Law	☐ Heavy Electric Traction	☐ Patternmaker
☐ Certified Public Accountant	☐ Electrical Draftsman	☐ Toolmaker
☐ Higher Accounting	☐ Electric Machine Designer	☐ Foundry Work
☐ Railway Accountant	☐ Telegraph Engineer	☐ Blacksmith
☐ BOOKKEEPER	☐ Telephone Work	☐ Sheet Metal Worker
☐ Stenographer and Typist	☐ ARCHITECT	☐ STEAM ENGINEER
☐ Good English	☐ Architectural Draftsman	☐ Stationary Fireman
☐ Window Trimmer	☐ Contractor and Builder	☐ MARINE ENGINEER
☐ Show-Card Writer	☐ Building Foreman	☐ GAS ENGINE OPERATING
☐ Sign Painter	☐ Carpenter	☐ Refrigeration Engineer
☐ CIVIL SERVICE	☐ Concrete Build r	☐ Metallurgist or Prospector
☐ Railway Mail Clerk	☐ PLUMBER & STEAM FITTER	☐ CIVIL ENGINEER
☐ Mail Carrier	☐ Heating & Ventilation	☐ Surveying and Mapping
☐ CARTOONIST	☐ Plumbing Inspector	☐ R. R. Constructing
☐ Illustrator	☐ Foreman Plu··ber	☐ Bridge Engineer
☐ Perspective Drawing	☐ CHEMIST	☐ SHIP DRAFTSMAN
☐ Carpet Designer	☐ Analytical Chemist	☐ Structural Draftsman
☐ Wallpaper Designer	☐ Locomotive Engineer	☐ Structural Engineer
☐ Bookcover Designer	☐ Roundhouse Foreman	☐ Municipal Engineer
☐ TEACHER	☐ MINE FOREMAN OR ENGINEER	☐ NAVIGATION ☐ Spanish
☐ Common School Subjects	☐ Coal Mining	☐ Motor Boat Russ'g ☐ French
☐ High School Subjects	☐ Metal Mining	☐ AGRICULTURE ☐ Italian
☐ Mathematics	☐ Assayer	☐ Fruit Growing
☐ AUTOMOBILE OPERATING	☐ TEXTILE OVERSEER OR SUPT.	☐ Vegetable Growing
☐ Automobile Repairing	☐ Cotton Manufacturing	☐ Live Stock & Dairying
☐ Auto. Electrical Work	☐ Woolen Manufacturing	☐ POULTRY RAISER

Name_____

Occupation and Employer_____

Street and No._____

City_____ State_____

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Q. S. T.

Radio experimenters buying through this association are purchasing the goods of every advertiser in this magazine at considerable savings. We fill orders the day they arrive. After deducting their membership discounts they obtain the following prices:

Audiotron Tubes	**$5.00**
22 V "B" Batteries	**1.10**
001 Mfd Assembled Variable Condensers	**3.50**
De Forest Honey Comb Coils 10% off list price.	
130-230 Wavemeters	**5.90**
High Frequency Buzzers	**2.00**
Filament Back Panel Rheostats	**1.55**
Tubular Bulb Adaptors	**1.05**
Marconi VT Tubes	**6.50**
Marco Storage Batteries	**7.00**

We guarantee you some saving on anything advertised in this magazine if purchased through this association.

Send for detailed information

MUTUAL PURCHASERS ASSOCIATION

2 and 4 Stone Street **Dept. EV-1** **New York City**

EXPERIMENTAL · SCIENCE ·

· CHEMISTRY ·

A New Magazine of Science for the Experimenter and Practical non-Technical Man.

RADIO

· PHYSICS ·

First Issue out May 5th. $1.50 per year; Canada $1.75, 'New and Original.'

WRITTEN BY AUTHORITIES

Literature Sent on Request

Send In Your Subscription NOW!

Experimental Science Publishing Company

710 Fourteenth Street **Washington, D. C.**

WIRELESS MANUAL

We make a charge of 25c for it Issuing a coupon receipt redeemable on a purchase of $5 or more.

No. K-12
Ready May 25

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble.

Our 180 page combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments.

MANHATTAN ELECTRICAL SUPPLY CO., INC.

New York—17 Park Place **St. Louis—1106 Pine St.**
Chicago—114 So. Wells St. **San Francisco—604 Mission St.**

EXPERIMENTAL PHYSICS

(*Continued from page* 141)

readily through ordinary glass, so the interposition of glass will often cut out the rays entirely. It is for this reason that a person will not tan so readily inside a glass conservatory as out in the open air. Quartz, however, passes ultra-violet light easily,, so in all work with this type of radiation prisms and lenses must be of quartz.

There are many methods of producing ultra-violet light experimentally; the most common being, the mercury vapor lamp, a spark discharge, and an electric arc. When using a mercury vapor lamp it must be provided with a quartz window to allow the rays to escape, and since this type of lamp is somewhat expensive the author has used the spark and arc methods exclusively.

Of these two the arc is much preferable. If, however, the experimenter is the possessor of a wireless transmitting set, he may use his transformer, condenser, inductance and gap, to produce ultra-violet light of fairly good intensity. The spark gap should be fitted with zinc electrodes, as this produces much better rays.

The construction of a good arc lamp for the experimental production of ultra-violet rays is shown in Fig. 2. The completed instrument is shown in Fig. 3. From these two illustrations the construction should be easily seen. Of course, any small hand arc lamp may be used, and the following description of the author's is only given for those who do not have one suitable for this type work.

A small round metal container is fastened horizontally on the top of a wooden support. In each side of the container two holes about an inch in diameter are cut to allow the electrodes to enter the container. On each side a common ten cent monkey-wrench is fastened by a suitable clamp arrangement. The object of the monkey-wrenches is to permit easy manipulating of the electrodes. An insulating clamp formed of two thin pieces of fiber or hard rubber bolted together, is attached to the moving portion of the monkey-wrench. Through this clamp the electrodes are inserted and firmly fixed in place. By turning the small worm screw on each monkey-wrench the electrodes may easily be brought together, an arc struck, and then separated sufficiently to form a good arc discharge. The cheapness of construction and the ease of handling should recommend this arc lamp to the amateur experimenter. Besides ultra-violet ray work it may be used in countless other experiments, and is a valuable addition to the amateur's laboratory.

In the rear of the metal container a reflector is placed. This cannot be of

(*Continued on page* 168)

Digitized by Google

Wireless Telephone Industry Presents Tremendous Field of Opportunity to Ambitious Americans

E. R. Haas, Director of the National Radio Institute, tells how the development of the Wireless Telephone has opened a fertile and uncrowded field of opportunity to American men and women.

When Alexander Graham Bell announced his invention of the telephone to the skeptical world he was hooted, laughed at and told that his device was simply a scientific toy. But the men and women who backed the Bell Telephone with their money and their energies have reaped rewards far beyond their rosiest dreams.



Marconi met with a similar experience when he claimed completion of the first Wireless Telegraph with which messages could be sent through space without wires. But Marconi started something which has revolutionized all former methods of communication for today it is possible to send messages around the world by Wireless Telegraphy. There are thousands of people and millions of dollars involved in carrying on the industry and a permanent demand exists for more men and women, trained in Wireless than can possibly be supplied. Salaries in the wireless field have advanced steadily and today range from approximately $250 a month to $15,000 a year.



And now comes the last word in the development of Wireless with the perfection of the Wireless Telephone and the announcement that wireless telephone communication is actually established between New York and Chicago and that perfectly audible conversations may now be held between rapidly moving aeroplanes high in the air and stations located on land.

The Wireless Telephone annihilates space and in doing so overcomes many of the serious objections to older methods of telephonic communication. So great has been the development in this line that Congressman Steenerson of Minnesota recently stated that all telegraph and telephone wires would soon be scrapped owing to the perfection of Wireless.

Men and women are needed and will be needed in ever increasing numbers to carry on the work made necessary by the advent of the Wireless Telephone. Those who realize this fact and who prepare now to successfully fill positions in this great field, will be the first to profit—as in the case of the pioneers in the telephone, automobile, talking machine and flying machine industries.



America has always been at a disadvantage because of the inadequacy of her oceanic cable system. This is one of the many important obstacles to greater world commerce which the Wireless Telephone will effectually remove. In fact the Wireless Telephone puts the world at America's front door and elevates her from a minor to a major position in world communication.

The permanent success of Wireless Telephony in America is definitely assured because of the recent formation of the Radio Corporation of America (controlled by the General Electric Company) which has taken over the basic Alexanderson patents covering radio intercommunication and will virtually control this important industry in America and as a further sign of progress American apparatus is now standard throughout the world.



Due to its low cost of operation, installation and maintenance, the wireless telephone is steadily supplanting the long distance telephone for practical business purposes. Branch factories located in different cities may now enjoy the advantages of frequent telephonic intercourse by means of their individually controlled wireless stations; the wireless telephone makes possible telephonic communication between moving trains, ships and other carriers, something heretofore impossible of accomplishment and it will soon be as simple a matter to talk by wireless phone with people across the ocean as it now is to phone across the street.

The Wireless Telephone is bound to do more toward unifying the commercial, political and social interests of the world than any other single factor. The day of wireless, while still at its dawn, is here to stay and the field of opportunity which it has opened to ambitious men and women is second to none.



Each new step forward in the development of wireless creates a still further demand for men and women who are trained in this modern method of communication and it was in order to help meet this ever increasing demand that the National Radio Institute was founded in the Nation's Capital, in 1914 by James E. Smith, E. E.

The National Radio Institute was one of the first schools of Wireless Telegraphy in America and was the first to teach this science by mail. Thousands of students have completed their practical courses in this fascinating study. Hundreds of them are still holding important positions in the wireless field and a permanent demand now exists for all graduates of the National Radio Institute.

It is only natural that the National Radio Institute should also be first in the field to teach Wireless Telephony by mail to the hundreds of progressive Americans who realize that this modern method of communication in all its various branches presents a broad field of commercial opportunity in which to exercise their abilities and make their fortunes.



You, who have read this far will find in Wireless Telephony the opportunity for growth and successful accomplishment for which you have long been seeking. By taking up the study of Wireless Telephony now, as taught by the National Radio Institute you will advance rapidly as its universal use increases and you will be carried along on the crest of the wave to success in what is fast becoming one of the foremost industries in the world.

Text Book and Advance Lesson on Approval

The National Radio Institute's home study course in modern wireless telephony consists of a complete text book containing 300 modern illustrations, a complete index and ten individual lessons, personal instruction and aid, each treating a practical phase of the subject, but depending on each other for a firm foundation and thorough knowledge of the entire subject. The real value of the course lies in the personal instruction, correction of lesson papers and individual help to suit each case. In order to quickly introduce the course we offer it complete for only $15 cash or $17.50 in payments of $7.50 down and $10 in thirty days. This enables you to examine the course before paying the full tuition. We will send the complete text book and first lesson on receipt of the attached coupon, properly filled out with $7.50 on account. You may examine the text book and lesson for three days and then remit an additional $7.50 and we will send the remainder of the course in full; or you may remit an additional $10 in thirty days; or return the text book and lesson in good condition and your $7.50 will be refunded to you.

SEND THIS FREE TRIAL COUPON TO-DAY

The National Radio Institute
Division of Radio Telephony
Dept. 206, 14th & U Sts., N. W.
Washington, D. C.

Inclosed find deposit of $7.50 on account for which send me prepaid your complete text book and lesson No. 1 of your Home Study Course in Modern Wireless Telephony for three days examination on approval. At the end of three days I agree to either remit an additional $7.50 in full payment for the entire course or to remit an additional $10 in thirty days, or return the text book and lesson to you in good condition on receipt of which you will refund the inclosed $7.50.

Name.....

Address.....

City.....State.....

THE NATIONAL RADIO INSTITUTE

Division of Radio Telephony, Dept. 206

WASHINGTON, D. C.

Digitized by Google



RADIO INTERNATIONAL

SQUARE AND LINEAR LAW VARIABLE CONDENSER

The Square-Law Variable Condensers provide a most convenient element in all circuits for adjustment to wavelength. The Linear-Law Variable Condensers are used where capacities are to be measured and as energy storing units. The International Condensers are all housed in *standard* interchangeable cases, and may be incorporated in a complete receiving outfit of any type by adding to other International Sectional Radio Units such as Amplifiers, Detectors, etc.,—at any time. Write to Dept. 21 for *free* bulletin describing the International Experimental products.

International Radio Telegraph Company
326 BROADWAY NEW YORK CITY

THE WAY TO SATISFACTION

Lies thru a careful purchase of trustworthy equipment.

Let your first cost be your only cost by "Buying Right" at the very start.

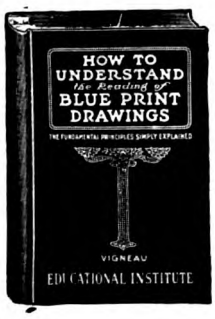
Inferior apparatus can but produce inferior results.

ALL RADIO EQUIPMENT

carried by us is selected stock—selected with a view toward dependability, service and reasonable cost.

Bulletin 14 will be sent upon receipt of 10 cents—applicable on first dollar order.

ATLANTIC RADIO CO., Inc.
88 Broad Street Boston 9, Mass.



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr., U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE, YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
169 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 136 Rowland Bldg., Detroit, Michigan

EXPERIMENTAL PHYSICS

(*Continued from page* 166)

glass as ultra-violet rays do not pass through glass readily, nor are they well reflected from it. The reflector then, must necessarily be of metal. It has been found that a nickel plated brass or tin reflector is the best suited for this type of work. For some unaccountable reason silver plated reflectors do not give very satisfactory results. For good results the reflector should be parabolic in order to focus the rays on one spot. This is necessary as it is impossible to use a lens to focus the rays, as glass is impervious to the rays.

At first the arc should be provided with ordinary carbons. Using them fairly good ultra-violet content will be found to the light. Using one metal and one carbon electrode more rays will be formed. The author has found that the combination of one iron electrode and one carbon gives excellent results, although the arc is somewhat hard to start. One authority on the subject has suggested the use of two tungsten electrodes, but the price of tungsten has kept the author from trying this combination.

By far the best method, however, is to use ordinary carbon electrodes impregnated with certain salts. The manner in which these electrodes are made is as follows: Two ¼ inch arc carbon electrodes are cut the required length for the arc lamp to be used. Some uranium nitrate, easily procurable at any good chemical supply house, is dissolved in water and placed in a large test tube. The carbons are now placed in the solution which is boiled until the carbons are well soaked with the salt. When dried the carbons are inserted in the lamp and used just as ordinary electrodes. More ultra-violet light will be found to emanate from the lamp using these electrodes than by the use of any other combination.

Just what constitutes the efficacy of the uranium salt for the production of ultra-violet rays is not known. Whether the fact that uranium is a radio-active element has something to do with the matter, or simply the fact that uranium is the heaviest element, is not known at the present time. To be sure other salts when soaked into the electrodes will aid in the production of the ultra-violet rays; chief among which are the salts of tungsten, thorium, iridium, etc. It is a wonderful field for experimentation and study. This field holds forth as much opportunity for original research as any in the work in modern physical science.

The next article of this series will outline a number of very interesting experiments with ultra-violet.

(*To be continued.*)

Digitized by Google

THE PERFECT VACUUM TUBE COMBINATION

PRESENTING TWO *NEW* TYPES OF VACUUM TUBES FOR EXPERIMENTERS

—the De Forest 20 Audion Detector and the Moorhead VT Amplifier-Oscillator: perfected to meet the increasing demand for tubes of superior efficiency, wherein all desirable characteristics are combined without subordinating any essential elements.

THE DE FOREST 20 AUDION DETECTOR

Type 20 combines all the advantages of the tubular type De Forest audion, in its extreme sensitiveness as a detector, with those of the Navy standard base. This tube is of the so-called "soft" type, requiring relatively low B battery potential, and is unexcelled as a detector.

Both types of tubes are of unusually rugged construction.

THE MOORHEAD VT AMPLIFIER-OSCILLATOR

The VT Amplifier-Oscillator is similar to the Navy "hard" tube, and is designed and manufactured expressly for amplification and oscillation purposes.

A combination of two or more Moorhead tubes as amplifiers with a De Forest tube as the initial detector or oscillator is the ideal receiving combination for long distance amateur or long wave reception.

These tubes are licensed under the De Forest Audion and Fleming Patents.

PRICE $7 EACH

Specify full names of tubes when ordering. Orders may be placed through a dealer or sent direct, with check, draft, or money order, to the Laboratories. Immediate delivery.

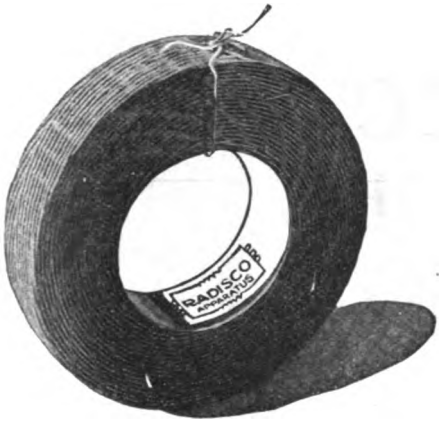
Dealers—Write for prices and particulars.

PACIFIC RADIO SUPPLIES CO., SAN FRANCISCO

SOLE SALES AGENTS FOR MOORHEAD LABORATORIES, INC.

REFERENCE, THE AMERICAN NATIONAL BANK, SAN FRANCISCO.

Digitized by Google



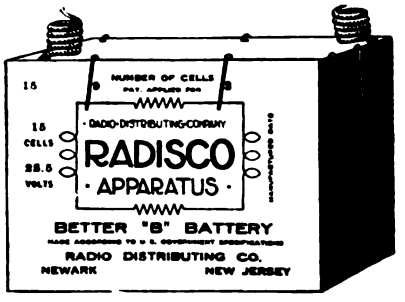
Two Famous
RADISCO SPECIALTIES

RADISCO COILS

conceded by several well known Radio Men to be far superior to any similar type of Inductances. Made in seventeen sizes, tapped and plain. Wave length range from 200 to 20,000 meters, priced from 70c to $4.85. Plentiful supply in stock at all Radisco Agencies.

RADISCO BETTER "B" BATTERY

is made according to Government specifications in two (2) sizes—3¼x2x2½" and 6½x4x3". A first-class 15 cell, 5 group battery, VARIABLE VOLTAGE (Pat. applied for) is a special feature of this battery which enables you to provide critical voltage regulation for your vacuum tube by means of a switch connection with cells, taps of which have been taken off. Very economical and convenient. If one cell goes bad just test each group of 3 cells and short circuit the bad one. Price, small size, $1.40. Large size, $2.40, at any agency, or if ordered by mail include postage for 2 pounds on small size and 5 pounds on large size.



RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the RADISCO COILS, Better "B" Batteries and are our Agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace

ATLANTIC CITY, N. J.
Independent Radio Supply Co.
118 So. New Jersey Ave.

BALTIMORE, MD.
Radio Engineering Co.,
614 N. Calvert St.

BEINVILLE, QUEBEC, CAN.
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street.

BROOKLYN, N. Y.
Kelly & Phillips Electric Co.,
312 Flatbush Ave.

BRONX, NEW YORK
Amateur Wireless Equipment Co.,
1390 Prospect Ave.

CHICAO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.

EUREKA PEORIA ILLINOIS
Klaus Radio Co.

HAMPTON, N. H.
Delancey Felch & Co.,

LOS ANGELES, CALIF.
The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.
K. & L. Electric Co.,
427 Olive Street.

NEW ORLEANS, LA.
L. A. Rose,
121 Camp St.

NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street.

NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave.
"8HA"

PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets.

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.
45 Washington Street.

PITTSBURGH, PA.
Radio Electric Co.,
4521 Forbes St.

SCRANTON, PA.
Shotton Radio Mfg. Co.,
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street.

TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street.

WASHINGTON, D. C.
National Radio Supply Co.,
1405 U Street, N. W.

WICHITA, KAN.
The Cosradio Co.,
1725 Fairmount Ave.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY : : Newark, New Jersey

Digitized by Google

EVERYDAY SCIENCE NOTES

An elaborate report on the effect of the utilization of electric light on the laying of eggs has been issued recently from the Manitoba Agricultural College. The experiments were carried on in the winter, when daylight was short. The light was turned on at dusk and was kept going until 10.30 p. m. It was next turned on at 7 a. m. The most impressive results were obtained between November 15th and April 15th, 1918-1919. In the darker months, the cost per dozen including light was 21.1 c. and 9 ounces of grain were eaten per egg produced. This was for the artificial light division. For the other, the eggs cost 33.6 c. per dozen and for each egg 24 ounces of grain were eaten. From November 15th to March 1st the artificial light division gave 6,324 eggs against 2,557 eggs of the unlighted division. But for the period from October 27th to June 22d, the relative production was not so favorable to the lighted part; the eggs produced were 13,544 against 11,661.

A simple test for the hardness of steel has been introduced. Sample bars of standard hardnesses are supplied. They are placed in a holder with a steel ball below them, and the whole is then held on the sample to be tested. A light blow is given and both sample and standard bar are indented. The indentations are compared, and if the same then the two are of identical hardness. Each bar can be shifted about so as to be used over and over again, and the effort is to obtain a bar that will give the same indentation as the piece tested.

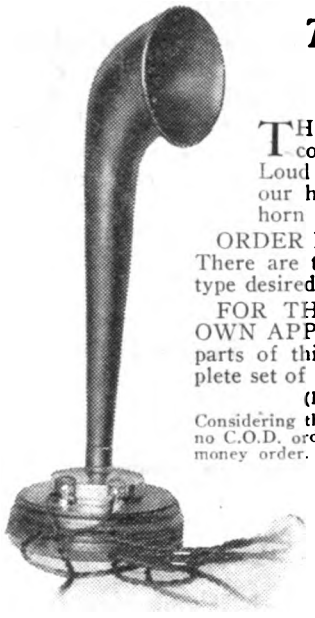
The relation between shoemakers' sizes in the French and English or American system have been published in a French contemporary. The English system is the same as the American, three numbers to the inch. In France there are four sizes to the French inch; this reduces to almost the same dimension as the English shoe size; the English inch is .0255 meter, the French is .027 meter, a difference of about .08 inch, and the English size number is .06 inch longer than the French.

Efforts are being made to utilize horse-chestnuts. By steeping them in a proper solvent, such as water, and fermenting the liquid by a special process, acetone and butyl alcohol are produced. The distillate from the fermented liquid, called the "mixed oil", contains 1/3 acetone and 2/3 butyl alcohol. The nuts give 19% of the "mixed oil". The works are at King's Lyn, Eng.

Pomace, the residue left in the press after the juice has been expressed from fruit, such as from apples in making cider, is of little value for cattle food, as it is deficient in some of the important elements of nutrition. It can be made a valuable food by mixing it with 45% of its weight of molasses. This has to be done at a temperature of about 180° F. with vigorous stirring. The result is a dry product, easily handled, and a good feed for cattle. The molasses supplies the deficiencies of the pomace.

The explosion of meteorites as they approach the earth is accounted for by the resistance of the air. Their velocity is so great (it may be 30 miles a second) that the contact with the air is almost or quite like a blow. The loud sound they make when exploding is attributed to what is called the shock wave. This was observed with projectiles in the war. They produced a noise like that of an explosion, under conditions of high velocity as they passed on their trajectory.

SPECIAL ANNOUNCEMENTS



This is Important to You

READ IT

THE ever increasing cost of raw material and labor compels us to advance the price of our famous Loud Speaking Horn. After May 31st the price of our horn will be $15.00. You cannot buy a better horn at twice the price we ask.

ORDER NOW AT THE OLD PRICE OF $12.50 each. There are two styles—Desk type and wall type. Specify type desired.

FOR THOSE WHO PREFER TO MAKE THEIR OWN APPARATUS we would suggest that they buy the parts of this horn and assemble same themselves. Complete set of parts ready to be assembled—either type, $11.50.

(Prices of parts shall be advanced also)

Considering the very low price asked for such high grade instruments no C.O.D. orders shall be accepted. Remit by post office or express money order.

Our New Vacuum Tube Detector and Amplifiers now in course of construction which embody many new features will be ready soon. Don't miss next month's advertisement.

MODERN RADIO EQUIPMENT CO.
Designers and Manufacturers of High Grade Radio Apparatus
ELIZABETH, NEW JERSEY

RADIO APPARATUS

Distributors of reliable radio apparatus for Experimenters in every branch of the radio field

"PITTSCO"

The sign of service and immediate deliveries. All we ask is a trial.

"REMEMBER"

We carry an immense stock and can make immediate delivery on every item listed.

"De Forest Vernier type Variable air condensers, mounted and unmounted. A splendid condenser in any set, ideal for wave-meter work, and a good laboratory standard."

Cat. No.	Cap. MFDS	Mounting	Price
CV-1000	.001	Unmounted without vernier	$14.80
CV-1003	.001	Unmounted with vernier	17.10
CV-1010	.001	In standard glass case without vernier	21.00
CV-1013	.001	In standard glass case with vernier	23.50
CV-1500	.0015	Unmounted without vernier	16.80
CV-1503	.0015	Unmounted with vernier	18.75
CV-1510	.0015	In standard glass case without vernier	21.80
CV-1513	.0015	In standard glass case with vernier	24.75
DE FOREST UNIT TYPE VERNIER AIR CONDENSERS			
UCV-1500	.0015	On unit panel without vernier	17.80
UCV-1503	.0015	On unit panel with vernier	20.10
UCV-1000	.001	On unit panel without vernier	16.32
UCV-1003	.001	On unit panel with vernier	18.60

Important! Every article listed sent to any part of the U. S. A. postage prepaid. We want your business!

Send 6 cents in stamps for new catalog!

F. D. PITTS CO. Inc.
12 Park Square Dept. F. Boston 11, Mass., U. S. A.

"PRECISION"

In Every Sense of the Word

Radio Transmitting and Receiving Apparatus of Precise Performance
Instruments Built to Specifications
Standard and Special Equipment for School and Laboratory Use
Hot-Wire and Milliammeters

J. EDW. BROADBELT, Jr.
Maker of
PRECISION RADIO EQUIPMENT
553 E. Thirty-Eighth Street Dealers Write Baltimore, Md.

Digitized by Google

A GOOD WAVEMETER
AT A MODERATE PRICE



is accurate, simple and rugged. Comprises a portable oak case 5¾" x 8¼" x 6½" with hinged cover, bakelite panel, balanced condenser, buzzer, detector, switch, binding posts, and two 2-unit inductance windings, range 200 to 2000 meters.

Price $27.50

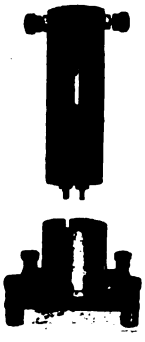
These meters are in stock for immediate delivery, and are carried in stock by most good dealers.

TYPE B. Q. WAVEMETER

Bulletins Z and F sent for 4c Stamps list our complete line of high grade, moderately priced apparatus for the radio laboratory. Bulletin R lists the Cambridge Rectifier for Storage Battery Charging.

CLAPP-EASTHAM CO., 131 Main Street, Cambridge, Mass.

YOU CAN USE AUDIOTRONS IN YOUR RADIO SET, WITHOUT CHANGING THE SOCKETS, IF YOU HAVE A



Radio Electric Audiotron Adapters are the logical means for using tubular audions in standard apparatus equipped with four-point sockets. The superiority of this adapter is evident in the simplicity of construction and protection afforded the vacuum tube.

AUDIOTRON ADAPTER, $1.50, Shipping weight 1 lb.

The Radio Electric Company carries a complete line of Bunnell, Radisco, Murdock, Clapp-Eastham Radio Apparatus, Federal and De Forest Instruments. Special equipment made to order. Pittsburgh experimenters are invited to visit our retail store. A 10c stamp will bring our catalog.

RADIO ELECTRIC COMPANY 3807 FIFTH AVENUE PITTSBURGH, PA.

OF SPECIAL INTEREST TO AMATEURS!



We have a number of GENERAL RADIO CO. HOT WIRE AMMETERS range 0-2.5 amperes which were left on our hands at the termination of the war. These instruments are of the flush type, calibrated, and in good condition, exactly like a large number supplied by us to the U. S. Army Air Service.

We also have a few ammeters of the same type, range 0-1 ampere, adapted to use in measuring the filament current of vacuum tubes or low power transmitting sets.

While they last, $5.00 will bring you either range, although our regular price is $10.00.

Dealers write for our proposition

GENERAL RADIO COMPANY CAMBRIDGE, MASS.

Arnold Loose Couplers

Combination Loose Coupler Parts and accessories.

Send 4c stamp for literature which is sure to interest you.

J. F. ARNOLD 2082 Lexington Av., N.Y. Established 1910

BACK NUMBERS OF EVERYDAY ENGINEERING MAGAZINE

Cannot be supplied dating back of January, 1919. All back numbers are now 20 cents, and only a few are in stock. SUBSCRIBE NOW—YOU CANNOT AFFORD TO MISS A SINGLE ISSUE.

EVERYDAY SCIENCE NOTES

The output of ships and vessels in the United States for the year 1919 was 57 per cent. of the output of the world, and nearly 74 per cent. of that of all other countries. Of turbine-driven ships, about 1,900,000 tons, and of ships for internal combustion engines, about 43,000 tons were built. Of the internal combustion-driven ships one was of over 6,000 tons. Five concrete vessels of an aggregate of 18,046 tons, including two of 5,000 tons, were launched. In Great Britain the concrete ships were 53 in number. No sailing vessel was reported launched there in 1919. The world's output for that year is placed at 7,144,549 tons.

There has been considerable trouble in treating Douglas fir with liquid preservatives, as they did not penetrate the wood beyond the outer layers. A system of superficial perforation is now applied. The logs are passed through rolls carrying projecting blades. These cover the surface with perforations ⅛-inch wide, ¾-inch deep and about 7 inches long. This facilitates the charging of the wood with liquid preservatives.

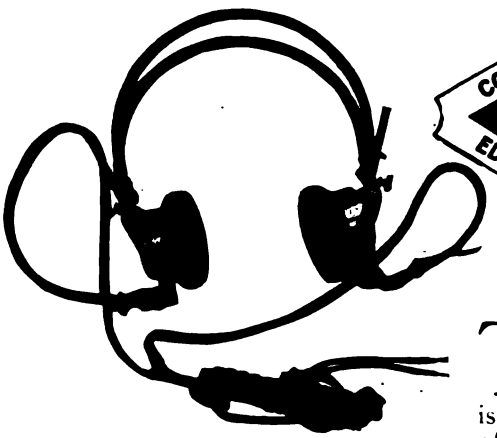
In England wooden centered car-wheels are still in use, although they seem to be going out of use. The center is filled with sixteen blocks of teak, and the principal problem in their construction is securing the wood in place. The bolt holes wear under the effects of the brake action. The tire is forced on by hydraulic pressure or by heat, blacksmith-fashion. The wheels are rotated at a standard of forty miles an hour to test their dynamic balance, and are brought into quiet running by counterweights. An ingenious method of making carwheels in use here is to rotate the mould. A manganese alloy steel is poured in and by centrifugal force forms a ring around the periphery; then a soft steel is poured in to make the center. Cast iron wheels are still made here in great quantity, the capacity is put at 20,000 per day. They are sold to the railroads under a five-year guarantee.

A thoroughly up-to-date aquarium is to be established in Golden Gate Park, San Francisco. In addition to the glass-sided exhibition tanks, there will be out-of-doors tanks, a feature to which the climate of the locality lends itself; the absence of extreme cold favors or facilitates the maintenance of outdoor features.

The readings of the mercurial barometer on a fast traveling ship are affected by the variations in centrifugal force, if the ship is going east or west. Traveling west, the ship's progress reduces the centrifugal force of the earth's motion, and its readings of the mercurial barometer vary from those of an aneroid, which is not affected. On an easterly course the centrifugal force is increased and the opposite effect is produced on the barometric column. It is calculated that a ship may weigh 4 cwts. less going in one direction than when going in the other at a speed of 22 knots. Aneroid barometers are unaffected by this phase of course and speed. An aeroplane will climb faster in the northern hemisphere going clock-wise, and the reverse is the case for the southern hemisphere.

The vibration of the engines on a ship affects and reduces the lag of the mercury, and draughts of air through the chart-room may affect its readings.

Digitized by Google



COMMERCIAL EXPERIMENTAL
wicony
RADIO PRODUCTS
EDUCATIONAL LABORATORY

"The Quality Mark"

Head Telephone, U. S. Navy Type CW 834, Army Type P-11

THE Standard Head Phone of both the U. S. Navy and U. S. Army is illustrated in the cut. More of these phones were purchased than all other types put together. No more sensitive or easy-wearing phone is made. They are manufactured for us by the Western Electric Company and are known as Navy type CW 834 and Signal Corps type P-11.

At the regular price of $14.50 this is the most economical phone—and one which excels in sensitivity all other types. Immediate shipment from stock. Dealers supplied at attractive discounts. The Balwin Mica Diaphram Phone can also be shipped from stock. Payment should accompany order.

Our complete line of other high grade radio products is now available to the experimenter.

WIRELESS IMPROVEMENT COMPANY

Radio Engineers, Manufacturers and Distributors

47 West Street **New York, U. S. A.**

Just Like

Finding Money

An organization for wireless men rendering personal, intimate and humanized service with every article it sells.

We are distributing a high grade line of Commercial and Amateur radio apparatus including such well known makes as Kilbourne & Clark, de Forest, etc.,—apparatus in accordance with the latest designs and theories, quality, workmanship and materials that guarantees you of maximum results under working conditions.

When in town drop in and see us. We will be here to greet you with a glad hand, ready to render a "Personalized Service" that makes you a satisfied customer.

INTERNATIONAL ELECTRIC CO.

"Quality Apparatus and service"

Our new catalog is "different" and is well worth the 10 cents we ask for it. Send for *your* copy *today*.

The International Electric Co.

Eugene Dynner, President

226-A Fulton Street, New York, N.Y.

WILCOX ROTARY GAP



Belt-driven — Well quenched
Solid balanced rotor — Short leading spark
Large steel shaft — Clear tone
Long brass bearing — High Efficiency

COMPLETE $10.00
Postpaid

The WILCOX LABORATORIES Inc.

Lansing Dept. D Michigan

Big Money for Boys!



Learn
ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into positions just as soon as they are ready. Good salaries are offered to start with splendid chances for rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6081B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____ 7-26-10

Present Occupation_____

Street and No._____

City_____ State_____

Recognized as the largest and best

Service Radio School

INCORPORATED

Send ten cents for descriptive catalogue to Dept. E, 900-902 Penna. Ave., N. W., Washington, D. C.

Digitized by Google

G. A. STANDARDIZED SUPPLIES

STANDARD BAKELITE PANELS

The highest grade of insulating material obtainable. The use of standard sizes of panels makes possible the interchangeable design of equipment.

Size	1/8 in. Thick	Weight	3/16 in. Thick	Weight	1/4 in Thick	Weight
2½x 5 ins.	$0.30	½ lb.	$0.45	½ lb.	$0.60	½ lb.
5 x 5 ins.	.60	1 lb.	.88	1 lb.	1.16	1 lb.
5 x10 ins.	1.18	1 lb.	1.76	1 lb.	2.30	2 lb.
10 x10 ins.	2.35	1 lb.	3.50	2 lb.	4.60	2 lb.
10 x15 ins.	3.50	2 lb.	5.25	2 lb.	6.85	3 lb.

Accurately cut, always kept in stock. Shipping charges extra.

G. A. STANDARDIZED AIR CONDENSERS

Rugged design, with a consequently permanent calibration is an outstanding feature of the G. A. Standardized Condensers.

Losses as high as 50 to 75% of the energy of received signals are common to condensers having end plates of moulded composition, fibre, or metal with insulating bushings. Losses in the G. A. condensers can be neglected because these heavy end plates are cut from extra grade sheet Bakelite.

Like the other G. A. instruments, these condensers are expensive because they are designed for men of such discrimination that they will not take something just as good, but demand the best.

For vacuum tube transmitters G. A. condensers are practically the only ones available to experimenters which will stand high voltages and heavy currents without breaking down.

SPECIFICATIONS: Small size, 0.00001 to 0.000585 mfd., 29 plates, overall height 3½ ins. Large size, 0.000015 to 0.00115 mfd., 59 plates, overall height 6⅜ ins. Bakelite end plates 3¾ ins. diameter. Exceptionally heavy adjustable bearings. Moving plates keyed to shaft. Shaft ⅜ in. diameter, protrudes 1 in. from end plate. Hole in end threaded for 6/32 screw. Will take Radisco or Grebe knobs.

PRICE: Small size.....$ 8.85 wt. 2 lbs.
Large size..... 13.65 wt. 4 lbs.
Calibration curve for either size.....$.50

G. A. Standard H. F. Cable for Receivers and V. T. Transmitters

10 No. 38 cable, D.S. covered, for receiving coils. Good for 2-bank winding. 40 turns per inch. Price per 100 feet $0.60.

20 No. 38 cable, D.S. covered. Gives greater signal strength and sharper tuning than solid wire, 35 turns per in., 100 feet $0.95.

3 x 16 No. 38 cable, D.S. covered. Must be used for V.T. transmitting inductances for maximum efficiency 20 t.p.i., 100 feet $2.00.

No. 24 S.S.C. wire, ¼ lb., $0.50—½ lb., $1.00—1 lb., $2.00
No. 26 S.S.C. wire, ¼ lb., 0.60—½ lb., 1.20—1 lb., 2.40
No. 28 S.S.C. wire, ¼ lb., 0.75—½ lb., 1.50—1 lb., 3.00
No. 30 S.S.C. wire, ¼ lb., 0.90—½ lb., 1.80—1 lb., 3.60

SEND 3c IN STAMPS FOR G. A. BULLETIN JUST OFF THE PRESS.

The G. A. Company has been completely reorganized under the management of Mr. E. L. Gulick, Jr. Watch the June issue for an important announcement.

MONEY BACK GUARANTEE ON EVERY ORDER

G.A.

QUICK SERVICE ABSOLUTE RELIABILITY

The General Apparatus Company
4310-A Broadway at 183rd St. New York City

Federal Radio Accessories

Are the Recognized STANDARDS for Their Respective Uses.

BULLETIN 102 W.A.

Gives full description. Besides it contains valuable information on

AMPLIFICATION of Radio Signals

Send 6c in Stamps today and receive this Bulletin.

FEDERAL TELEPHONE AND TELEGRAPH CO.
1756 Elmwood Avenue
BUFFALO, N. Y.

A Bird in the Hand

A ACE E

—is worth two in the bush. Yes Boy, and one readable signal is worth two unreadable signals.

Why not have readable signals? Using an antenna 2 wires 100′ long, 30′ high one end and 25′ other end amateur signals *readable every night* are received in Cincinnati from Connecticut to Texas. No amplifiers used.

The Ace Regenerative Tuner does the trick. Range 150 to 2750 meters. Price $55 f.o.b. Cincinnati.

You may pay more but you can't buy better.

The Precision Equipment Co.

2437 Gilbert Ave. Dept. B Cincinnati, Ohio

"POROX"

"Trade Mark"

High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.

Special Batteries made to order also duplicating of foreign batteries.

Prices on request.

ALBERT MULLER
8758 Queens Boulevard
Jamaica, Long Island, N. Y.

MERACO EQUIPMENT

"MERACO" PERFECT B BATTERIES

Are made in three sizes and are fully guaranteed. Our circular will interest you. Send for it.

Buy WHILE YOU CAN at This Price

Here Are a Few Other Meraco Offers:

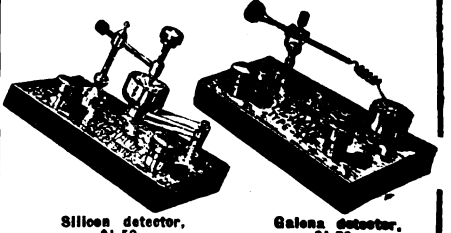
Hard rubber, ⅛, 3/16, ¼, ⅜, ½, in., $1.40 per lb.

Bakelite grade xx, natural, $2.90 per lb.; black, $3.00 per lb.

Flexible rubber tubing to slip over leads, 4c per foot; $3.50 per 100 ft.

Note: Postage must be included, as extremely low prices prohibit shipment otherwise.

MERCURY RADIO APPLIANCE CO.
672-A Broadway, Brooklyn, N. Y.



Silicon detector, $1.50 Galena detector, $1.50

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 33rd St. Valparaiso, Indiana

Digitized by Google



Indicating Dials

Make your radio apparatus up to date. Indicating dials now available at a reasonable price.

Made of fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. Have bevelled edge. We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted..$1.30 Postpaid

OUR NEW CATALOG now ready for distribution contains 24 pages of real, live, up to the minute illustrations, news and descriptions of all standard Radio parts, including the above Indicating Dial.

Sent anywhere upon receipt of 10c.

For sale at all Radisco Agencies and by

A. H. Corwin & Co.

4 West Park Street **Newark, N. J.**

"Ask anyone who has used it"

What Our Patrons Say:

"I can hear the signals three times as loud and clear as I could with my old receivers." (Name on request.)

Brandes Wireless Headset



"Superior", 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. **32 Union Square, Room 822, New York**

Wireless Receiver Specialists

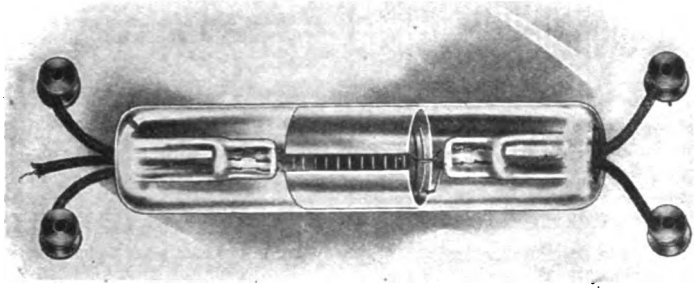
Licensed by De Forest

AUDIOTRON

The Original Tubular Vacuum Amplifier

The AudioTron vacuum tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos 841387 and 879532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.



PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

Laminated closed core, two coil type

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO., Lick Bldg., San Francisco, Calif.

YOUR FUTURE IS ON THE SEVEN SEAS



Be a Ship Officer

Join America's Mighty Merchant Marine

Hundreds of first, second and third mates, masters and captains are needed by the big shipping companies and America's great merchant marine.

Salaries up to $412 per mo. and living expenses.

Ships flying the American flag pay the biggest salaries of any in the entire world.

Learn Navigation at Home or on Board Ship.

Captain Warren Sheppard's Course on Ocean Coast and Lakes Navigation is now ready. It is a life time of practice placed before you for quick mastery. Captain Sheppard was instructor for the United States Shipping Board during the war. All of his students received licenses—from third mate to master. Not one failed. He offers this same sure method to you at a very low price. You cannot fail.

Valuable Booklet FREE

Fill out the coupon below and return to us. A 36-page booklet telling how you may become a ship officer at a big salary will be sent you free. Don't delay. Officers urgently needed.

FREE COUPON.

.....

World Technical Institute
Dept. 12, Fuller Bldg., Jersey City, N. J.

Gentlemen:—Send to me free booklet. "Your Future is on the Seven Seas."

Name .....

Address .....

.....

Digitized by Google

Useful Books

Complete Practical Machinist
by Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage No machinist's library is complete without this volume.

547 Pages. 432 Illustrations

Price $3.00

Metal Worker's Handy-Book of Recipes and Processes
By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations

Price $3.00

Techno-Chemical Receipt Book
Edited with Additions by Wm. T. Brannt and Wm. H. Wahl

This well-known Receipt Book is a mine of accurate information that everyone may work to great advantage. It is encyclopedic in range, yet gives only the best formulas for each preparation or operation, and thorough tests by competent men guarantee their intrinsic merit.

A compact and reliable collection of approved receipts and processes, containing thousands of receipts covering the latest, most important and most useful discoveries in chemical technology and their application in the useful arts and industries. It is indispensable to every practical man and contains 500 pages, closely printed, giving an immense amount of matter on a great variety of subjects. Every care has been taken to select the very best receipts of each kind and there are few persons, no matter in what business or trade they may be engaged, who will not find in this volume something of use and benefit to them. The library of the laboratory, factory or home is not complete without a copy of this handy and useful book of reference.

516 Pages. 78 Illustrations

Price $2.50

Friction, Lubrication, Fats and Oils
By Emil F. Dieterichs

When we realize that it is no figure of speech, but a bald statement of fact, to say that lubrication alone keeps the wheels of industry turning, then we must look respectively upon this as a question of vital importance in this mechanical age. The author, himself a chemist and an inventor and manufacturer of lubricants, wrote this manual for the mechanic and manufacturer of ordinary education, that the busiest man might learn the main facts of friction, the origin and charteristics of fats and oils, their uses, their adulterations, their practical testing and the best ways to make them serve his own particular ends

Price $1.50

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.
Publishers of Mechanical and Industrial Books
2 West 45th Street, New York, N. Y.

We're Prompt!

RECO QUALITY

You don't have to wait from three weeks to three months, for the apparatus you order. On everything except apparatus specially constructed to order, you'll have the benefit of

Shipment Guaranteed Within Twenty-Four Hours

Watch for our new bulletins and ads in the magazine describing our new apparatus. A new design every month at prices within reach of all.

Audions and Amplifiers

Audion Control, without bulb or B batteries	$22
1 Step Amplifier, without Detector	$28
With Detector	$33
2 Step Amplifier, without Detector	$45
With Detector	$50

10-Ampere Reco Key

Mounted on Italian marble base with solid silver bar contact points, finished in brushed brass or nickel. Absolutely no side play in this Key. A great big special at $6.50 postpd.

The RECO ADAPTER $1.50 P.P.

If you want a bright, snappy, monthly bulletin that means something; send us 6c in stamps.

Any apparatus made "your way" from your own design, and all parts furnished for Variometers and short-wave regenerative receivers.

Radisco Agents for the South

Baltimore, Md.
The Radio Engineering Co.

614 North Calvert Street

BURGESS "B" BATTERIES

SEVERAL SIZES FOR SPECIAL WORK



SEND FOR CATALOGUE

BURGESS BATTERY COMPANY

HARRIS TRUST BLDG.- CHICAGO, ILL.



DUCK'S No. 13 264 Pages
Electrical and Wireless Catalog
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

Send for
HALCUN Radio Catalogue
Full Line of
Amateur Requirements
Halcun Radio Co.
San Francisco, Calif.
Formerly Haller Cunningham Elec. Co.

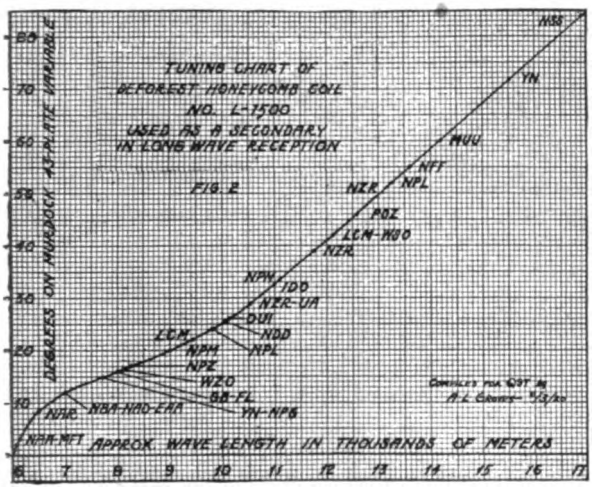
RADIO APPARATUS
on the
INSTALLMENT PLAN
Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.
J. DONALD VANDERCOOK
LOMBARD Box 442 ILLINOIS

EVERYDAY ENGINEERING MAGAZINE
Is Now 20 Cents Per Copy
SUBSCRIBE AND SAVE MONEY

Digitized by Google

DE FOREST

This is What Amateurs Do



(Illustration by Courtesy of Q. S. T.)

A wave-length chart showing DeForest "Honey Comb" Coil reception by an Amateur unknown to us. He has written an article on the value of these Coils. Read it in the March number of Q. S. T.

With "Honey Comb" Coils and a *Single* Audion!

Look at this chart. The Amateur who made it says that with DeForest "Honey Comb" Coils *"P O Z jumped up at me like he had suddenly moved a thousand miles nearer."* Nothing exceptional about his results. Thousands of Amateurs report equal satisfaction with DeForest "Honey Comb" Coils. Any Amateur can do as good. If you haven't tried DeForest "Honey Comb" Coils you are not getting signals you can brag about! Find out more about them now.

Send for the DeForest Catalogue

A 36-page book full of vital Radio information for the Amateur, including hook-ups and much other data. Sent postpaid for 10 cents in stamps. *Send for yours today.*

DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY

Inventors and Manufacturers of High Grade Radio Apparatus.

1403 SEDGWICK AVE. NEW YORK CITY

Lee DeForest Incorporated, 451 Third St., San Francisco, Cal.

Western Distributors Shipments Made from San Francisco Stock

DE FOREST

STATIC

comes in at low audible frequencies

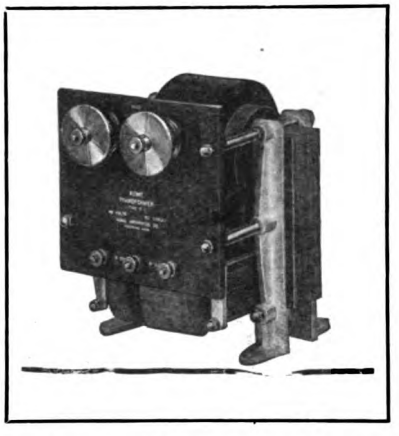
Signals from Acme Transformers

come in at high audible frequencies.

Designed for use with rotary gap of 700 to 800 sparks per second.

RESULT

With ACME TRANSFORMERS communication can be maintained when others have given up hope.



Acme Apparatus Company, 24 Windsor St., Cambridge 39, Mass.

RADIO AND TRANSFORMER ENGINEERS AND MANUFACTURERS

A Few of the Distributors Who Can Supply You With

The Famous "Standard VT Batteries"

American Electro Tech. Appl. Co.
L. Bamberger & Co.
Clapp-Eastham Co.
De Forest Radio Tel. & Tel. Co.
William B. Duck Co.
A. H. Grebe & Co.
Holt Electric Utilities Co.
Kelly & Phillips Elect. Co.
Manhattan Electrical Supply Co.
A. P. Merchant Co.
Paramount Radio Supply
Geo. W. Parezo Co.
Radio Electric Co.
Radio Equipment Co.
J. M. Zamoiski Co.



Ask your dealer for the "Standard VT Battery" — The "B" Battery of sterling quality that assures satisfaction. Outclasses the ordinary "B" Battery in operating life and costs no more. Refuse imitations or substitutes and insist on the genuine "Standard VT Battery"—made in two sizes and two types—variable and non-variable.

RICHTER & BYRNE, *Manufacturers*, 1377 40th St., Brooklyn, N.Y.

PACENT ELECTRIC CO., INC., SOLE EASTERN AGENTS, 150 NASSAU STREET, NEW YORK, N. Y.

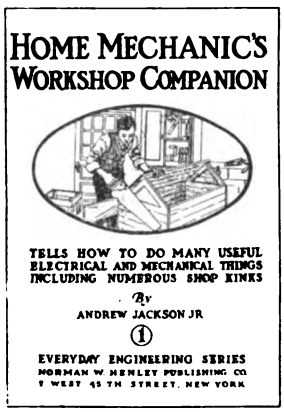
Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

A SPECIAL OFFER TO OUR READERS

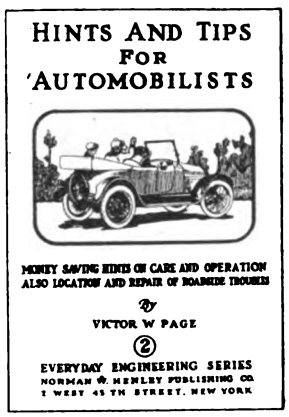
ANY ONE OF THESE VALUABLE BOOKS WILL BE SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION

ILLUSTRATED BY SPECIAL DRAWINGS AND PHOTOGRAPHS—RADIO BOOKS CONTAIN MANY WIRING DIAGRAMS



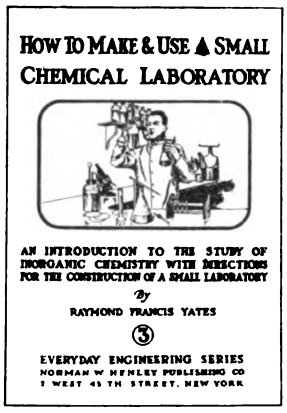
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.



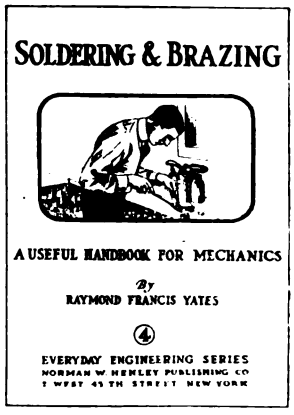
For the Automobile Owner or Driver

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints.



For the Student Chemist and Experimenter

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.



For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work.

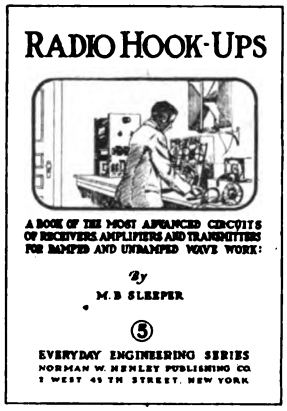
For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuit diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details.

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

For the Radio Engineer and Student

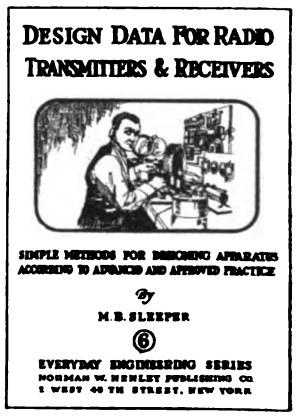


All of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest.

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOUR OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

Fill Out the Special Blank Below
Check Off the Title Desired and Mail with Your Remittance.
Special Circular Describing These Books Sent On Request.

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man—the Mechanic and the Radio Experimenter.



EVERYDAY ENGINEERING MAGAZINE

2 WEST 45th STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for.....years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the.....
(Date of issue)
issue. I enclose $....., and according to your special offer send me copy of book checked off.

Name .....

Street .....

City .....

State .....

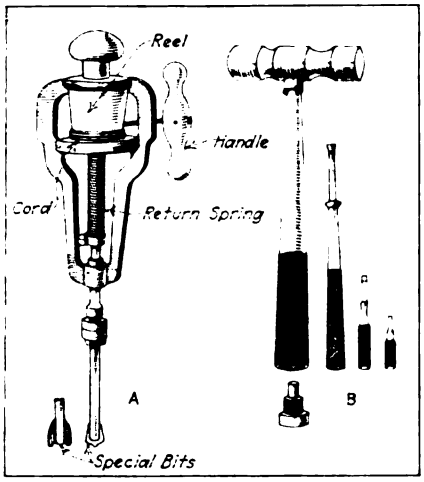
TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS Check off title desired here		
1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google

NOVEL ENGLISH TOOLS

THE tools shown in the accompanying illustration were exhibited at a recent English motor car show and should be valuable to motorists because of their simplicity. A new form of valve grinder which is shown at A is provided with special bits to suit the various types of slots in the valve heads.



It is actuated by a reel over which a piece of cord is wound by a spiral spring. Pulling on the handle unwinds the cord and imparts several revolutions to the valve grinding bit. Releasing the pull on the handle allows the spring to return the reel and cord to its original position, which imparts a rotary motion to the valves in a reverse direction to that given when the bit is actuated by the cord. A very neat arrangement for carrying a set of screwdrivers nested into a hollow metal hammer handle is shown at B. All the screwdrivers have hollow handles and fit into the next larger size. The nest of screwdrivers is held in place by a threaded plug which fits into the end of the handle, and the parts are so proportioned that they are firmly held and do not rattle around when the hammer is used.

UNTYING KNOTS

IT is often a difficult business to get rid of knots in ropes especially if these are of long standing. By following the plan indicated it is a simple matter to free the hardest knots whether these be in straps, harness, rope, cord, or anything of a similar nature. As a first step place the knot on some hard surface and give it a good hammering on all sides with a mallet or thick piece of wood. Now boil up a little water with soap in it sufficient to make rather a cloudy solution. Then soak the knot for two or three minutes in the liquid. At the end of this time it will be found that it can be quite easily untied, often enough with the fingers. The loosening can be done with some sharp implement.

The toolmaker says:

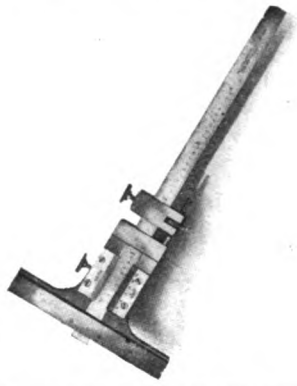
"Yes, I've got quite a number. No more, probably, than most toolmakers, but quite a number just the same. But then, I ought to have a lot of 'em. I've been buying Starrett Tools ever since I was an apprentice.

"You know my work calls for pretty close limits, and some way or other I've got a feeling of confidence in Starrett Tools that makes it easier for me to do good work.

"When did I get my first Starrett Tool? Oh, somewhere back in the 80's. In fact, it must have been pretty soon after the Starrett factory started. There's one thing that always impressed me. Right from the start, Starrett Tools have been designed and made by men who knew machine shop practice You know, practical men. And somehow it shows in the quality of the tools."



Starrett Tools



The L. S. STARRETT COMPANY
THE WORLD'S GREATEST TOOLMAKERS
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

42-988

Accuracy, utility, and quality are built into every Starrett Tool. Write for Catalog No. 21 "M B"

Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $2.00.

An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO., Niles, Mich.

HANDY

THAT'S THE WORD TO DESCRIBE THIS NEW utility chest—the handiest, sturdiest, chest for garage or home use, for auto-mechanics, electricians, plumbers, linemen. Its solid oak frame, rigidly held together by lock-cornered joints—twice as strong as dove-tailing—insures tool safety against theft, rust, bangs, knocks or outdoor weather. Get the details about this chest and the other 18 Union sizes and styles. Write for Catalog, prices and name of nearest dealer and guarantee. If no dealer near you, write for special offer.



Union Tool Chest Co., Inc., 34 Mill Street, Rochester, New York

UNION TOOL CHESTS

Speed Lathe $7 Complete Swing 7 ins. 24 in. metal bed

Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

REWINDING A. C. MOTORS

And all methods for connecting and reconnecting are clearly shown in the ELECTRICAL WORKERS FRIEND. 66 diagrams with detailed explanations solving every rewinding and reconnecting problem. Electricians and Experimenters will find this book exactly what the name implies "The Electrical Workers Friend." Price $4.00 Cash with order or (C.O.D.—U.S.A. only).

HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Penna.

EVERYDAY ENGINEERING MAGAZINE
Is Now 20 Cents Per Copy SUBSCRIBE AND SAVE MONEY

Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

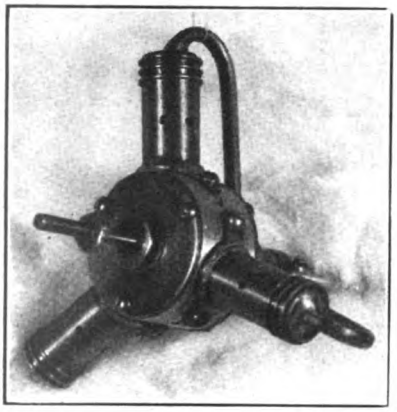
SET OF II SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

Compressed Air Motors



THE new and improved method of propelling your model aeroplane. Manufactured of the finest materials. Workmanship guaranteed. Special propellers for the above motors. Send stamp for descriptive circular of these wonderful motors. We manufacture everything for the model aeroplane builder. Give us a trial and be convinced.

HEC AEROPLANE CO.

302 East 49th St. New York City

NOW YOU CAN FLY!

A REAL AEROPLANE AT LOW COST



THE DELERAY D-5 SPORT PLANE

Wing Span 18 ft Speed 35-65 m.p.h.

Planned by men with 4 years' experience in Designing successful U. S. Government planes. Equipped with 15 H.P. engine (practical engineering made it possible for this biplane to be flown with only 8 H.P.) Use your own motorcycle engine if you wish.

Send $6.00 for complete set of 18 large detailed blueprints, actual duplicates of our shop drawings, showing exactly how each part is made and fitted.

DELERAY AIRCRAFT WORKS

AEROPLANES ENGINES PARTS

FREEPORT, LONG ISLAND, N. Y.

Send for This Book of Model Aeroplanes

Tells how you can build and fly accurate, reduced-scale Models of real Aeroplanes; DE HAVILLAND Battle Plane, NC-4 and others. You can build one easily. Send 10c in stamps NOW and get this 48-page book. Plans for Model Aeroplanes—NC-4, 50c; DE HAVILLAND Battle Plane, Curtiss Military Tractor, Bleriot Monoplane, Nieuport Monoplane, Taube Monoplane, 35c each; Cecil Peoli Champion Racer, 25c. Send for Plans or Book Today.



IDEAL AIRPLANE & SUPPLY COMPANY

Making Model Aeroplanes Since 1911

Cor. W. Houston & Wooster Sts. New York



BOYS Get the most attractive warning sign made. Your den is incomplete without it. Printed in bright red on white stiff cardboard. 7¼" x 11¼". Reduced to 10c each, in coin only. Send stamp for postage. Don't buy plain printed signs. Satisfaction guaranteed or money back. Sent unbent.

BECK NOVELTY HOUSE

Dept. D, 1298 Carroll Street, Brooklyn, N. Y.

UmakeM Airplanes Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Don't Scrap Aluminum Parts

Save them with SO-LUMINUM. New, great welding solder, stronger than aluminum, perfect substitute for acetylene, welding—¼ time and cost. Use gasoline torch or soldering iron. No flux required. Booklet on request. Sample bar $1.00. Used and endorsed by United States Army and Navy, British Munitions Board and leading aeroplane and motor truck companies.

SO-LUMINUM MANUFACTURING CO.

1790 Broadway New York

FLYING AT HIGH ALTITUDES

THE advantage of flying at high altitudes, with provision for maintaining engine power, is pointed out in a recent issue of *Flight* and the difficulty of attaining such conditions discussed.

Under normal conditions the density of the air at 20,000 ft. is only half that at ground level; also the engine power falls off approximately as the density. At the same time, owing to the density being halved, the lift of the wings is also halved, and to make up the loss in lift the angle of incidence must be increased.

If, on the other hand, it were possible to maintain power at height the machine would be able to fly faster, since the resistance, other things being equal, is directly proportional to the density; but the speed has to be increased to obtain the required lift. However, as the horsepower varies as the cube of velocity and thrust is inversely proportional to speed, the increase in speed to obtain the same lift as a constant angle of incidence is not attainable.

In order to maintain engine power it would be necessary to either carry a supply of oxygen, or over-dimension the engine, raise its compression and regulate the fuel supply at low altitude or supercharge; all of the above add weight to the airplane in addition to the extra weight which might be required for apparatus to supply air or oxygen to the pilot and passengers.

THE LANGMUIR CONDENSATION PUMP

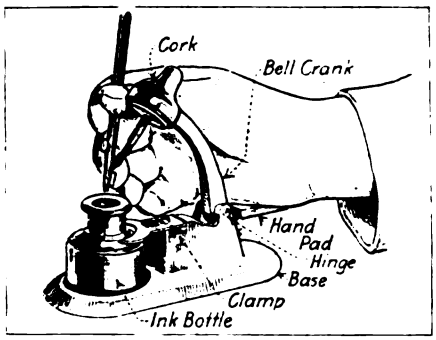
(*Continued from page* 130)

ness, so let us try it this way. First, to get an idea of what atmospheric pressure means in terms of molecules, suppose each molecule of air enlarged to the size of a fine grain of sea-sand or sure means in terms of molecules, suppose each molecule of air enlarged to the size of a fine grain of sea-sand or 1/100th of an inch in diameter. How big a beach could be made from the sand corresponding to the contents of a cubic inch of air at atmospheric pressure? It would make a beach extending from New York to San Francisco, one thousand feet wide and over ten feet deep. Had it been on such a beach as this that Alice's friends were strolling when the Walrus put his hypothetical question of seven maids with seven mops sweeping for half a year, there could have been no doubt in the Carpenter's mind of the futility of their suppositious efforts. And yet by the aid of the Langmuir pump, assuming the sand were air again, that magnificent beach could in a few minutes be reduced to an almost invisible line only two grains broad and one grain deep.

Digitized by Google

DUST-PROOF INK BOTTLE

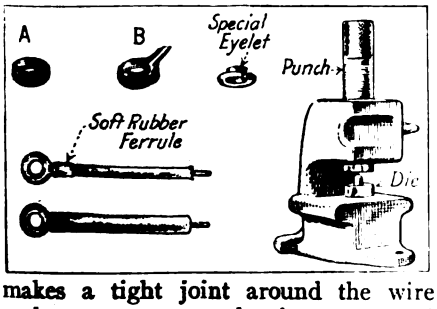
THE simple device shown herewith is a very useful ink bottle holder for draftsmen and artists. The ink bottle is tightly closed, but with a cork that is installed in one end of a bell crank lever instead of one that is free from all connection with the bottle. The lever is hinged at the base holding the bottle, and connected in such a way that the pressure of the hand on the short arm of the bell crank lifts the cork out of the bottle neck and leaves the bottle open.



The cork is one with a quill fixed in its bottom; and the relative position of the hand pad and the quill is such that while the cork is held out of the bottle with the wrist, the hand is in the right position to sweep the pen across the point of the quill and load it with ink. So instead of three unconnected operations, one fills the pen from this dust-proof bottle with a single series of motions—a sweep of the arm bringing the wrist down on the lever, followed by a twist of the wrist to secure the ink. The re-corking is automatic, taking place by spring action as soon as the weight of the hand is removed from the lever, so that no forgetfulness can result in an open bottle. The heavy base keeps the bottle from tipping over and the automatic cover means positive enclosure and keeps the dust out.

NEW TERMINAL MACHINE

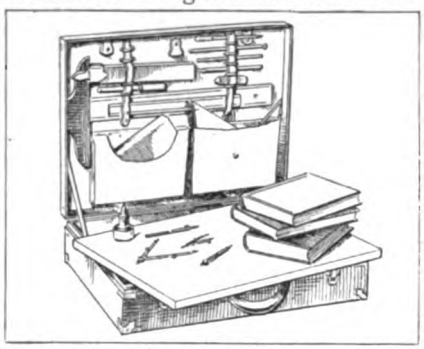
A VERY simple form of punch and die arrangement for rivetting over a copper or brass eyelet, to form a terminal is being marketed by a prominent magneto concern. This



makes a tight joint around the wire and a very neat one, that insures a good contact under the terminal clip. The terminal end is composed of a cup having a channel in which the wire is placed and a central opening in which the tubular shank of the eyelet is pushed after the wire is laid in the channel. The terminal end is then laid on the die and the punch is driven down with a sharp blow from a hammer. This bends over the shank of the eyelet and firmly holds the wire between the two parts of the terminal. Two forms of cups are provided, the one shown at A being the simplest. That at B shows a form with an extending lip covered with a rubber ferrule after the joint is made.

DRAFTING KIT FOR TRAVELING ENGINEERS

THE travelling engineer in many branches of industry, especially in the construction and erection lines has been inconvenienced in his drafting work by the lack of a kit which could be easily moved from point to point and one in which he could carry all the paraphernalia such as T-square, instruments, slide rule, bottles of ink, etc. A Milwaukee engineer has contrived a



kit to meet these conditions, which is shown in the accompanying illustration. It consists of a leather-covered case much like the ordinary suitcase. This is large enough to hold an 18 by 24-inch drafting board which is placed on top of the lower portion of the case when open. There is enough space below the board to carry several handbooks, ink bottles and miscellaneous supplies. In the cover are two slip-in envelopes for triangles and set of instruments. Then there are two narrow leather straps made up with loops to hold a T-square, slide rule, eraser, pen, pencils and scale, all of which are plainly shown in the illustration.

DISTILLATE PRODUCTION DISCONTINUED

THOUSANDS of owners of motor vehicles on the Pacific Coast who have been operating their machines with distillate will be forced to use gasoline unless a carburetor is perfected to burn kerosene, through the decision of the Standard Oil Co., to discontinue the distribution of distillate. This action was taken by the company because of the scarcity of crude oil and the necessity to refine it more thoroughly in order to produce more gasoline.

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 2079B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____

Present Occupation_____ 7-28-10

Street and No._____

City_____ State_____

UmakeM Club You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 19 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money. W. Q. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 5th Ave., N.Y.

Mathematics Made Easy

The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only $1.00 postpaid. Order today before you forget. Dept. U, L. J. LEISHMAN CO., Ogden, Utah

Digitized by Google

THOMAS-MORSE MAIL PLANE

THE Thomas-Morse mail plane illustrated herewith is a biplane which has a center nacelle and twin fuselages. It carries its two engines in the center nacelle, one in front and one in rear. The pilots, having dual control, sit in the two fuselages, the nacelle being given over to the engines, which are Wright-Hispano engines rated at 300 hp. each, and to compartments for freight.



Side view of Thomas-Morse mail plane using two engines in a central nacelle

The ratio of loading is such that the weight of plane empty is 2890 lbs., the useful load being 2610 lbs., almost the weight of the machine itself. The framework is laminated wood built up to a strength which gives a factor of safety of six. A cross-section of the wing is said to be more nearly like the cross-section of the wing of a bird than that of any other airplane. It is usually thick at the front like the wing bone and tapers toward the rear. The foundation of the trailing edge is a wire stretched across the spar tips. Every part of the plane is streamlined to reduce parasitic resistance. The only exposed wires are those used for bracing between the planes. The control wires except those to the ailerons are inside the fuselages. There are two complete control systems—one in each fuselage. In flight tests, the plane has demonstrated that it will stay in the air without losing altitude with only one engine running. The wing spread is 45 ft. 6 in., the wing chord 8 ft. 10 in. and the overall length 25 ft. 10 in. The maximum speed is 130 m.p.h. Four of these machines are being assembled for the aerial mail service.

INK FOR WRITING ON CELLULOID

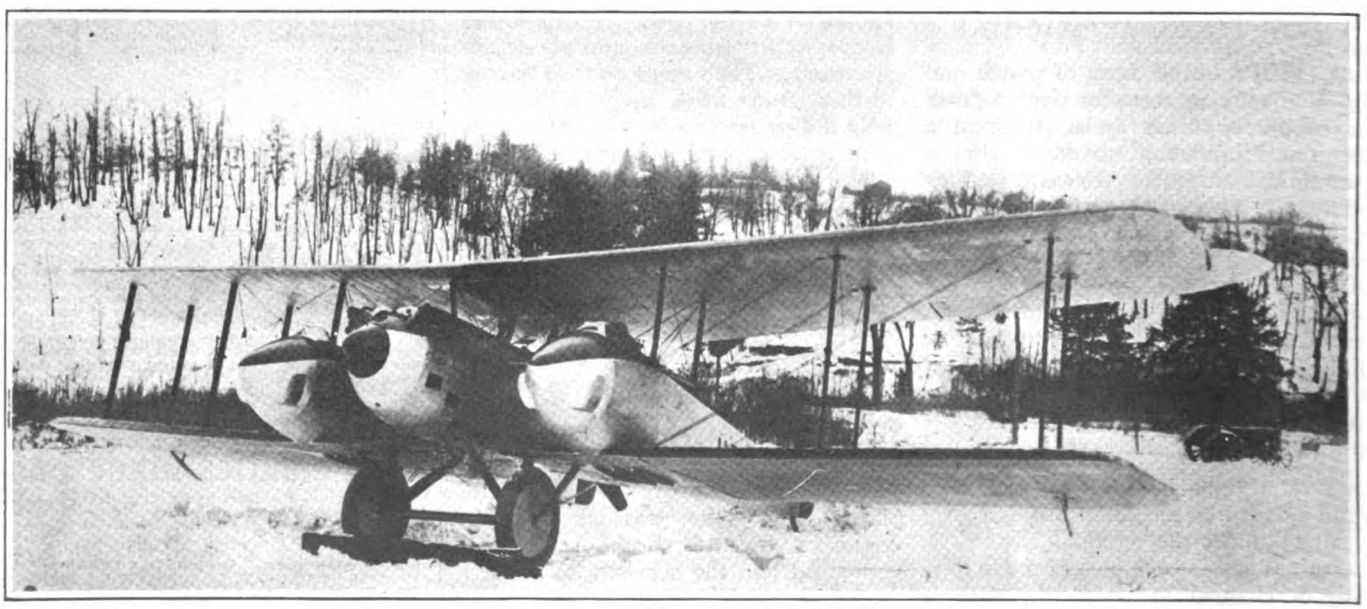
INK for writing on celluloid triangles, etc., can be prepared by dissolving a tar dye stuff of the desired color in anhydrous acetic acid.

WHEN PUTTING CAR IN COMMISSION

IF a car has been laid up for more than a couple of months, it is advisable to introduce a plentiful supply of oil into the cylinders through the valve caps or spark plug orifices. Care should be taken that the oil does not run out through the open valves, but that it is applied to the top of the pistons. The quantity to be introduced is as a rule, two or three tablespoonfuls, which should be sufficient, and when the engine is subsequently started (with a full supply of fresh oil in the sump) a great deal of blue smoke will issue from the exhaust, but this will soon pass off. The engine should not be run at a high speed for five or ten minutes after it has been started, to give time for the oil to circulate to the bearings. On the other hand the engine speed should not be very low, but one that will be sufficient to cause the lubricant to be thoroughly thrown up by the connecting rod ends to the various parts.

The air pressure at the center of the earth, were there a shaft reaching thereto, would be about 6,000 tons to the square inch. The figures calculated for the proposed 12 mile deep shaft give a doubling of the atmospheric pressure for every two or three miles. Air shields and locks would be needed to make it accessible to the workmen and observers. To ventilate it liquid air might be sent down in vacuum-jacketed pipes. Aeroplanes have gone up over seven miles in the air, but our penetration of the ground is in only very few cases a little in excess of a single mile.

A totally immersed water wheel, mounted on a float, has been tried at Lyons, France, at the confluence of the Saonne and Loire rivers. It gave 25 horse power at an efficiency of sixty per cent. It would seem that much could be done on this line on rivers free from winter ice.

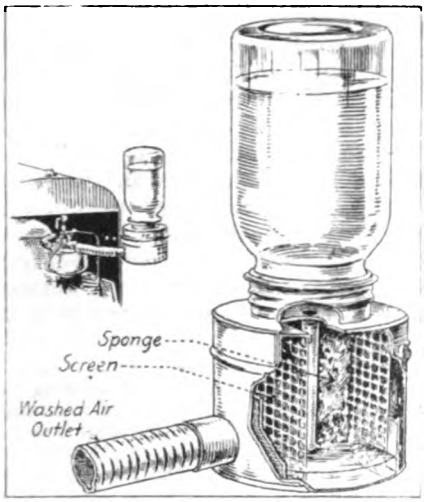


Three-quarter front view of Thomas-Morse mail plane showing central nacelle for engines and twin fuselages for pilots and mail

Digitized by Google

AIR CLEANER FOR TRACTORS

IT has been found desirable to use special types of air cleaners before air is supplied to the carburetors of gasoline or kerosene engined tractors because the dust laden air not only contributes to carbon deposits but also assists in mechanical depreciation by wearing cylinders and bearings and other parts of internal mechanism. Dry cleaners of the centrifugal type are stated to have the disadvantage of not removing the light and fine particles of dust from the air because these do not separate out either by centrifugal force or gravity. Water type cleaners are said to remove all dust only when the air bubbles are very small which is sometimes accomplished by screens in the water to break up air bubbles.



A new type of air cleaner in which water is used has been developed by the Midwest Engine Co. The method of cleaning the air in this device is to draw it through the pores of a wet sponge saturated through its capillarity by resting in about ¼ in. of water maintained automatically and supplied from the transparent reservoir above. As the air zigzags through the pores, the dust is caught by the wet surfaces and held on the surface of and in the pores of the sponge. The sponge is washed out once or twice a day, depending upon the amount of dust in the air.

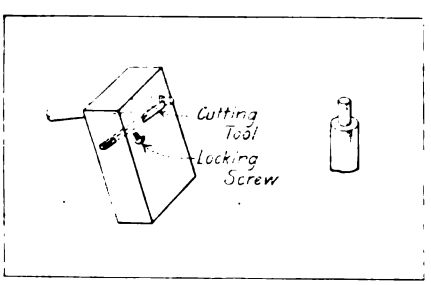
As the cleaner is used, dust will begin to work through the sponge, and if the day is very dusty the dirt may penetrate one quarter the way through. Every time the reservoir is filled, which will be once or twice a day, the sponge should be taken out and thoroughly washed in a bucket of water, put back and the reservoir put in place. There is a hole through the sponge for the feed pipe. When the reservoir is inverted, water will flow into the sponge cup until the end of the tube is covered, and as the water passes up by capillary attraction through the pores, more water will be fed to the sponge cup. Little water is said to be taken up by the air in this cleaner because the air cannot pick up globules of water, only absorb sufficient for complete saturation.

THE DEEP ETCHING OF STEEL

IN Technologic Paper No. 156 of the Bureau of Standards the extent to which defects in steel may be brought out by deep etching is described. A lack of homogeneity is shown at once, internal fractures are emphasized, and any faults due to initial stresses, caused by preliminary mechanical and thermal treatment, may be revealed. Segregation is indicated by a roughened surface after etching, due to the greater extent to which the non-metalic inclusions, such as sulfides and oxides are soluble as compared to the metal itself. Stresses due to the mechanical and thermal treatment have been found great enough to cause specimen balls made from the metal to crack when subjected to the action of strong acids. In the case of steel, this is similar to the behavior of brasses and bronze under corrosion tests. Lack of physical homogeneity is usually evidenced by minute cavities resulting in spongy metal. Often internal fractures are so small that the metal appears to be continuous, and this type of fault is frequently found in defective rails of the transverse fissures type. Deep etching reveals these internal fissures as short cracks. Special methods have been developed for the examination of metals by the deep etching process.

TURNING WITHOUT A LATHE

THE cuts show how a shoulder can be cut on brass rod without a lathe. A hole the size of the rod to be turned down is made through a block of fibre. In a direction to intersect this hole a second hole is drilled to receive the cutting tool. The cut shows the disposition perfectly. The tool is set so as to



be in a position to cut off all that is to be removed in one cut. When thus in place it is secured by a set-screw. The rear end of the rod is held in a drill stock or auger brace and turned by hand and gradually fed forward. The result, if the operation is properly carried out, is a perfect shoulder, such as shown in the smaller figure.

Tycos

The Engineering student, the experimenter and the professional technician all find *Tycos* Temperature Instruments — Indicating, Recording, Controlling—well-adapted to their individual needs; and thoroughly *dependable*.

Tycos Instruments include:

Indicating Thermometers
Recording Thermometers
Controlling Thermometers
Pyrometers
Pressure Gauges
Time Controls
Hygrometers
Hydrometers
Barometers
Vacuum Gauges
Thermographs
Oil Testing Instruments
Laboratory Glassware
Compasses
Household Thermometers
Altimeters
Actinometers

Write for information regarding the instruments you use in your own work.

(G.G.-9)



Taylor Instrument Companies
ROCHESTER, N.Y.
There's a *Tycos* and *Taylor* Thermometer for every purpose



Be a Draftsman!
Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial
CYCLOPEDIA OF DRAWING
4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-355 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-355
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

Digitized by Google

Pattern Work in Wood and Metal

Prompt Service Guaranteed

U.S. PMC

Mail Order Work Solicited

Perfect wood or metal patterns made for any of the machines or model engines described in Everyday Engineering Magazine.

BRING YOUR PATTERN PROBLEMS TO US

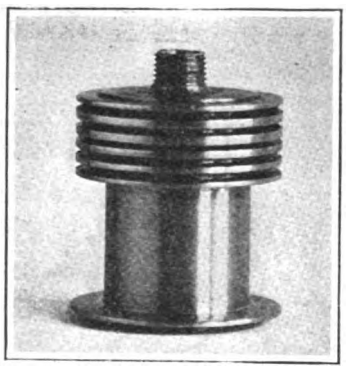
We solicit the work of experimenters, inventors and model makers. Quotations gladly made upon the receipt of drawings and specifications. Patterns both large and small made for any part no matter how intricate or complicated.

Have you had the sad experience of taking a set of home-made patterns to the foundry only to have the foreman laugh and tell you that they are made wrong? Let us save you this embarrassment.

Our charges are reasonable, our service prompt and courteous.

U. S. PATTERN AND MFG. CO.

64-66 High Street, West. Detroit, Mich.



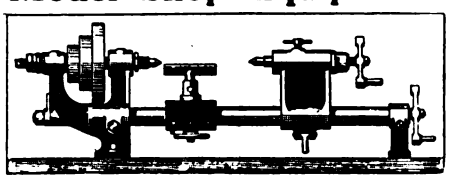
ROTARY steam engines, ¾" bore ¾" stroke, cylinders made of solid steel stock, aluminum crankcase, bronze valve.

We also build motors to specification and will be glad to furnish quotations upon the receipt of drawings. Send for circular to:

Model Machine Shop Company

415 East 71st Street New York, N. Y.

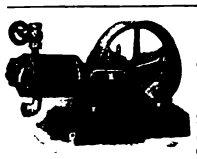
Model Shop Equipment



6 INCH BENCH LATHE

Castings or finished machine. Shop tools and supplies. Designs for Model Boats. Drawings of U. S. Destroyer. Stamp for catalog.

HUHN MFG. CO., 592 Elm St., Arlington, N. J.



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 Illustrations.

MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg. Chicago, Ill.

MODEL ENGINE CASTINGS

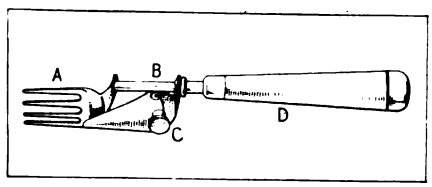
For engines described in previous numbers of "Everyday Engineering." Castings made in Bronze or "Duralite." Model water pumps and spark plugs also supplied.

J. E. CARRINGTON

49 So. Clinton St. East Orange, N. J.

COMBINED KNIFE AND FORK

THIS table utensil is especially for the use of one armed people, although we are free to regard it as adapted for anyone to use to eat his dinner with. Back of the fork, A, and normally above it is a curved knife, C. When the handle, D, is pressed down, the knife slides down back of the fork.



A piece of meat or other food held by the fork is thus cut. If simple pressure of the knife is insufficient a rotating motion can be given by turning the handle to and fro. When pressure on the handle is released the knife is drawn back into its original position, sliding along the rod, B. This rather clever aid to the injured comes from France.

DETECTING FLAWS IN MICA WITH X-RAYS

(*Continued from page* 149)

sharply defined outlines. In fact, the —tinfoil, etc., are a jet black, with smallest piece of metal or wire shows with a distinctness that reduces the possibility of its remaining undetected to almost an impossibility. The same is true of weak or thin spots in the mica itself. The trays themselves are equipped with clearly marked scales, one on the side, and the other on the bottom, as it appears in the reflection, so that by reading the figures it is possible for the observer to tell any one outside exactly which mica piece is faulty and indicate the location of the fault in the piece.

The only limit to the number of strips that can be tested is the speed with which the trays can be loaded and set on their tracks.

The result is a test that cannot fail to show instantly any piece of mica that is faulty for any reason whatsoever, and thus assures the company that all the mica that is sent out is as nearly perfect as is possible from an insulation is that one of the tubes used in this test has an actual running time of one thousand hours to its credit, which is standpoint. A further item of interest nearly, if not, the record for life in an X-ray tube.

An ingenious arrangement for ensuring the perfectly even angular velocity of a rotating body is the following. On the shaft in question there are mounted a square, a pentagon, a hexagon and a star. The rotating figures are shown by a timed series of sparks. Thus if the square appears motionless it shows that, during the interval between two sparks, it has rotated through 90° or some multiple of 90°. Other speeds of rotation are shown by the other figures appearing stationary. A stationary pentagon means a higher speed, and so for other figures of a greater number of points. It enables a high speed of rotation to be closely watched and to be kept constant.

Tidal power, long neglected, is now coming into the field. The great tides of the Bay of Fundy are to be used in a power station of 90,000 horse power. The station is in the center of a 25,000 population. The horse power will cost per unit $80.00 per annum. The tide in the Bay of Fundy rises and falls from 32 to 40 feet.

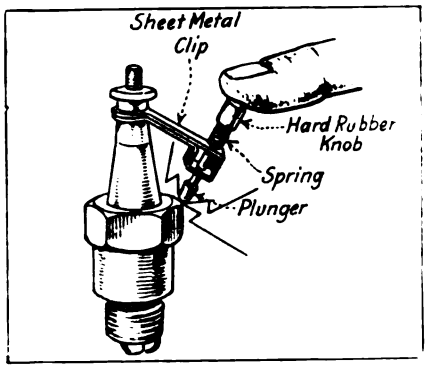
The Pyrenees are now in course of development as a manufacturing region, their water power is being utilized, ten times as much being harnessed as in 1914. What may be called the Niagara Falls products are being made, bleaching compounds, abrasives, caustic soda, cyanamide, aluminum, carbide nitric acid from the air, steel alloys, and it is proposed to make electrolytic iron.

In studying ballistics by the kinematograph exposures at the rate of 20,000 per second were required. This rate and even more were obtained without the use of a shutter by using the Leyden jar spark at 5,000 volts potential, and controlled by a jet of air. It was found possible to get 80,000 sparks a second. Each spark gave an exposure; no mechanical shutter could be operated at anything like such speed.

Digitized by Google

NOVEL SPARK PLUG TESTER

A NEW device for testing spark plugs has recently been introduced by an English manufacturer. The device consists of a spring supported plunger carried by a simple bent sheet metal fitting that screws down under the terminal nut. Pressure on the insulated knob overcomes the spring pressure and brings the plunger close enough to the plug body to show a spark if the ignition device is functioning properly. The construction is



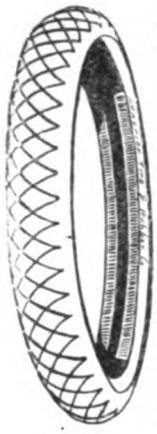
simple and there is nothing about the device to get out of order. It eliminated the use of a screwdriver blade, hammer head or other makeshift in making the tests and permits one to short circuit a plug at will in endeavoring to locate a cylinder that is not firing. If only one cylinder of a four or six cylinder engine is at fault, when the spark plug in that cylinder is short circuited, it will not affect the running of the engine. If the plug in one of the operative cylinders is shorted the engine runs even more irregularly so the faulty cylinder can be easily lolated by testing each plug in turn.

VALUE OF U. S. PETROLEUM PRODUCTS

PETROLEUM and its products can well be said to be our greatest national asset, the exports to date exceeding $4,000,000,000, or more than all the gold mined in America since its discovery. The annual production of oil is now eight times in value the production of gold, and it equals, if indeed it does not exceed, the annual output of all of the minerals, as well as all other precious metals and gems combined. There are over 300 by-products made from crude oil. They include benzine, gasoline, lubricating oil, naphtha, kerosene, fuel and paraffin, asphalt products, axle grease, coal tar and soaps.

Off the coast of Queen Charlotte's Island, in the North American Arctic, it is proposed to use the aeroplane to search for whales. The cetacean can be detected at a distance of thirty miles from the working height attained and its location is given to the ship by wireless.

Triple the Mileage at ¼ the Cost



4000 Miles Guaranteed

Reconstructed for durability. Superior Super-Fabric Tires represent quality, value, service and satisfaction, and are guaranteed for 5,000 miles good wear. Tires have 12 plies of fabric of ordinary tires making them practically puncture and blow-out proof.

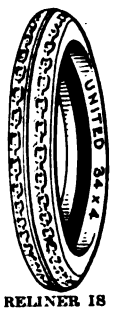
Look at these Low Prices

SIZE	TIRE	TUBE
30x3	$6.00	$2.50
30x3½	7.00	2.60
32x3½ s. s. only	8.00	2.70
31x4	9.00	2.90
32x4	9.25	2.95
33x4	9.50	3.00
34x4	9.75	3.10
34x4½	11.25	3.35
35x4½	11.50	3.40
36x4½	12.00	3.50
35x5	12.75	3.70
37x5	13.25	3.85

Reliner Free With Every Tire—State whether you want straight side or clincher, plain or non-skid. Send $2.00 deposit for each tire; $1.00 deposit on tubes; balance C. O. D. subject to examination, or 5% discount if full amount is sent with order.

SUPERIOR TIRE & RUBBER COMPANY
Dept. 100, 633 First Avenue, New York City

SAVE MONEY!
A High Grade
INNER TUBE FREE
6000 MILES Guarantee



Economy Reconstructed Tires made by our new special process are guaranteed to give good service because the best materials are used in their construction. Our tires are guaranteed for 6,000 miles and we give a FIRST quality inner tube free with every tire ordered from us. Our tires are reinforced with extra plies of fabric making them strong so they resist punctures and blowouts.

RELINER IS FURNISHED WITH EACH CASING AT NO EXTRA COST.
THESE PRICES INCLUDE CASING, RELINER AND TUBE.

30x3	$7.15	33x4	$11.00	35x4½	$13.15
30x3½	8.25	34x4	11.25	36x4½	13.50
32x3½	9.00	32x4½	11.75	36x5	14.50
31x4	10.10	33x4½	12.25	37x5	14.50
32x4	10.45	34x4½	12.90		

State with your order whether a straight side or clincher, plain or non-skid tread. Send a deposit of $2 for each casing ordered. Balance C. O. D. subject to examination. 7% discount if full amount is sent with order. References furnished if desired.

UNITED ECONOMY TIRE CO.
205 West 48th Street New York City

GOODYEAR
SERVICE STATION
(At Jamaica and Far Rockaway)
LET US QUOTE YOU
on any tire made. We stock:—

Always the BEST at the RIGHT price.

GOODYEAR
PENNSYLVANIA
GOODRICH
GLOBE
McCLAREN
HORSE SHOE RACINE
NORWALK-CORD
MARTIN-CORD
KELLY-SPRINGFIELD
(At New York)
UNITED STATES, etc.

Supplies AT COST to tire patrons. IT WILL PAY YOU to trade with:—

JAMAICA TIRE & RUBBER CO., INC.
138 West 49th Street.....New York
Hillside and Flushing Avenues.....Jamaica, N. Y.
1508 Central Avenue.....Far Rockaway, N. Y.
43 East Main Street.....Patchogue, N. Y.
"Largest, because we serve best".

$1 Week
Own This Superb Bicycle!



Have fun and healthful exercise with a Black Beauty, the finest bike in the world. *Write Quick* for our Illustrated Catalog. Pick your wheel from our 40 styles. Black Beauty will be shipped at once. We pay freight. To make the Black Beauty yours, pay a small deposit, then $1 a week.

18 Exclusive Features of this sensational wheel are: $10 FIRESTONE Blue Non-Skid Tires; New Departure Coaster Brake; Duckworth nickel roller chain; motorcycle saddle, pedals and handlebars, etc.

Repair Kit, Tool Case and Stand, Free! Although low in price, the Black Beauty far outclasses other wheels. Racy, graceful lines, fascinating color combinations, dazzling nickel and enamel finish! Absolutely *guaranteed for 5 yrs.* Six months' *free accident insurance.*

Sundries Get our factory prices. Positively lowest in country. Tires, bells, lamps, horns, pedals, etc. Send for *Free Sundries Catalog.*

HAVERFORD CYCLE CO.
(Established 24 years)
Dept 475. Philadelphia

pays for the **Black Beauty.** FREE Catalog in colors

WANTED

Want ads for thousands of trained Automobile Repairmen are appearing in all the papers all over the Country. New Garages and Shops are badly needed everywhere. If you are earning less than $30 a week—YOU SHOULD LEARN THIS TRADE.

You Can Earn $150 to $400 a Month

Come to this school and learn. We teach by actual practice on all kinds of cars. A few weeks time learning will fit you for a position in a garage, service station, or you can start in business for yourself. (No colored enrollments solicited.)
WRITE FOR FURTHER PARTICULARS

DO IT TODAY SEND IN COUPON

BUFFALO AUTO SCHOOL, No. E.E.I.
463-471 Connecticut St., Buffalo, N. Y.
Please send me full particulars of your complete Automobile Course.

Name..... Age.....
Street or R. F. D.....
City..... State.....

TIRES 1/3 LESS



Perfect, new tires, all sizes, non-skid or plain, fabric or cord. Prepaid on approval. 8000 to
10,000 Miles Guaranteed
30,000 Customers. Catalog Free. Agents Wanted.
Service Auto Equipment Corporation
986 Service Bldg., Kansas City, Mo

You Can Save $50.00



By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. **$8.46 and up** Parcels Post Paid
We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.
LIBERTY TOP & TIRE CO., Dept. E3, Cincinnati, O.

Digitized by Google



NOW is the time to start to build your own permanent, profitable battery charging business. Others are making big profits from HB Battery Charging every month. You can too. The demand for reliable, high-grade battery charging was never better. Start NOW, with HB equipment.

Make HB Battery Charging Your Biggest Money-Maker

It costs only 10c to 15c each to charge batteries—the customer pays 75c to $1.50. Figure your profits. All HB Chargers are sturdy, dependable and absolutely reliable. Built of practically wear-proof materials. No burnouts, no expensive renewals or repairs. No attention except occasional oiling. Use power from your lighting lines. Big, quick, clean profits, easily made. A size to suit any battery business.

SMALL CASH PAYMENT—BALANCE ON EASY MONTHLY TERMS

CHOOSE THE SIZE YOU NEED



Sold on Trial Under HB Absolute Money-Back Guarantee

All HB Equipment is sold under our absolute guarantee of satisfaction. You run no risks. If not satisfied after using any HB Equipment 10 days, you may return it and receive all you pay us. The HB Monthly Payment Plan is an additional guarantee.

Check the Charger You Need. Then Mail this Ad.

Mark a cross on the HB Charger you are interested in. Tear out this ad and mail TODAY for full information. Be the first in your town to have a money-making HB Charger. Don't delay. Act Now. Write to

HOBART BROS. CO., Box EE57, Troy, O.
Successful Manufacturers Since 1893.

Genuine Armstrong Stocks and Dies



Great care should be exercised in the selection of stocks and dies. Work of quality demands quality tools.

Genuine Armstrong Stocks and Dies are quality tools. Made of the highest quality of material and by expert workmen. They are dependable and accurate tools of constant service.

Send direct to us if your dealer cannot supply you.

Descriptive Catalog on Request

The Armstrong Manufacturing Co.
701 Knowlton Steet Bridgeport, Conn.

SHIP BY TRUCK

Motor Cartage.

One to Five-ton Trucks.

Hauls made to any point in United States and Canada.

Rates by hour, day or contract.

W. H. SQUIRES
1561 Woodward Avenue
Detroit, Mich.

THE KNACK OF CARBURETOR ADJUSTMENT

(*Continued from page* 118)

the mixture. In this form the multiple nozzle construction is employed to do away with the automatic air valve, all air being drawn through the primary air opening at the bottom of the mixing tube D. A strangling tube A is dropped into the air tube in order to constrict its area at the spray nozzle and secure a Venturi tube effect. Outside of the idling jet adjustment the only way to alter the mixture in a Zenith carburetor is to change nozzles and strangling tubes.

Rayfield Mixed Type

Rayfield uses a metering pin, as shown at Fig. 9, which is lifted as the throttle opens in the main jet through a linkage, and so establishes a right to be classified as a metering pin type, but it goes further: It incorporates an auxiliary nozzle, which also has a metering pin which is depressed when the auxiliary air valve opens. Thus, by having two distinct nozzles, it establishes its right also to be classified as an expanding type of instrument. But Rayfield goes still further in that it combines a pumping action on the gasoline in the auxiliary nozzle whereby a very rich mixture is furnished for acceleration whenever the air valve is opened suddenly. This is accomplished by the piston, the lower end of the air valve stem this piston working in a dashpot above the piston and is admitted to the space below the piston by the disk valve in the piston. When the air valve suddenly opens, forcing the piston downward, this disk valve is closed automatically, forcing or pumping the gasoline upward through the fuel passage into the nozzle, where it is sprayed into the inrushing air. Only when the valve opens is this pumping function occurring. At other times the gasoline issues through this auxiliary nozzle according to the suction of the motor. Thus Rayfield is a compound of two metering pins in conjunction with the pumping function for acceleration. The dashpot also prevents any fluttering action of the valve, since the gasoline flow dampens sudden opening or closing.

Rayfield Adjustment for Various Speeds

Adjusting low speed. With throttle closed and dash control down, close nozzle needle H by turning low-speed adjustment N to the left until the block Y begins to leave cam M; then turn to the right about two complete turns. Open throttle not more than one-quarter by advancing lever marked G on steering wheel. Prime the carburetor by pulling steadily a few seconds on lever G (see cut of carburetor). Start motor and allow it to run until warm, then with retarded spark (see lever marked S on steering wheel), close throttle until motor runs slowly without stopping. Turn low speed adjustment N to the left until motor slows down, then to the right, a notch at a time, until the motor idles smoothly. If the motor does not throttle low enough, turn stop screw B to the left until the motor runs as slowly as desired. Adjusting the high speed.—With dash control down, advance the spark about one-quarter and open the throttle rather quickly. Should this cause the motor to backfire, the mixture is lean. Correct this by turning the high-speed adjustment O to the right, one notch at a time, until the throttle may be opened quickly without causing backfiring. If "loading" or "choking" is experienced when the motor is running under heavy load with throttle wide open, the mixture is too rich. This may be overcome by turning high-speed adjustment O to the left. Adjustments made for high speed will in no way affect low speed. Low-speed adjustment N must not be used to get a correct mixture at high speed; it is to be used only when motor is running idle.

General Rules for Carburetor Adjustment

The adjustments should only be made by one possessing an intelligent knowledge of carburetor construction and must never be made unless the reason for changing the old adjustment is understood. Before taking up the adjustment a few hints regarding the quality to be obtained in the mixture should be given some consideration, as if these are properly understood this knowledge will prove of great assistance in adjusting the vaporizer to give a good working mixture of fuel and air. There is some question regarding the best mixture proportions and it is estimated that gas will be explosive in which the proportions of fuel vapor and air will vary from one part of the former to a wide range included between four and eighteen parts of the latter. A one to four mixture is much too rich, while the one in eighteen is much too lean to provide positive ignition.

A rich mixture should be avoided because the excessive fuel used will deposit carbon and will soot the cylinder walls, combustion chamber interior, piston top and valves and also tend to overheat the motor. A rich mixture will also seriously interfere with flexible control of the engine, as it will choke up on low throttle and only run well on open throttle when the full amount of gas is needed. A rich mixture may be quickly discovered by black smoke issuing from the muffler, the exhaust gas having a very pungent odor. If the mixture contains a surplus

(*Continued from page* 190)

Digitized by Google

Statement of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of EVERYDAY ENGINEERING MAGAZINE published monthly at New York, N. Y., for April 1, 1920.

State of New York, County of New York, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Stephen Roberts, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Everyday Engineering Magazine and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager, are: Publisher, Everyday Mechanics Co., Inc., 2 West 45th St., New York City; Editor, Raymond Francis Yates, 2 West 45th St., New York City; Managing Editor, Victor W. Page, 2 West 45th St., New York City; Business Manager, Stephen Roberts, 2 West 45th St., New York City.

2. That the owners are: Everyday Mechanics Co., Inc., 2 West 45th St., New York City; Norman W. Henley, 2 West 45th St., New York City; Edward J. Richmond, 2 West 45th St., New York City; Stephen Roberts, 2 West 45th St., New York City; George Rosendale, 52 Broadway, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiants' full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

S. ROBERTS.
Business Manager.

Sworn to and subscribed before me this 30th day of March, 1920.

(Seal.) ANNIE M. HOLDEN.
(My commission expires March 30, 1921.)

Reg. No. 1461, N. Y. Co. No. 501.

Through Yellowstone with an Auto-Wheel

It makes a dandy hike. You can load all your baggage on the

Auto-Wheel Coaster
or the
Auto-Wheel Convertible Roadster

and see all the sights. See Old Faithful Geyser shooting a column of steaming hot water 175 feet in the air, or a thousand other wonderful things.

The Auto-Wheel Coaster or Convertible Roadster is a mighty dependable helper on such tramps. It carries all the baggage—even a 1,000 pound load is carried without effort. Roller-bearings make the Auto-Wheel pull easily over most any old road.

You may not be able to hike through Yellowstone but the woods 'round your home will make a fine hiking ground. Try it some day.

Our New Magazine for Boys

tells how fellows are making hiking trips. We'll be glad to send it to you. We'll also send you a **Free Felt Pennant** and tell you about the Auto-Wheel Coaster Club which you can organize, if you write telling us the names of three coaster dealers, mentioning which handles the wagons with the name "Auto-Wheel" on the sides.

The Buffalo Sled Co.,
159 Schenck St.
N. Tonawanda, N. Y.
In Canada: Preston, Ont.



$110 A Month To Start As Railway Traffic Inspector



ONLY THREE MONTHS spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today and they're on the road to still further advancement. so write immediately for Booklet D 48 before you turn this page.

WE ARRANGE FOR A POSITION

Standard Business Training Institute, Buffalo N.Y.

BE AN EXPERT
Penman
Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.** Write C. J. Ozment, Dept. 60 St. Louis, Mo.

A USEFUL BOOK
FOR THE AMATEUR ELECTRICIAN

Electric Bells

By M. B. SLEEPER. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated.

Norman W. Henley Publishing Co.
Dept. EE, 2 West 45th Street, New York

Earn $35 to $100 a Week
BECOME A PROFESSIONAL
PHOTOGRAPHER

Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:

MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free

Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.

N. Y. INSTITUTE OF PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.



10 Cents a Day Pays
for This Symphonola

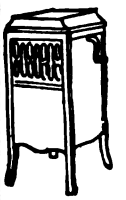
Plays all records, Victor, Columbia, Edison, Pathe, Little Wonder, Emerson. Take a year to pay, after 30 days' trial. Compare its tone for clearness, volume, with more costly instruments. Return at our expense if it fails to make good. Ask today for the

Beautifully Illustrated Symphonola Book FREE
Shows this and other Symphonola styles sold on easy payments.

Symphonola Records Get our list of the latest song, dance, popular, clear sounding, full toned disc records. Playable on any Phonograph.

Larkin Co. Desk SEE 420, Buffalo, N. Y.

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 35 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46M, E. 12th St., N. Y., U.S.A.

DISCOVER YOUR TALENTS

What are you best fitted for? Why drift from job to job? Why experiment with your future? Let an expert psychologist tell you the right vocation in life for YOU. Personal analysis by Dr. S. S. George, former U. S. Army psychologist, will help you to know your mind and what career you are most suited for in life. Send for Booklet "B." Phone Schuyler 5969

THE VOCATIONAL GUIDANCE INSTITUTE
Room 27, 2255 B'way. (81st St.), New York, N. Y.

STUDY HUMAN NATURE

MAKE PEOPLE LIKE YOU

Get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "PERSONAL POWER," a little book that points the way. Address

PROGRESS LEAGUE, 5831 Union Sq., N. Y.

GOING AWAY THIS SUMMER?

You may not be near a news stand while you are away this summer, but you must not miss the radio articles, for you will want the information when you start up in the fall. Don't take chances **SUBSCRIBE BEFORE YOU GO!**

EVERYDAY ENGINEERING

See Our Special Subscription Offer on Page 178 Valuable Books Given Away Free

Digitized by Google

THE
Wireless
World

The Official Organ of the Wireless Society of London

Commencing with April 3d, will be published fortnightly in order to adequately deal with the increasing amount of Wireless Experimental and Research Work.

Full of Practical hints and useful information for Wireless Amateurs.

Extensive reports of the Wireless Societies of Great Britain.

Annual Subscription 17s, Post Free

Single Copies 9d, Post Free

To be entirely up-to-date in your knowledge of Wireless you must be a subscriber to The Wireless World.

To the Publisher,
The Wireless World,
12-13 Henrietta St.,
London, WC2, England.

Please enter me as a subscriber to the Wireless World for the period ..... to .....

for which I enclose.....

Name .....

Address .....

Please write distinctly.

SCHNOTER'S
SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit and low price. If your druggist does not carry Schnoter's, Accept No Substitutes. Sent direct upon request of $1.00.

Send for booklet of other styles and prices.

J. C. SCHNOTER CO.
628 SIXTH AVE. Dept. (E) N. Y. CITY

BUILDING A TWO-PASSENGER SEAPLANE

(*Continued from page* 115)

Select any point (say for instance 2 feet) a given distance from the hub center, then by the aid of a protractor find the angle the chord line of the blade makes with the table. Lay this angle out on paper (this may be laid out to any convenient scale) or the table top, as shown in Fig. 13.

A = Angles of incidence at a given point.

B = Selected diameter X 3.1417.

C = Length of line (taken at 90 degrees to circumference line) is the pitch of the propeller in inches.

For example, the point selection is 2 ft. from the hub center, which is the radius, double it equals the diameter 4 ft. X pi. 3.1417 equals 12.5668 ft., the circumference at that point. Now draw a line from C (which is the length of the circumference 12.5668 from A) 90 degrees to the circumference line, until it intersects the chord line at C. The length of this line is the actual pitch, and should be within one-half of a degree of the specified pitch of the propeller, which should be stamped on the hub. Any error is usually due to the propeller blade distortion, to faulty manufacture, to the hole in the propeller hub being out of place or hub not properly bolted, which is also the cause of the error in tracking. Both blades should be tested at points 2 ft. from the hub and each additional six inches.

Propeller blades should be within 1/8 inch of each other in length. The propeller should balance exactly on a ball-bearing shaft. The camber should be equal in curvature, the area should be tested for equality in surface. Tracking is also esential and may be tested by revolving the propellers, while measuring corresponding points in both tips with some convenient established point. The limit allowed is 1/8 of an inch. This may be corrected by the manipulation of the hub bolts or shimming with paper between the propeller hub and the shaft flange.

When bolting the propeller hub in place it should be set at about 45 degrees past the vertical and should cause ignition in the motor when slightly above the horizontal.

Notes on Flying

The A B C of Aviation by Pagé is an excellent book on Aviation. The suggestions for the art of flying are about as complete as it is possible for a book to give, and its use is recommended to prospective pilots. There is very little that I can add to it. Although the writer was taught to fly by the Army instructors officially at Mineola, he feels convinced that it is quite safe to acquire the art without concrete flying instructions. I realize that I will be criticised severely for this statement, but I shall state a few facts and leave it to your judgment. Of course if it is possible to receive proper instructions it surely is by all means the only sane thing to do. However, the Wright Bros., Curtiss, Bleriot and most of the early pioneers were self-taught with s l u g g i s h , ill-balanced, poorly proportioned machines. Up to and including 1911 the writer saw a number of amateurs take the initiative and became quite proficient aviators. Hadley, in a Farman type, Schneider in a Curtiss type, Brown in a Wright type, Dixon in a Bleriot type of their own manufacture were self-taught and never had an accident with the exception of young Dixon, who was killed flying over the Rocky Mountains in a factory-built airplane in the fall of 1911. These men began by taking short, straight-away flights, gradually increasing the "hops" until they got accustomed to the motion and speed.

It is obviously necessary to understand the controls perfectly, working them automatically as far as humanly possible, and have a thorough knowledge of the mechanics of the airplane. The Army method is to give the student a course of instruction in aerodynamics and aero-mechanics, then have him watcsh the flying until he gets so enthusiastic and anxious that he will almost steal a plane to fly it. He is then given a few rides called "joy rides" to further arouse him. Finally he is taken up in a dual control machine, and after an indeterminate time ranging from the first trip to the 'steenth trip he is given permission to hold the "joy stick" with the admonition that if he did not let go at a prearranged signal he would be struck on the "bean" with a cudgel.

Finally he is permitted to use the "joy stick", and after they attain 500 to 1,000 ft. altitude to bank, elevate and depress the machine on signal from the pilot, who is in the front seat. He continues this until the instructor has a heart to advance him, depending on the personal equation both sides. He is then permitted to use the rudder with the ailerons until he banks and steers simultaneously and satisfactorily. He then practices climbing and gliding. Later he practices the landings and eventually "solos" or flies alone. I have yet to learn of a single accident in all the first solos of more than 200,000 Army and Navy flyers. Any experienced one may acquire riding a fast motorcycle at top notch speed (the Indian model 16 is supposed to do 72 m.p.h) will accustom one to speed and making quick decisions.

THE OUTSTANDING FEATURE OF THE RADIO ARTICLES IN EVERYDAY is that you can believe what you read because tha instruments described are actually built and tested and known to work. They are not ideas on paper. That is why EVERYDAY carries such a high reputation among experimenters.

Digitized by Google

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.
Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop then.

PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs. Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School
YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

"Old Town Canoes"

Form a canoe club. We will furnish constitutions and by-laws. You can pick a fleet of "Old Town Canoes" from the new 1920 catalog. Thirteen graceful models pictured in natural colors. Complete list of accessories. All prices given. First cost is the last—there is no upkeep to an "Old Town". Write for free, postpaid catalog today.

OLD TOWN CANOE COMPANY
945 Fourth Street
Old Town, Maine, U. S. A.



You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 908 Bogue Bldg., Indianapolis

UmakeM Lathe

You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $25. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

NOW 35cts EACH

MODEL LIBRARY SERIES

1. The Study of Electricity for Beginners.
2. Dry Batteries, How to Make Them.
3. Electrical Circuits and Diagrams, Part 1.
4. Electric Bells, Annunciators and Alarms.
5. Modern Primary Batteries.
6. Experimenting with Induction Coils.
7. Electric Gas Igniting Apparatus.
8. Small Accumulators, How to Make and Use.
9. Model Steam Engine Design.
10. Practical Electrics.
11. Inventions, How to Protect and Sell Them.
12. Woodwork Joints, How to Make and Use.
13. The Fireman's Guide to the Care of Boilers.
14. The Slide Valve Simply Explained.
15. The Magneto Telephone.
16. The Corliss Engine and Its Management.
17. Making Wireless Outfits.
18. Wireless Telephone Construction.
19. The Wimshurst Machine, How to Make it.
20. Simple Experiments in Static Electricity.
21. Small Electrical Measuring Instruments.
22. Electrical Circuits and Diagrams, Part 2.
23. Induction Coils, How to Make Them.
24. Model Vaudeville Theatres.
25. Alternating Currents, Simply Explained.
26. How to Build a 20 foot Bi-plane Glider.
27. A B C of the Steam Engine.
28. Simple Soldering, Hard and Soft.
29. Telegraphy for Beginners.
30. Low Voltage Lighting with Storage Batteries.
33. House Wiring for Electric Light.
34. Magnets and Magnetism.
36. Small Windmills and How to Make Them.
37. Collin's Wireless Plans, Part 1.
38. Collin's Wireless Plans, Part 2.

SPON & CHAMBERLAIN
Publishers of Technical Books
120-122 Liberty Street : : New York

Stop Forgetting

The Key To Success

The secret of business and social success is the ability to remember. I can make your mind an infallible classified index from which you can **instantly** select thoughts, facts, figures, names, faces. Enables you to **concentrate, develop self-control, overcome bashfulness, think on your feet, address an audience.** Easy. Simple. The result of 20 years' experience developing memories of thousands.



Prof. Henry Dickson, Principal

Write Today for free booklet "How to Remember" and Copyrighted Memory Test, also how to obtain my FREE book, "How To Speak In Public."

Memory the Basis of All Knowledge

Dickson School of Memory, 1740 Hearst Bldg., Chicago, Ill.

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6080B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREMAN OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name _____

Present Occupation _____ 7-26-19

Street and No. _____

City _____ State _____

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$24.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$46.50
1	H. P., 110-220 volts, repulsion, with sliding base	$67.50
2	H. P., 110-220 volts, repulsion, sliding base	$108.50
3	H. P., 110-220 volts, repulsion, sliding base	$124.50
5	H. P., 110-220 volts, repulsion, sliding base	$164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

8 volts, 10 amp.	$16.50
15 volts, 10 amp.	$21.00
40 volts, 6 amp.	$24.50
110 v, 2½ amp.	$24.50
40 volts, 12 amp.	$38.50
110 volts, 5 amp.	$38.50
40 volts, 25 amp.	$58.50
110 volts, 10 amp.	$58.50
Moving Picture Arc Generator	$85.00

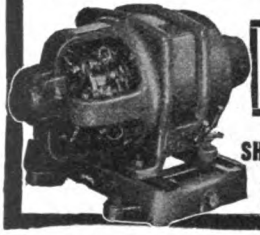
Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 RPM., complete with base and pulley.

½ H. P.	$42.50
1 H. P.	$59.50
2 H. P.	$72.50
3 H. P.	$84.50
5 H. P.	$102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt. 24 volts, without switchboard	$40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard	$68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard	$75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard	$85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard	$85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard	$110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard	$125.00

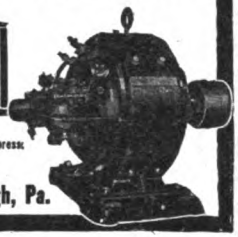
WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL **1/4 H.P.** 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors. Coffee Grinders, Bottle Washers, Etc. **$19.75 EACH** Reg. Value $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express; Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

Professional Assistance and Consultation

We solicit the patronage of inventors and will give prompt, confidential service in the perfection of ideas. Complete drawings and plans prepared. Specialists in steam and gas engine appliances.

Correspondence Invited.

Let Us Know Your Problem

Bell & Hoyt
1731 Broadway, New York, N. Y.

Don't Wear a Truss



Mr. C. E. BROOKS

Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.

Brooks' Rupture Appliance

Has automatic Air Cushions, Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.

Brooks Appliance Co., 264A State St., Marshall, Mich

Telegraph Pictures
BY ELECTRICITY



A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.

L. J. LEISHMAN CO. Dept. L, Ogden, Utah

CELLULOID

SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.

NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY



Small Investors Wanted

To co-operate in recovery of $1,400,000 cargo. Salvage already accomplished by use of LEAVITT DIVING ARMOR proves practicability and big profits in future operations.

For full particulars address

Leavitt Deep Sea Salvage Co. Inc.
Temple Bar Annex, Brooklyn, N. Y.

DRAFTING

Inventions and Ideas Developed!

Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE

A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

Inventors and Experimenters

The Elk Manufacturing Company offers special facilities for the development and manufacture of inventions and labor saving devices, as well as the construction of special parts for model makers and experimenters.

Write us about your work. You will not obligate yourself in any way.

ELK MANUFACTURING CO., INC.,
1926 Broadway, New York City

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing Lists St. Louis

UmakeM Outfit

No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

THE KNACK OF CARBURETOR ADJUSTMENT

(*Continued from page* 186)

of air there will be popping sound in the carburetor, which is commonly termed "blowing back." To adjust a carburetor is not a difficult matter when the purpose of the various control members is understood.

For example, types are illustrated which have a single needle valve to change the fuel flow, others are adjusted by altering the lift of the air valve or otherwise varying the amount of air admitted to the mixture, either at the carburetor itself or at the air stove around the exhaust pipe. Before any attempt is made to change a carburetor adjustment, it is well to make sure that the trouble does not exist in the ignition system or that dirt and water are not present in the gasoline.

The first thing to do in adjusting a carburetor is to start the motor and to retard the sparking lever so the motor will run slowly leaving the throttle about half open. In order to ascertain if the mixture is too rich cut down the gasoline flow gradually by screwing down the needle valve until the motor commences to run irregularly or misfires. Close the needle valve in those types having this method of fuel regulation as far as possible without having the engine come to a stop and after having found the minimum amount of fuel gradually unscrew the adjusting valve until you arrive at the point where the engine develops its highest speed. When this adjustment is secured the lock nut is screwed in place so the needle valve will keep the adjustment.

The next point to look out for is regulation of the auxiliary air supply on those types of carburetors where an adjustable air valve is provided. This is done by advancing the spark lever and opening the throttle. The air valve is first opened or the spring tension reduced to a point where the engine misfires or pops back in the carburetor. When the point of maximum air supply the engine will run on is thus determined, the air valve spring may be tightened by screwing in on the regulating screw until the point is reached where an appreciable speeding up of the engine is noticed.

If both fuel and air valves are set right, it will be possible to accelerate the engine speed uniformly without interfering with regularity of engine operation by moving the throttle lever or accelerator pedal from its closed to its wide open position, this being done with the spark lever advanced.

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.

PRINCE ALBERT *the national joy smoke*

Our exclusive patented process cuts out bite and parch.

THE RADIO REVIEW

A MONTHLY RECORD OF SCIENTIFIC PROGRESS IN RADIO TELEGRAPHY AND TELEPHONY

Monthly - Half-a-Crown

Single copies, post free 2s. 9d. Annual Subscription, post paid, 30/- post free.

THE RADIO REVIEW, a new monthly magazine, devoted entirely to the technical side of radio communication.

Edited by Professor G. W. O. HOWE, D.Sc., M.I.E.E., assisted by PHILIP R. COURSEY, B.Sc. A.M.I.E.E.

THE RADIO REVIEW is the Authoritative Journal of Wireless Research. Contributions from the pens of the World's leading Radio Scientists will be a special exclusive feature.

. . . . . .

Editorial and Publishing Offices
12-13, HENRIETTA STREET
LONDON, W.C. 2

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS

Official Organ: American Radio Relay League

Radio Developments, Vacuum Tubes, Regenerative Receiving, Loop Aerials, Relaying, Operating Department Work, all A.R.R.L. News, Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER

Regular price $1.50 per year, 15 cents per copy. Introductory rate: 9 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

Enclosed find $1; please enter my trial subscription to QST for 9 months.

Name_____

Address_____

The positive electrification of the atmosphere is found to increase more and more in degree with the height. The rate of increase is quite irregular, and is due to the action of the sun's rays, which ionize it; the action is virtually the same as that of the heated conducting filament in a vacuum tube. Its charge may have a potential of many thousand volts. The upper layers are most highly charged; they get more of the powerful ultra-violet rays, and being further removed from the earth lose less of their charge by conduction to the earth. In the dry air of winter the electrification is greater than at other seasons. In January, 1917, at an elevation of 3,500 meters the U. S. Weather Bureau determined the potential as 26,835 volts, and at 500 meters it was but 410 volts.

An Italian racing automobile is provided with wings, like those of an aeroplane, but they are set at a negative angle of incidence so as to hold it down on the ground instead of tending to raise it or reduce its net weight. Their use would seem to be of rather doubtful value.

Switzerland is electrifying her railroads; twenty years will be required to carry out the work as planned, with an annual expenditure of $25,000,000. The work has been delayed by the difficulty of getting insulators for the power lines.

EVERYDAY SCIENCE NOTES

The wearing away of concrete in seawater, where it is exposed to great variations of temperature has been noted. But another cause of wear is the attrition with the stones and sand of the beaches, where it is used on the sea coast. On the Sussex shore, in the south of England, as much as 4 to 6 inches of material have been worn away in a year. An attempt to prevent this wear by facing the surface exposed to the waves, with four inch flint stones, met with a degree of success, as the stones lasted five years. Wooden blocks, set with the grain end-wise, like paving blocks are being experimented with as a facing.

In England experiments in running automobiles with a mixture of 45% of ether with 54% of alcohol denatured with 1% of triethylamine have met with much interest. The triethylamine acts not only as a denaturant but also neutralizes any acetic acid which may be produced in the combustion. This is desirable as the acid is corrosive. The calorific power is as 95 to 134, compared with gasoline, yet it gives 85% to 95% of the mileage of the latter. It is in practical use in South Africa; 3,000 gallons a day are made in Durban, and it is also made in East Africa, and is in prospect of further extension. The ether is cheaply produced, and it fulfils its function of making the engine start easily. It is said that the carbureter needs no readjustment for the new fuel.

Fairly good results are claimed for solar engines in Egypt, still in the experimental stage. An efficiency of 4.2% was shown; with the range of temperature utilized the theoretical efficiency would be 5.9%. A steam engine under the best possible practical conditions would give 11.5%. The expense of running the engine figured out as equivalent to a coal-price of £3 10s. a ton.

The war brought out the fact that the existing French maps were on too small a scale. For future work three scales are assigned or suggested; for artillery 1/20000, for general staff work 1/10000, and for infantry use 1/5000. The artillery scale bids fair to be the most generally useful.

Pulverized coal in use in this country on railroad work is being tried in the Netherlands, in New South Wales and in Italy. In the latter country there is no coal, unless lignite be so considered. This fuel is to be used if possible to give some degree of independence of foreign fuel.

On the Northern Pacific road larger cylinders have been placed on existing engines, the boilers have been lengthened, and better efficiency, lower boiler pressure and an increase of power has been secured. The driving mechanism of the engines was not changed.

An interesting example of what can be done in the way of propagating pedigreed seeds is cited in an exchange. A peck of Red Rock wheat was sown and from it the succeeding year there was obtained 7½ bushels of seed. This took care of several acres. The last reports are that in 1919, six years from the first sowing, about 60,000 acres were planted. This report comes from the State of Michigan.

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 5c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

SCIENCE CREATES NEW AUTO WONDER; solves puzzling problem; no more rain or snow blurred windshields; mystic cloth works like magic, deposits invisible chemical film; one rub keeps glass clear 24 hours; one agent sold 5,000. Security Mfg. Co., Dept. 255, Toledo, Ohio.

MAKE $30.00 NEXT SATURDAY. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Mich.

HI-LIFE MOTOR GAS. The new auto fuel, eliminates carbon, increases power. Enough for 100 gallons, $1.00 prepaid. Agents wanted. R. P. Neiers, Manufacturer, Dept. E, Cascade, Iowa.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

MORE POWER, less fuel, no carbon. No Mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

Aviation

$175.00 BUYS motors, propeller, wing frames, tail frames and under-carriage for single seater tractor biplane. Brubaker, 522 East 78th Street, New York.

BUILD YOUR OWN AEROPLANE, on installments, materials cut to fit or in the rough. J. Angeles, Centralia, Wash.

CONSULTING AERONAUTICAL AND AUTOMOTIVE Engineers. Inventions analyzed and developed—Designs prepared. Tests. Expert advice. Van Muffling & Marx, City College, New York.

Books

BOOKS DELIVERED FREE. Write today for Illustrated Guide to the Latest Books. Wesley Mills Co., Dept. A, 500 Fifth Avenue, New York, N. Y.

THE ABUSE of the Marriage Relation. For single, engaged and married men and women. Saves disappointment, prevents diseases, and makes happiness. Postpaid for seventeen 3-cent stamps. Naturopathic Publishing Co., 110 East 41st St., New York.

MARRIED AND ENGAGED people should read "Science of a New Life," nature explained. 400 pages illustrated. $2.00. Central Company, 601 Ninth Ave., New York.

Business Opportunities

FREE information regarding large earnings, Raising Canaries for pastime. Birdland, Lynnhaven, Virginia.

USED CORRESPONDENCE COURSES, Bought and Sold Stamped Envelopes. E. Moffett, Ruston, Louisiana.

SUBSTANTIAL Manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $1,500 necessary. Will allow expenses to Baltimore as explained. Address, Treasurer, 416 N. Howard St., Baltimore, Md.

MANUFACTURER WANTED—Have the best Lock Nut and Nut Locking invention; seeking connection with reliable manufacturer on royalty basis. Simple, inexpensive, Positive. Rolph J. Lackner, 136 W. 49th St., New York.

AMBITIOUS MEN—Grasp this opportunity to make money. You can make $5.00 to $10.00 every day in your spare time at home. Not a cheap scheme, agency or soliciting proposition, but substantial business plans. Investigate this today. Address, Business, Box 175, Fredonia, N. Y.

Chemicals

EXPERIMENTAL LABORATORIES, fully equipped—$11.00 to $100.00. Payment Plan or Cash. Descriptions and actual photographs free. Write Dept. E-27. Lions Scientific Institute, "Laboratory Outfitters," Mt. Oliver, Pittsburgh, Pa.

Electric Motors

MOTORS ELECTRIC, no delay, ¼ H.P., 110 volt, 60 cycle, single phase. New, money back guarantee $24.50. We buy motors of various sizes. 25% with order, balance C. O. D. General Distributing Co., 22 West 1st St., Duluth, Minn.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

MILLION TESTED FORMULAS, Trade Secrets, Processes. Everything! Thousand pages. Cost? Only $2.00 Postpaid. Can I find it? Yes; and 999,999 others. Write us. J. Goodnow. Highland Ave., South Sudbury, Mass.

Ford Owners

FORD CAR REPAIR BOOK sent free. This complete, well illustrated, valuable book explains in a simple way the Causes and Cures of Overheating; Repairing Ford Timer; Curing Piston Ring Troubles; Carburetor Adjustments and Repairs; Connecting Rods; Transmission Troubles; Care and Repair of Rear Axle; Stopping Axle Grease Leaks; also covers practically every other phase of Ford Car repairing. Another feature is a chart showing exactly how much to pay for work done by repair men. Send 25c coin for three months' trial subscription and get the valuable repair book free. Ford Owners' Magazine, 499 Montgomery Bldg., Milwaukee, Wisconsin.

For Sale

FOR SALE. Brand new Bausch Lomb F. F. Microscope with complete eye pieces and objectives Abbe Condenser, also four-inch astronomical telescope. Both Bargains. H. E. Bussey, Box 1698, Atlanta, Ga.

Help Wanted

MEN-BOYS-GIRLS, 16 or over. Get ready for Railway Mail Clerk Examinations. $100-$150 month. List positions obtainable—free. Franklin Institute, Dept. T-99, Rochester, N. Y.

WE WILL START YOU in the cleaning and dyeing business, little capital needed, big profits. Write for booklet. The Ben-Vonde System, Dep. C-G, Charlotte, N. C.

Inventors

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

INVENTOR'S MANUAL, HOW TO MAKE A PATENT PAY is a work of special interest to inventors in perfecting their inventions, taking out their patents, and disposing of them. It is not in any sense a Patent Solicitor's circular nor a Patent Broker's advertisement. No advertisements of any description appear in the work. It is a book containing a quarter of a century's experience of a successful inventor, together with notes based upon the experiences of many other inventors. 120 pages. Price $1.25 postpaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

TWO VOLUMES on MECHANICAL MOVEMENTS by G. D. Hiscox are works every inventor should have for reference. If the thing you want has been invented, it is illustrated in these volumes. If it hasn't been invented, then you'll find in it the nearest things to what you want, some movement or device that will apply in your case, perhaps; or which will give you a key from which to work. No books ever published are of more real value to the inventor, draftsman or practical mechanic than this set of books. Price per volume each $4.00 prepaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

Lathes

LATHE WANTED. Small second-hand screw cutting in good condition. State price. Address: M. S., 505 South St., Alliance, Ohio.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM 36. Standard Business Training Institute, Buffalo, N. Y.

FIREMEN, BRAKEMEN, BAGGAGEMEN, $140-$200. Colored Porters by Railroads everywhere. Experience unnecessary. 898 Ry. Bureau, East St. Louis, Ill.

Miscellaneous

TOBACCO OR SNUFF HABIT cured or no pay. $1.00 if cured. Remedy sent on trial. Superba Co., S. M., Baltimore, Md.

SHAWNEE, OKLAHOMA, a growing city, a good place to live. Write for information. Board of Commerce, Shawnee, Oklahoma.

DETECTIVES EARN BIG MONEY. Travel. Experience Unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

COMPLETE SET OF DRAWINGS of the Liberty 12 engine. A United States Standardized Aircraft Engine. Giving all views with number of parts, names of parts and weights of parts. Mail $1.00. Dept. A., Ocean Publishing Co., 25 W. 42nd St., New York City.

CANDY—How to make it for pleasure or profit. 25 cents, descriptive circular FREE. Acme Supply House, 409 Chestnut Street, Milwaukee, Wisconsin.

EXCEPTIONAL OPPORTUNITIES ARE OFFERED to men, with or without experience, to act as subscription agents for Everyday Engineering Magazine.

This Magazine is very readily sold in all kinds of machine shops, electrical plants, and vocational schools. Everyday sells itself because it sells on its own merits. It contains the kind of articles which appeal to all classes of mechanics as well as students, teachers, and professional men.

The terms to solicitors are so liberal, and the Magazine so easily sold that many of Everyday's subscription solicitors own automobiles in which they travel from town to town.

If there is a large manufacturing plant, college or garage in your city, you can start, without any expense to you, in your own locality.

Remember that the summer is the ideal season. If you want big money and pleasant work, write immediately for Subscription Solicitor's proposition.

Models

BUILD a Model Electric Motor Complete working outfit $2.00. Blue Prints 25c. A. F. Cassel, 52 W. 130th St., New York.

WANTED—Will Buy Historical Models of Locomotives, Steamships, etc. Furnish description, Photograph and Price. Please. G. W. McIntosh, 51 Blanch St., Battle Creek, Mich.

BUILD a Model "Speedster". Complete outfit $2.00. Blue Prints 25c. A. F. Cassel, 52 W. 130th St., New York.

Motion Picture Plays & Supplies

$25-$300 PAID ANYONE for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

Patents

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS—Herbert Janner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York. 625 F Street, Washington; Tower Building, Chicago; Hobart Bldg., 582 Market Street, San Francisco, Calif.

GET YOUR OWN PATENTS: Save attorney's fees; instructions and advice free. Carl Larsen Co., Park Row Bldg., New York.

PATENTS. In all matters pertaining to invention consult National Institute of Investors, 118 Fulton St., New York City, having three thousand members. Booklet free.

DON'T LOSE YOUR RIGHTS to patent protection. Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster and Allwine, 237 Ouray Building, Washington, D. C. "Originators of the form "Evidence of Conception".

PATENT what you invent. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" Free. Franklin H. Hough, 510 Loan & Trust Building, Washington, D. C.

PATENTS—Prompt, personal efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years' actual experience. Full information upon request. B. P. Fishburne, 322 McGill Bldg., Washington, D. C.

PATENTS—Fees in instalments. Frank T. Fuller, formerly Lieutenant, Engineers, Washington, D. C.

Phonographs

BUILD YOUR OWN PHONOGRAPH—Big saving. We furnish parts and cabinets. Write today for free instructions. Associated Phonograph Supply Co., Dept. V, Cincinnati, Ohio.

Photo Finishing

MAIL US 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 283 Bell Ave., Roanoke, Va.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

Watches

WATCHES REPAIRED. Expert Watch repairing for the public. Write for prices or send for estimate. Include return postage. Henry Dietrich, Watchmaker, Hamler, Ohio.

Wireless

GENUINE "JUPITER" stranded aerial wire, 1 cent per foot, $9.00 per thousand. Seven strands No. 22 solid copper; High Conductivity, Large surface, Strong, Low, resistance. No C. O. D.'s. Sent postage. Shipping weight 15 lbs. per 1000 feet. Lee A. Bates, 8 Moen St., Worcester, Mass.

TO YOU WHO ARE USING OUR CLASSIFIED COLUMNS:

Do you realize that you are placing whatever products you have for sale or exchange before an ever growing audience? An audience whose Purchasing Power is among the greatest? Do you realize you are paying an exceedingly low rate for this opportunity? Here is an audience which has increased by considerably over 9,000 in three months!

Now, you know you have to pay more for materials, cost of production—so do we. Heretofore we have not advanced our price, which has remained at the same old standard. Now, it is absolutely imperative. Consequently we are making the small and exceedingly justifiable increase of two-cents a word, thus, the rate for these columns AFTER JUNE 1st, 1920, WILL BE SEVEN CENTS A WORD.

Do you see the significance of this advance information?

EVERYDAY ENGINEERING MAGAZINE.

Digitized by Google

CONTENTS

VOL. 9 JUNE, 1920 NO. 3

HEAT TREATING ALLOY STEELS. PART 2..... 201
By Victor W. Pagé, M.S.A.E.

A STUDY IN LENSES..... 205
By J. F. Comstock

DRESSING AN ALUNDUM STONE..... 207

A SEA-SLED ON THE TIGRIS RIVER..... 208

PREVENTION OF DOPE POISONING..... 208

THE GEAR SHAPER AND HOW IT WORKS..... 209

RENEWED INTEREST IN AIR-COOLED ENGINES.. 211

SYSTEMATIC LOCATION OF CARBURETOR FAULTS 213
By Victor W. Pagé, M.S.A.E.

A ONE-MAN TORPEDO BOAT..... 216

RECORD-BREAKING RACING CAR..... 217

METAL HULL CONSTRUCTION FOR SHIP MODELS 218
By Chas. A. Myers, Jr., U.S.N.R.F.

ELECTRICITY COMBATS SMOKE NUISANCE..... 220

CALCULATING AIR RESISTANCE OF TRAINS..... 221

A UNIVERSAL LATHE ATTACHMENT. PART 2.. 223
By H. H. Parker

THE EVERYDAY MOTORIST..... 225
Removing Motor Truck Wheels—Lanchester Vibration Damper—Locating Unusual Noises in Engine—Shaft Straightening Device—Running Board Accessories—Correct Tire Inflation.

AUTOMOBILE AS EMERGENCY POWER..... 227

EXPERIMENTAL PHYSICS 228
By James L. Clifford

LEGALIZED FRENCH METRIC MEASURES..... 229

ELECTRICAL PROGRESS DIGEST..... 230
Large Steam Turbine Generator Has Record Run—Electrolytic Treatment of Metals—Screw Couplings for Conductors—Storage Battery Stopper—Arc Lamp—Commutator Brush—Photographing Magnetic Curves—Lamp Socket.

AVIATION BRIEFS 232

THE HENRI GEORGE MERCURY VAPOR LAMP... 234
By Prof. T. O'Conor Sloane

A SMALL BOAT FOR OUTBOARD MOTOR..... 236

STRENGTH OF UNIVERSAL JOINTS..... 237

MANUAL ARTS AND CRAFTS..... 238
By Chas. E. Muller, M.A.E.
Slipper Box and Foot Rest—Mission Chair—Glue for Model Making—Foreign Biplane Flying Model.

A MODEL MARINE STEAM ENGINE..... 243
By Ensign D. L. Jones, Jr., U.S.N.

EVERYDAY SCIENCE NOTES..... 244
By Prof. T. O'Conor Sloane

A HETERODYNE WAVEMETER FOR 170 TO 21,000 METERS 247
By M. B. Sleeper

CONDENSER CAPACITY RATIO..... 251

THE MEASUREMENT OF HIGH FREQUENCY RESISTANCE. PART II..... 252
By L. M. Clement

DUO-LATERAL TYPE INDUCTANCES..... 254

THE RADIO DEPARTMENT..... 255

A DUPLEX RADIO TELEPHONE SET..... 256

RADIO TUNING CIRCUITS..... 259

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

A Dependable, Instructive Digest of Current Mechanical, Scientific, Automotive and Radio Progress.

Managing Editor VICTOR W. PAGÉ
Science Editor PROF. T. O'CONOR SLOANE
Radio Editor M. B. SLEEPER

Contributing Editors

L. M. CLEMENT, *Radio Engineering*
CHAS. E. MULLER, *Manual Arts and Crafts*

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Office
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, INC.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechanics Co., Inc.

The Metric System Controversy

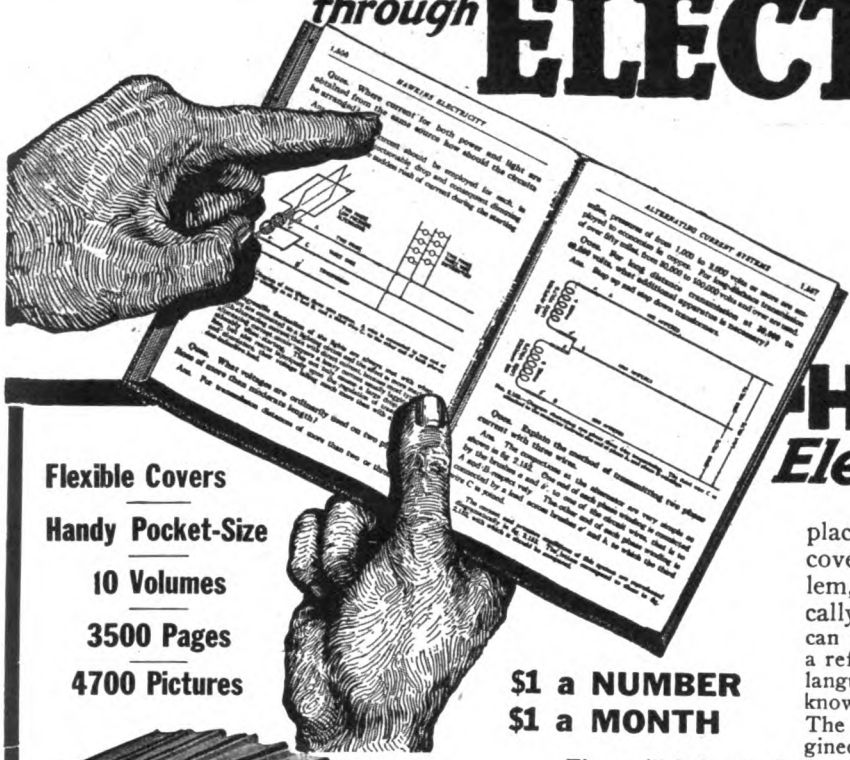
THE columns of our mechanical contemporaries are full of letters and editorials against the adoption of the Metric System of weights and measures as an American standard, and there seems to be real cause for their alarm. Considering the subject from the viewpoint of the mechanical and civil engineer, it would be undesirable to have any learned, well-meaning but impractical group of professional men influence Congress in passing legislation to confuse any industry that has always thought and worked to dimensions and values such as inches and pounds by making a system of foreign units such as millimeters and kilograms compulsory.

ANY mechanical man knows that the adoption of the metric system would entail an enormous first cost of new equipment to conform to the new standards and a constantly augmenting cost in the maintenance of a double standard for repairs and renewals, and also an increased cost of the product to the consumer. The confusion would be even greater among mechanics, most of whom would have to be re-educated to think and plan their work in accordance with the unfamiliar, and to them, new units. The opportunities for errors are great enough now without introducing any new hazards. The matter is very serious, and American manufacturers are thoroughly alive to the trouble-making possibilities of any double standard. Practically all are using their influence to retain the present reasonably satisfactory British system every one is familiar with.

THERE are two sides to every question, however, and the advocates of the Metric System have a substantial following among men of science who are able to and who do use metric units advantageously in their work. The British units are those long used in our commerce and industry, the metric units are evidently best for our chemists, physicists and other scientists who are using these units and who are thoroughly familiar with them. No law is needed for them to continue the use of units best adapted to their requirements. The issue should not be made more complex by legislators trying to force the majority in this country to use weights and measures that are obnoxious to them while there is no obstacle to their use by those who do favor them and do apply them to good advantage in scientific research work.

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro-therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

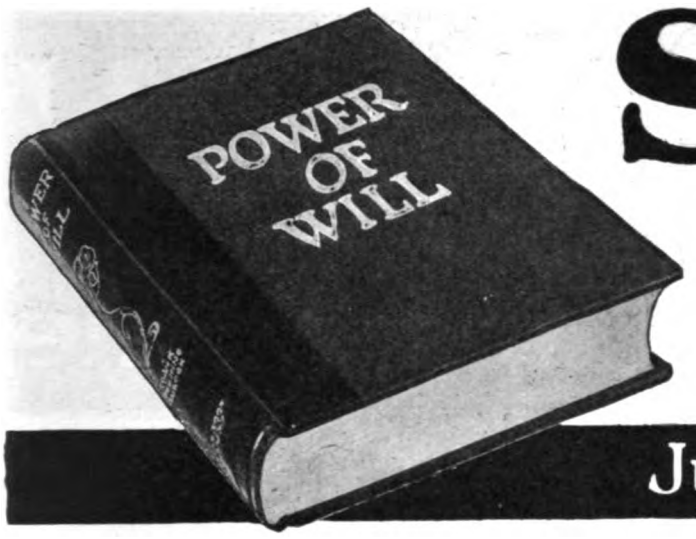
Employed by .....

Residence .....

Reference .....June

SEND NO MONEY - USE THE COUPON

Digitized by Google



Sent Free

Just Mail Coupon

A Maker of Millions —and Millionaires

DON'T miss this rare offer—the greatest opportunity that ever has come to you. Take no chances. Do not risk delay. This unparalleled offer m y not appear again. Fill out the coupon and mail it NOW. We will send you at once, abso.utely free for examination, the most remarkable book of recent years—the most sensational success in the whole history of books. In this small space we cannot begin to explain what this amazing book will do for you—how it will turn your feet into the straight and sure road to success and riches. In the panel at the left are just a few of the thousands of words of praise written to us by persons who have read the book.

No matter who you are or where you are—no matter if you have made some progress or none at all toward financial independence—you need this book. And while this offer lasts it costs you nothing—not one penny—to see it and read it and to learn for yourself its priceless secrets. "Power of Will" is not like any other book you ever saw or read—entirely new and different—the first practical, thorough, systematic course in Will training ever produced.

Other men get rich, and they do not kill themselves in the struggle either. You can make money, you can win success just as easily as they when you know how—when you have read the simple secret of their method.

Partial Contents

The Law of Great Thinking. The Four Factors on which it depends.

How to develop analytical power.

How to think "all around" any subject.

How to throw the mind into deliberate, controlled, productive thinking.

Detailed directions for Perfect Mind Concentration.

How to acquire the Power of Consecutive Thinking, Reasoning, Analysis.

How to acquire the skill of Creative Writing.

How to guard against errors in Thought.

How to drive from the mind all unwelcome thoughts.

How to follow any line of thought with keen, concentrated Power.

How to develop Reasoning Power.

How the Will is made to act. How to test your Will. How a Strong Will is Master of Body

This is only a partial list—a complete list of contents would almost fill this page.

Extraordinary Offer

Personal Experiences

Among 400,000 users of "Power of Will" are such men as Judge B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, ex-U. S. Chinese Ambassador; Assistant Postmaster General Britt; Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, former Vice-Pres. Art Metal Construction Co.; Gov. Ferris of Michigan; E. T. Meredith, Sec'y of Agriculture, and many others of equal prominence.

Here are just a few extracts from the thousands of voluntary letters from owners telling what the book has meant to them.

800% Increase in One Year

"I recommended 'Power of Will' to a young man and his salary has increased 800 per cent within a year."—*W. M. Taylor, the noted Efficiency Expert.*

$1,500 to $50,000 Yearly

"Three years ago I was making $1,500 a year and working day and night. To-day I make $1,000 a week and have time for other things as well. To the lessons in the book 'Power of Will' do I owe this sudden rise."—(*Name on request.*)

Worth $3,000 to $30,000

"From what I have already seen I believe I can get $3,000 to $30,000 worth of good out of it."—*C. D. Van Vechten, Gen. Agent North Western Life Ins. Co., Cedar Rapids, Ia.*

$896.50 Profit First Week

"'Power of Will' is a compilation of mighty forces. My first week's benefit in dollars is $900—cost $3.50; profit $896.50"—(Figure what his yearly profit would be.)—*F. W. Heistand, 916 Tribune Bldg., Chicago, Ill.*

Another 50% Increase

"More than a year ago I purchased 'Power of Will' and I firmly believe that it—and it alone—has enabled me to increase my salary more than 50 per cent in that time."—*L. C. Hudgens. Principal Mayhew Consolidated Schools, Boswell, Okla.*

You may never have such a chance again. Act now! It has long been known that the Will can be trained into a wonderful force for achieving. But only a few men have learned for themselves, unaided, how to train their will power and cultivate it. Now comes Haddock, who has perfected a simple systematic course of training by which YOU can develop an indomitable, irresistible Will based on a most profound and scientific analysis of human character.

"POWER OF WILL"

has pulled thousands out of the slough of despondency and set them on the road to success and prosperity. It will do the same for you. Young and old men alike testify to the almost magical changes in their lives after reading this great book written by a scholar whose name ranks with such leaders of thought as James, Bergson and Royce.

Send No Money

If you miss this great opportunity you will surely regret it. We will simply be flooded with requests as soon as this advertisement appears. But if you act quickly and mail the coupon today you can be sure of receiving a copy of this amazing book for free examination. "Power of Will" contains 400 pages, half leather, gold top leaves, and includes more material than many correspondence courses selling at $25.00. Fill out the attached coupon. Send no money. Keep the book for five days. Then mail it back if you are not satisfied that it is worth its weight in gold to you. Or, if you want to own it, simply send us $3.50, and it is yours. Send NOW, before you forget.

SPECIAL NOTE

In nearly five years the price of "Power of Will" has been increased only 50c. We find it necessary now to raise the price as soon as the present edition is gone. This means that by July 1st or sooner, the price must be increased to $4.50.

PELTON PUBLISHING CO.

156-K WILCOX BLOCK MERIDEN, CONN.

Pelton Pub. Co.
156-K Wilcox Block
Meriden, Conn.

Gentlemen—Please send me a copy of "Power of Will" on approval. I agree to remit $3.50 or remail the book in five days.

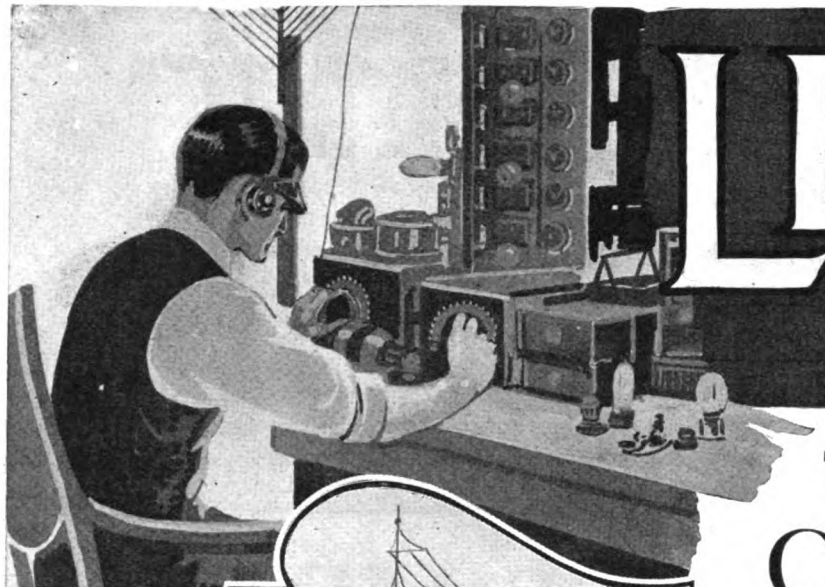
Name.....

Address.....

.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



LEARN At Home

Through National Radio

CALLS coming in steadily for National Radio Institute graduates from all parts of the country. Four concerns guarantee to take all the operators we can furnish.

Commercial radio has arrived and many attractive positions are now open in the Commercial Land Radio Service, Merchant Marine, Railroads, Radio Supply Factories, Lake and Ocean Steamship Companies, Telegraph Companies, Aerial Mail Service, and Radio Compass Stations. We are now receiving requests for more National Radio Institute graduates than we can furnish.

Salaries Up to $15,000 a Year

Our graduates start work as Senior Operators at $125 a month, with all living expenses paid (an average total of about $200 a month). Advancement is rapid to high positions with bigger pay, as follows: Radio Aids, $6 to $15 a day; Aerial Mail Service, $1,500 to $2,400 a year and 10% bonus; Radio Inspectors, $1,200 to $3,500 a year; Radio Engineers, $2,500 to $15,000 a year. Our graduates are guaranteed positions upon securing their official license after taking our course. You can learn wireless the National Radio Institute way in a few months by mail, right in your own home. Many of our students secure positions before completing the course, because it is based on actual practice and teaches what is needed to make a big success of wireless work.



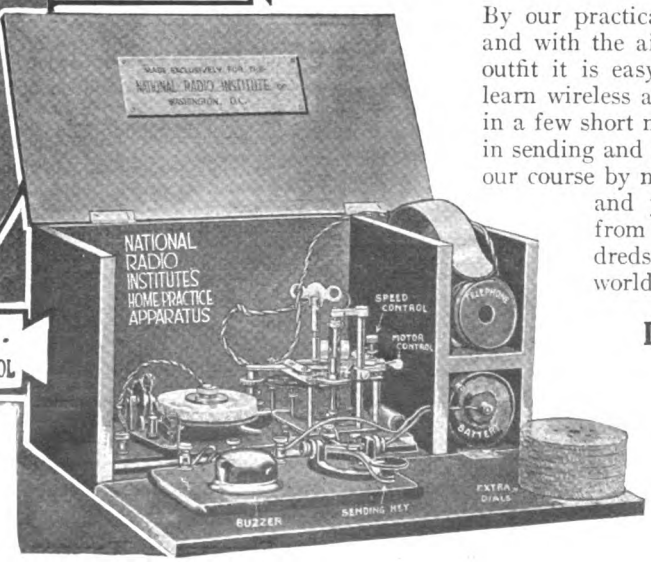
DOWNTOWN SCHOOL



JAMES E. SMITH . . . .
DIRECTOR DOWNTOWN SCHOOL

Easy to Learn Wireless at Home By Our Method

By our practical method of home instruction and with the aid of our improved Natrometer outfit it is easy for any intelligent person to learn wireless and become an efficient operator in a few short months. You get actual practice in sending and receiving messages while taking our course by mail. Every step is made clear and you will make rapid progress from the start. We now have hundreds of students throughout the world.



Instruments to Every Student

In addition to 5 text books, one hand book, 46 special lessons and 18 personal examinations, we send you, while taking our course, the fine Natrometer outfit here pictured. It becomes your personal property upon completion of course.

NATIONAL RADIO INSTITUTE
America's First and Foremost
(Est. 1914)
Dept. 226, 14th and U Streets, N. W.
Washington, D. C.

Digitized by Google

WIRELESS in a Few Weeks

Institute - Washington, D. C.

Travel If You Want To

If you want to travel and see the world, go to foreign countries and increase your knowledge of world affairs, wireless offers you the chance of a life time. However, you are not obliged to travel, but may secure a permanent position at one of the many commercial land radio offices, telegraph or steamship companies near your home, if preferred.

Membership In N. R. I. Relay League

Upon enrollment every student in the National Radio Institute is presented with a handsome blue and gold pin, signifying his official membership in the N. R. I. Relay League, with a rapidly growing membership throughout the world.

Extra Course In Radio Telephony

In addition to our complete course in modern radio telegraphy every student is given our complete course in Modern Radio Telephony. This course combines ten special lessons and ten personal examinations. This combined telegraphy and telephony course enables our students to secure positions requiring knowledge of both radio telegraphy and modern radio telephony.

Get Your Instructions by Mail From the Nation's Capital

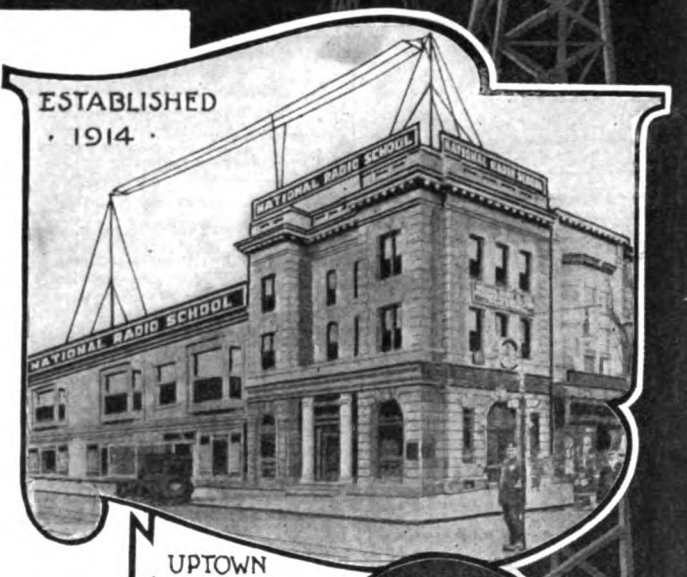
(Our Course is Recognized by United States Government Officials)

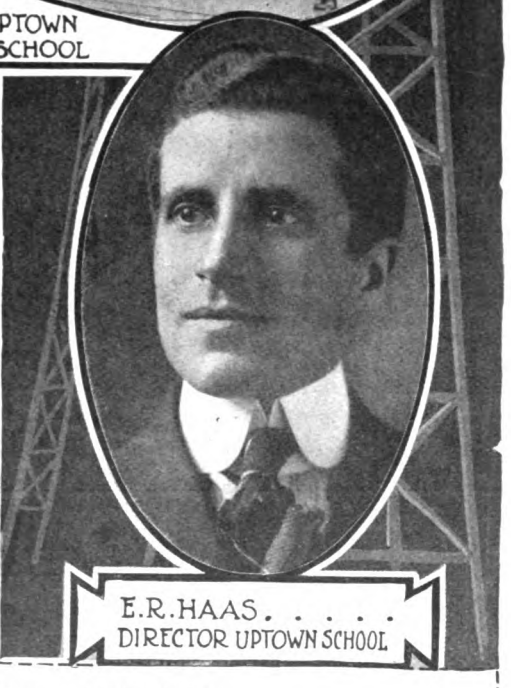
The National Radio Institute, established in 1914, was the first in America to successfully teach wireless by mail. It is headed by authorities who have been closely allied with government training of students. The work is under the direction of J. E. Smith, E. E., formerly director of the Radio Department, Howard University, and E. R. Haas, formerly of the Radio Division of Yale University, assisted by a competent corps of trained instructors and lecturers.

We now maintain two schools in Washington and through our Home Study course have successfully trained hundreds of students throughout the world by mail. Our location in the Nation's Capital, together with the standing of our officers and their wide acquaintance among government officials connected with Wireless activities, places us in position to give our students the best instruction obtainable and to be of the utmost help in assisting them to secure good paying positions.

SEND THIS COUPON FOR FREE BOOK
containing particulars of our special offer to students enrolling now.

NATIONAL RADIO INSTITUTE
America's First and Foremost
(Est. 1914)
Dept. 226, 14th and U Sts., N. W.,
Washington, D. C.





NATIONAL RADIO INSTITUTE,
Dept. 226, 14th & U Sts., N. W. **(Write Plainly)**
Washington, D. C.

Send me your Free Book, "Wireless the Opportunity of Today." Tell me about your famous Home Study Course in Wireless Telegraphy and Telephony—your Post-Graduate Course, Membership in the N. R. I. Relay League and your Special Wireless Instrument offer.

Name .....

Age..... Address.....

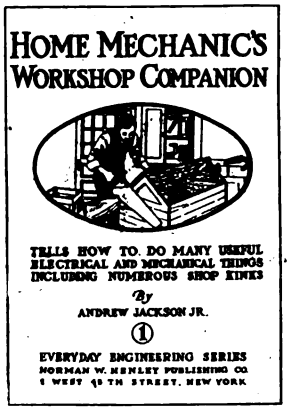
City..... State.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

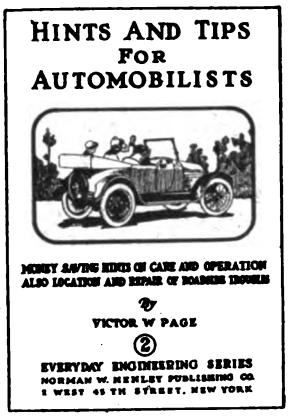
A SPECIAL OFFER TO OUR READERS

ANY ONE OF THESE BOOKS WILL BE SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION



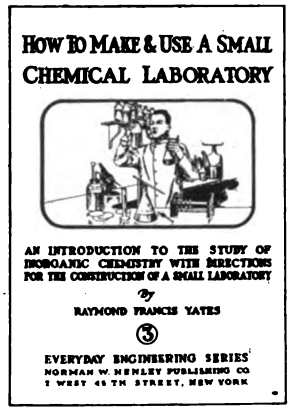
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.



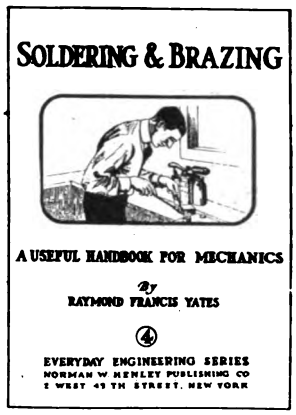
For the Automobile Owner or Driver

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints.



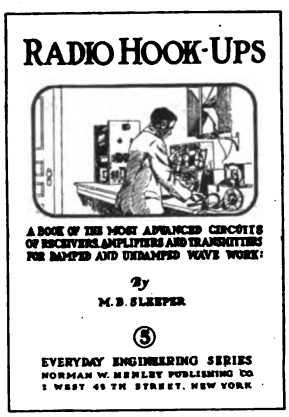
For the Student Chemist and Experimenter

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.



For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work.



For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuit diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details.

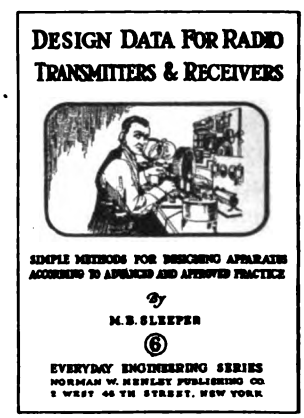
ALL of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest.

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOUR OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

Fill Out the Special Blank Below
Check Off the Title Desired and Mail with Your Remittance

Special Circular Describing These Books Sent on Request

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man —the Mechanic and the Radio Experimenter.



For the Radio Engineer and Student

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45TH STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for ..... years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the ..... issue. I enclose $....., and according to your special offer send me copy of book checked off.
(Date of issue)

Name .....

Street .....

City .....

State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS
Check off title desired here

1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google

Health-Strength-Beauty Thru Renulife VIOLET RAY Treatments at Home



A recognized scientific effective means of handling your own case is afforded by the RENULIFE VIOLET RAY HIGH FREQUENCY GENERATOR. It is so designed and made that anyone can apply the wonderful corrective, upbuilding forces of the VIOLET RAY. This pleasant POWERFUL form of electricity has done and is doing wonders in relieving and eliminating pain and suffering. You owe it to yourself to investigate—find out the facts. Get our new booklet explaining the nature of the Violet Ray—its uses, benefits, and applications—send the coupon below at once.

WHAT USERS SAY

"The Renulife Violet Ray High Frequency Generator is superior in efficiency because of its perfect character and control of current, compactness and perfect insulation. The smallness and lightness of Electrode holder is also a great advantage." "The doctor told me that the trouble was hardening of the arteries. I would not be without it for all the money in the world." "I cannot recommend it too highly." "I have been using mine now for a week for Sciatica and I am highly pleased with results." "I think it is one of the best little machines that was ever invented." "I have used it with excellent results for the restoration of hair and stiff and sore rheumatic finger joints." "Am well pleased with the Generator, and the kind treatment received from your Company." "My Generator has stopped my neuritis." "Every house should have a Renulife Violet Ray High Frequency Generator for the treatment of Neuralgia; Neuritis; Sore Throat; Kernels in Neck; Cramps; Headache; Stiff Neck Muscular Soreness; Rheumatism; Paralysis—in short, pain of all kinds."—M. D.

"I have been much relieved by the use of your Violet Ray Generator."

"It is fine for insomnia."

"I find it such a help in nervousness."

"I would not part with it for five times the price. It is sure a little wonder."

"I am more than pleased with the Generator, the whole family are using it."

THIS TYPE of Violet Ray instrument makes possible a light, convenient handle and permits large efficient units to be used contained in handsome case.

OUR NEW BOOK

JUST OUT. This latest edition explains in detail, with many illustrations, the uses and benefits of Violet Ray. You should have one. Free for the asking.

SEND FOR BOOK!

THOUSANDS OF VOLTS

No Shock—No Harm—Simply Great Benefits

Current from your light socket is transformed into the most powerful, effective purifying Health and Beauty giving agency; yet as painless and pleasant as a ray of sunshine. Made safe for use in any home, on infant or weakest invalid. Attacks the deep seated source of diseases, at the same time relieving the aches and pains which may be the annoying symptoms. Learn how this modern form of electricity—The Violet Ray—so acceptable to the human body actually saturates the whole system with invigorating life-laden forces, bringing back normal conditions. You may treat the local area but results are not confined to that part alone—the blood, nerves, tissues are revitalized, toned and restored.

Send for the Booklet—full of information—that tells the story so you can understand it.

Natures Own Aid

What is the strange relation between electricity and life? Some declare electricity *is* life. We do not know. But life cells do welcome and respond marvelously to electricity in the form of Violet Rays. It works with nature to restore where many other methods fail. It treats fundamentally and therefore is specified by physicians for a wide range of ailments—for rheumatism, neuritis, nerve and blood disorders—etc., etc.—both chronic and acute. See the list on coupon and ask for full particulars. Blood is brought to area treated—enriched and purified—assimulation and digestion improved—functions restored to normal. Combines the benefits of electricity, vibration, exercise, stimulation, and oxidation. Get the information as to what you may expect from the Violet Ray. Its astonishing low price places it within the reach of all. The Trial Plan *proves* its value, in actual use. Receive full information by return mail.

Renulife Electric Co., Inc.

1906 Marquette Building, Detroit, Mich.

Chicago Office, Room 410, 123 West Madison

Treat Your Own Face and Scalp as well as Specialists



Strengthens—Revitalizes—Builds up



Pain and Ache Eradicator—Without Equal



For Catarrh, Throat, Lungs—also Anemia

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
156 Marquette Bldg., Detroit, Mich.

Please send without obligation, your book **"Health,"** explaining Violet Ray treatments with Renulife Generators, also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

..Abscesses	..Facial Neuralgia	..Obesity
..Anemia	..Falling Hair	..Pain in Abdomen
..Asthma	..Female Complaints	and Chest
..Arteriosclerosis	..Goitre	..Paralysis
..Baldness	..Gout	..Piles
..Blackheads	..Haemorrhoids	..Pimples
..Brain Fag	..Hay Fever	..Pyorrhea
..Bronchitis	..Infantile Paralysis	..Rheumatism
..Bunions	..Insomnia	..Scars
..Bruises	..Lameness	..Sciatica
..Catarrh	..Locomotor Ataxia	..Skin Diseases
..Colds	..Lumbago	..Sore Throat and Throat Diseases
..Chilblains	..Nervous Affections	..Sprains
..Dandruff	..Neuralgia	..Toothache
..Deafness and Ear Diseases	..Neuritis	..Weak Eyes
..Eczema		..Wrinkles
..Enlarged Prostate		..Warts and Moles

Name .....

Address .....

.....

LOWEST PRICED Efficient **VIOLET RAYS**

Several Models for Home and Professional Use

High Class Sales Distributors Write for Proposition

OZONE Inhalations



Digitized by Google

LEARN DRAFTING

AT HOME—IN SPARE TIME

As You Would in Actual Practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher specially qualifies him to give you the training you need to become a successful Draftsman.



Chief Engineer, $5,000 to $50,000 a Year

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions, now open. Here is what "Columbia" training is doing for some of our graduates; Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.



Chief Draftsman, $50 to $150 a Week

BECOME A SPECIALIST

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but you receive the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

Draftsmen Get $35 to $100 a Week

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field, paying as high as $50,000 a year.



Draftsman, $35 to $100 a Week

Big Concerns Employ Columbia Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Our training spells Success for you. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them. General construction companies, manufacturers, railroads, ship building concerns, engineering projects, etc., need draftsmen today in greater numbers and at better salaries than ever before.

SEND THIS COUPON TO-DAY

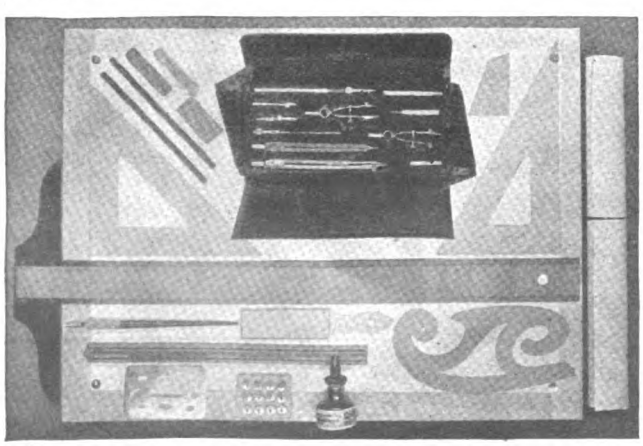
Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write to-day to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1138, 14th & T Sts., N. W.
Washington, D. C.



This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, Pres.
Dept. 1138, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below:

(Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting	Topographical Drafting .....
Automobile Drafting	Ship Drafting .....
Electrical Drafting	Statistical Drafting .....
Aeroplane Drafting	Radio Drafting .....
Special Machinery Drafting.....	Automotive Drafting .....
Sheet Metal Drafting.....	Hydrographic Drafting .....
Structural Drafting	Machine Design .....
Highway Drafting	Tool Design .....
Patent Drafting	Shop Mathematics .....
	Builders Course .....

Name .....

Address .....

City ..... State.....

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 9 JUNE, 1920 NUMBER 3

Heat Treating Alloy Steels

A Series of Simplified Articles Detailing the Various Methods of Heat Treating Modern Alloy Steels. This Instalment Explains the Various Heat Treating Processes for Simple Steels and Describes the Way They Are Applied in Everyday Work

By Victor W. Pagé, M.S.A.E.

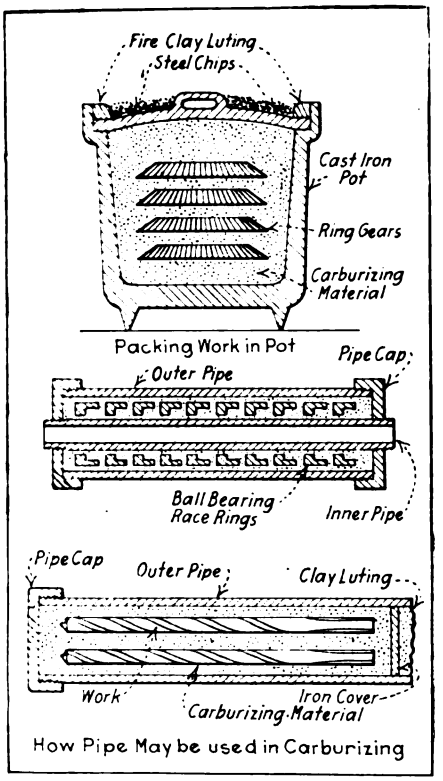
PART 2

IN the first article of this series, the point was brought out that heat treatment was an exact science and that modern methods of precision measurement made it possible to determine the best points to which various grades of steel should be heated and the temperature at which they should be quenched to secure the maximum benefit from the desirable physical properties of special steels. Before considering the treatment of different alloys, the writer believes that the non-technical reader can understand what is meant by heat treatment much better if the various simple treatments are defined and explained, so these are outlined in a manner that should be of value to the experimenter and practical man.

Annealing

Many varieties of steel are hard when the process of manufacture, especially if rolling or hammering is involved, is completed, these being principally grades used in tools and special machine parts. In order that they may be worked without too much trouble by ordinary machine tools it is imperative that the metal be soft, and this condition is obtained by a process known as annealing. While steel can usually be bought annealed cheaper than it can be treated at the factory or shop where it is to be machined, sometimes conditions materialize that make it necessary to anneal metal to facilitate work and reduce stresses upon the machine which completes the finished product. This process not only makes the steel softer, but also removes the internal strains or the tendency of the metal to crack and spring when hardened. The strains are caused by the rolling or hammering processes in the steel mill or forge shop while the rods or forgings were being made.

When the metal is a forging or a gear blank of nearly finished size, it is customary to remove part of the surface by taking several rough cuts, after which the piece is ready for annealing. In order to soften steel it is necessary to heat it to a uniform red heat and allow it to cool slowly, which process can be carried on by several methods.



How work is packed in pots or pipe for box annealing or carburizing

Box Annealing

The method commonly followed when the pieces are not of too large size is known as box annealing, and for this treatment it is necessary to have cast iron boxes or pots and furnaces of sufficient capacity, as it must be obvious that to do this work in a manner that is commercially practicable it will be necessary to treat a considerable quantity of work at the same time. The parts are placed in the container and packed in wood charcoal or other material of that nature which has been ground or pounded into small pieces. A layer of this material is first placed on the bottom of the box to a depth of an inch or more and then follows a layer of the steel, then another layer of charcoal, then more steel, and so on. For certain small work, the material may be packed in wrought iron pipe as shown in accompanying illustration.

How Pot Is Packed

The pieces of metal should not come within one-half inch of each other or within an inch of the walls of the container at any point, and the spaces should be filled with charcoal, the metal being covered with another layer of packing material about an inch in depth. This method of packing is repeated until the box is filled, care being taken that all pieces do not touch each other or the iron walls. A tight-fitting cover is then applied, and the seams are sealed to exclude the direct heat or hot gases of the furnace, by fire clay luting. Several test wires may be placed through the top of the box, which can be withdrawn from time to time to see if the contents are at the proper temperature if no pyrometer installation is supplied. The heat should be maintained a sufficient length of time to insure a uniform temperature and thorough heating of the parts and the color of the piece should not be allowed to go over a full red, as can be regulated by the heat of the furnace and determined by the test wires. After the box and contents have been maintained at the desired temperature for the proper length of time, the heat is shut off and the whole allowed to cool

Digitized by Google

slowly, the metal being left in the container until cold.

Two Simple Methods

Often in shops there are no facilities for box annealing and other methods may be used, though the work is not so uniform as by the treatment previously described. In one of these, the metal to be treated is heated in a forge or furnace until a uniform red, and then placed on a piece of board in an iron box, the wood resting upon a bed of ashes several inches deep. A second piece of board is placed on the pieces, and the whole covered with ashes. The pieces of wood will smolder and maintain the metal at a high temperature for some time, thus insuring gradual cooling, which is essential to secure a good anneal.

Another common method of annealing is to heat the pieces to a red heat and merely bury them in ashes, which is apt to give unsatisfactory results unless the ashes are also heated, which can be easily accomplished by burying a large piece of heated iron in the annealing box. When the steel piece has been sufficiently raised in temperature, this piece of iron is removed from the ash bed and the steel part buried in its place. The whole secret of successful annealing is to gradually heat and cool the metal to be treated; and the more gradually and uniformly the temperature rises and falls, the better the character of the work.

Hardening

After the parts have been machined to the finished or nearly finished size, approved practice is to further heat treat to either toughen or harden the steel. The amount and character of treatment depends largely upon the use for which the piece is intended and the composition of the material and will be fully considered in proper sequence. Steel may be hardened by several processes, the most common of which is raising it to a low red heat or dull cherry red and plunging it in some cooling medium such as water, brine or oil, or by case hardening, which merely acts on the surface of the metal if superficial methods are used or which can go to some distance below the surface if the work is properly carburized.

Steel should never be heated to a temperature greater than required to give the desired result, and the degree varies with the composition of the steel as relates to the carbon content, the size and shape of the piece and the purpose for which it is to be used. Much depends upon heating uniformly; the edges and corners should be no hotter than the center and the interior should be of the same temperature as the surface. If this precaution is not taken the metal may crack in the cooling bath, because uneven changes take place in the molecular structure. If metal is heated in an ordinary forge be sure that no air from the blast strikes it, which will prevent uniform heating.

When uniformly heated it should be plunged in a bath to give it proper hardness. It must be worked up and down rapidly in the bath to prevent the film of steam forming, which would surround the piece if kept in one position and prevent proper contact with the cooling fluid. If the piece is long and slender it must be moved up and down, but if short and with teeth on the outer edge, as on a milling machine cutter, or gear, it should be agitated rapidly so that all teeth will be cooled uniformly. If it is flat and has a hole through it, the walls of which must be hard, it should be so moved that the liquid of the bath passes through the aperture and at the same time strikes both faces.

Tool steel should always be hardened at a temperature (about 1350 to 1450 degrees) which leaves a fine grain when the piece is broken, which can be determined by hardening a test piece from the same bar as the part is to be made at various temperatures and breaking to determine the grain. A coarse grain denotes a higher temperature than is permissible. An excellent bath for hardening small pieces is said to be easily made by dissolving one pound of citric acid crystals in one gallon of water. The container should be tightly closed when not in use to prevent loss of evaporation. It does not require much experience to distinguish the silky, smooth grain that indicates that the piece was quenched at the proper temperature as compared to the coarse crystalline fracture that shows too high a heat.

A Rough and Ready Test

The notched bar test is an old one that is very good for purposes of comparison when work is heated in a forge and the eye is the only judge of temperature A bar of the same composition steel as that of which the steel tool or part is made is used, this being either round or square section about ½ in. in diameter and eight or nine inches long. It is notched every inch of its length and the notched pieces marked with a prick punch. The piece is heated in the forge so one end is hotter than it should be and the other end just showing color. The gradation of color is noted and the piece is quenched. When cooled, it is broken into its respective parts and the point or notch that shows the finest grain upon fracture indicates that the temperature to which it was heated was the best adapted to that particular grade of steel. Each section will have a different color when withdrawn, which will be remembered by the worker from the punch marks. In heat treating the finished piece, it is raised in temperature uniformly to the color that the operator remembers as having given the best fracture on the test bar. This is a rough and ready method of temperature determination that was popular before the days of precision heat measurements and is used today in many small shops when pyrometers are not available. The table below is a useful guide to temperature approximation by color, and while it has been widely published, its inclusion will save the reader looking it up.

Pack Hardening

Pack hardening is the method employed with pieces that are low in carbon and which cannot be treated by the ordinary processes without risk of springing or cracking them. The articles are packed in an iron box with some carbonaceous material and subjected to the action of heat to cause it to absorb enough carbon to enable hardening in an oil bath. While this treatment is not generally used, it is suitable for a number of different tools, such as milling cutters and taps or dies which must be hardened without altering the diameter or pitch, also for gears. The usual material employed is raw bone, charred leather or bone black which is mixed with an equal quantity of wood charcoal, coke or similar substance, both materials being reduced to particles about the size of a pea or even smaller, depending on the character of the work.

The pieces are placed in a container and packed in the same manner as for box annealing, and as is the case with that process, it is almost as cheap, as far as heat is concerned, to treat a number of pieces as it is one, providing the

HEAT DETERMINATION BY COLOR

Degrees F.	Degrees C.	Color of Heats	
752	400	Red-visible in the dark	Tempering.
885	474	Red-visible in twilight.	
975	525	Red-visible in daylight.	
1077	581	Red-visible in sunlight.	Annealing.
1292	700	Dark red.	
1472	800	Dull cherry red.	Hardening.
1652	900	Cherry red.	Carbonizing.
1832	1000	Bright cherry red.	
2012	1100	Orange red.	
2192	1200	Orange yellow.	Forging.
2372	1300	Yellow white.	
2552	1400	White-welding.	
2732	1500	Brilliant white.	

Digitized by Google

carburizing pot be of sufficient capacity. The pieces should be wired with ordinary iron wire of sufficient size to sustain the weight of the pieces when the wire is heated if their shape permits and one end of the wire should be covered with a luting of fire clay. Several holes should be drilled in the cover for test wires If they cannot be wired together, the pieces can be dumped on a coarse mesh screen so the carburizing material will not go into the quenching bath when the heated work is ready for cooling.

The box is placed in the furnace and heated sufficiently (about 1650 to 1700 degrees) to charge the parts with carbon. The time and heat varies with the character of the parts treated. For instance, with a piece of one-half inch diameter or under the heat is maintained for about one and one-half hours, while pieces from two to three inches in diameter must be heated for two and one-half to four hours after the parts have reached the carburizing temperature.

When the furnace has been maintained at the required temperature for the correct period the pot or pots are removed from the furnace and the covers taken off. The parts are then removed by means of wires attached to them and immersed in a bath of raw linseed or whale oil or other cooling medium. They should be moved about in the liquid until the red color has disappeared and are then lowered to the bottom and allowed to remain immersed until cold. When a piece of steel one inch in diameter or larger is hardened, it should be immediately reheated over a fire after cooling, to prevent cracking, which would be caused by internal molecular changes which take place after the outer surface is hardened and unable to yield. Reheating to a temperature of about 212 to 300 degrees Fahrenheit will accomplish the desired result without materially softening the steel.

Tempering

The hardening of a cutting tool, such as a chisel or lathe tool, makes it too brittle to stand up well in use, and consequently it is necessary to soften it somewhat. This operation is known as drawing the temper and is accomplished after the part has been quenched by reheating to a proper temperature. This is ordinarily determined by the color on the surface of the tool, which must be brightened previous to this operation. As the metal is raised in temperature a light, delicate straw color appears, and then in order, a deep straw, light blue, blue tinged with green and black. When black appears the temper is gone. These colors furnish a guide to the temperature and condition of the hardened steel. The

(*Continued on page* 266)

A New System of Airplane Propulsion

THIS proposed and experimental new system of propulsion uses the reaction from the pressure of a gas driven into the atmosphere by a blast engine; this principle has been tried before, but all previous machines had a very low efficiency. Any fuel whatever can be used, gasoline, kerosene, alcohol, etc. It is forced at high pressure to a burner. The proportions of the mixture of fuel and air can be regulated by a needle valve. The explosive mixture is lighted in the first instance by a sparking plug, and after that combustion continues uninterruptedly in the combustion chamber, which is made with fireproof sides. The mixture of gas and air is exhausted through a blast pipe and four blast engines—one large and three small, as shown at Figs. 1 and 2. At the inlet mouth of each of these air is drawn in by suction. The gas and air is exhausted by the last and biggest blast engine, and makes a direct thrust against the air at the rear of the engine. By this means a difference of pressure is set up between the inlet and the outlet of the tube, and is said to result in the propulsion of the craft. To obtain a high pressure of the gas, several means are provided by the inventor.

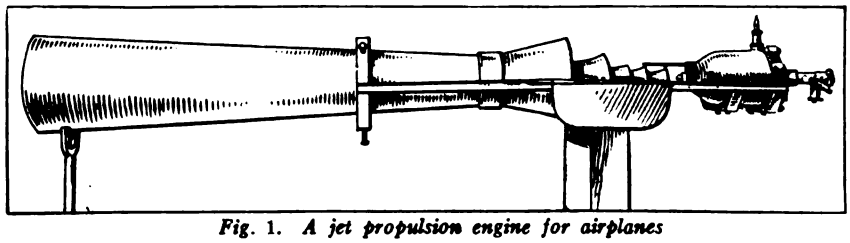
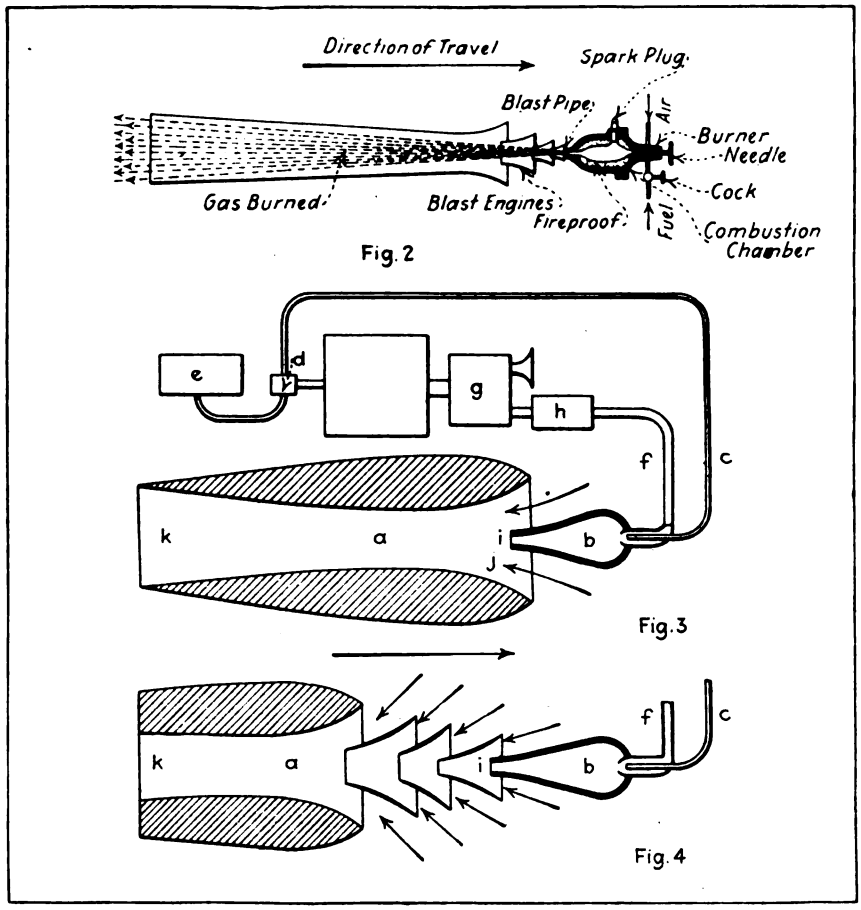


Fig. 1. *A jet propulsion engine for airplanes*

With reference to the sketches, Figs. 3 and 4 are modifications of the standard arrangement. In apparatus shown in Fig. 3 combustion chamber b is fitted in the front of ejector tube a, walls of b are lined with refractory material, and the chamber terminates at its front in a blast pipe i, which discharges into the blast engine a. Liquid fuel is supplied to b through c, and the air to support combustion through pipe f. The pressure in c and f is made greater than in combustion chamber b. The fuel burns inside b and the gases are discharged through i. The gaseous jet



Figs. 2, 3 *and* 4. *Diagrams explaining principles involved in jet propulsion scheme for airplanes*

Digitized by Google

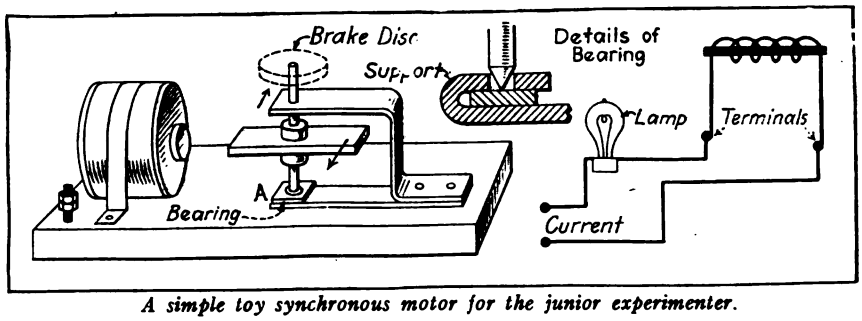
sucks in the surrounding air through j and transmits a portion of its energy to that air. The velocity diminishes in the rear portion of the blast engine, thus imparting increased pressure to the moving fluid at k. The difference in pressure between j and k exerts a thrust in direction of arrow f, and in opposite direction to that in which the fluid is discharged.

The engine shown in Figs. 1 and 2 was a trial machine; the inventor, Mr. Mélot, has been experimenting during the war at the Laboratoire du Conservatoire des Arts & Métiers with the French Ministre de l'Armement et des Inventions, and the results obtained are interesting. The machine gives 30 h.p. for a relative speed of 50 metres a second, the thrust is 45 kilogrammes. The trials gave a high efficiency.

The advantages of the system are numerous if it can be applied practically, seeing that the exploded gas pressure works directly to produce thrust to drive the machine without passing through the medium of a motor, transmission mechanism (geared engines only) and propeller. The construction is simple, as valves, pistons, connecting rods, crankshafts, water and oil circulation, etc., are all dispensed with. The weight per b.h.p. works out at .5 kilogramme (1.1 pound), which is a record in lightness, and the cost of the engine should also be extremely low. No trials of the device in an airplane are recorded, so one cannot judge its practical value by the theoretical considerations involved. Further details of actual trials in an airplane are awaited with interest, and will be sent as soon as available.—*E. H. Lémonon, Paris.*

A TOY SYNCHRONOUS MOTOR

THIS motor is designed to be run from an alternating lighting circuit. The axis is vertical, pointed at the lower end, and is supported in a frame consisting of a brass bracket screwed down to a base. Its pointed lower ends rests upon and turns upon a plate of glass, held in position by a bent plate of brass. This arrangement is shown in the small cut very clearly. The rotor is a bar of steel, which may be the armature from an electric bell. It is to be about two inches long, and through the hole in its center the shaft passes and two tightly fitting india rubber washers of rather thick stock hold the armature in place. A bobbin or induction coil with a core of soft iron wire is mounted close to the armature as shown in the cut. It will be seen that the bracket and foot of the frame and the brass part of the bearing for the foot of the shaft can all be made of a single piece of brass. The induction coil is connected in series with an incandescent lamp so as to cut down the current within safe limits, unless of course the inductance of the coil is enough to do it alone. The connection is shown in the diagram. When the current passes the armature or rotor is turned by hand tentatively, and after a few trials synchronous speed corresponding to the frequency of the current will be secured, when the motor will spin away of its own accord as long as the current passes. At the top of the shaft there is a drum, which represents a brake-drum or a driving pulley. For the induction coil a bobbin from a discarded electric bell will answer. By exercising braking action on the motor, by pressing on the little drum with the finger, it will be found that no change in the speed of the motor results. It must be synchronous in some way; it may run at a multiple of the speed indicated by the frequency of the current, but if the braking action is sufficient it will stop dead, but cannot be made to depart from synchronism, except by causing it to cease rotating.



A simple toy synchronous motor for the junior experimenter.

A TRUE EXPERIMENTER

THE late Lord Rayleigh has had his life's work commemorated in the scientific journals. He was a scientist whose work was of the nature which seemed to appeal to the less technically educated person. Investigating the sensitiveness of the ear he found that it could respond to pressure changes of one hundred millionth of an atmosphere. He found that the sensitiveness of the eye was of the same order. Investigating the action of the whispering gallery in St. Paul's Cathedral he put it, that the sound waves cling to the wall, as if hemmed in between two concentric doors. Another interesting demonstration was that to make the sound issuing from a fog-horn spread sideways in a horizontal plane, which is of course what is desired and necessary, an oblong aperture is most efficient, but curiously enough it should be a vertical and not a horizontal slot, as one would naturally suppose. Lord Rayleigh's advice to experimenters has been widely cited. It is, "Do not place too much reliance on the instrument makers." The great experimenter did his work, it is said, largely with wood, glass and sealing wax. This last fact should interest our working readers.

HELIUM FOR AIRSHIPS

HELIUM will certainly always be considerably more expensive than hydrogen, but there are two factors which to some extent reduce the importance of this. The rate of diffusion and consequent wastage with helium is only half that obtaining when hydrogen is used. This will, of course, reduce considerably the amount of gas consumed while an airship is lying in the shed, though it will not affect the loss of gas occurring while rising during a flight. In addition to the saving thus effected, helium is believed to be easier to repurify than hydrogen; although, owing to the comparative cheapness of the latter, it is doubtful whether the matter has been seriously considered.

When the purity falls below a certain figure the present practice is to "rip" the envelope and allow the hydrogen to escape into the air, the envelope or gas bags are subsequently reinflated with fresh gas. With the advent of helium, the gas will presumably be exhausted by fans into a reservoir, from which it will be taken to a purifying plant prior to being used again. This will naturally result in effecting a great saving in the amount of the gas that will be required.

The question of production is also extremely important from the practical point of view. Plants under construction capable of turning out 50,000 cu. ft. of helium daily are mentioned. This amounts to 18,250,000 cu. ft. per annum, or 1,520,000 per month. If this represents the total output of all the plants under construction it is totally inadequate. An airship consumes roughly its total capacity in gas per month, so that one modern rigid airship would require more than the whole output.

In Diesel engines an obturator has been tried to replace piston rings. This appliance is a brass or other metallic ring of U-shape in cross section, exactly like the leather ring used since early days in the hydraulic press. The pressure forces it out against the cylinder walls and it is reported as proving most effectual. It has a lap joint. It is considered good for a thousand hours running, and has operated well in a worn cylinder where piston rings failed in short order. A single obturator replaces all the piston rings.

Digitized by Google

A Study in Lenses

By J. F. Comstock

St. Lawrence University, Department of Physics

NEARLY every person is more or less familiar with the many different types of optical instruments, such as telescopes, microscopes, reading leness, moving picture machines, opera glasses, etc. Few of us realize how the skill of the designer of these instruments was taxed in order that he might produce an article satisfactory to the user. The defects such as chromatic aberration, spherical aberration, astigmatism, coma and distortion are due to improper focusing of rays as they converge toward the axis after passing through the lens. In order that a lens may form sharp images it should focus rays of light coming from all parts of the illuminant at the same spot.

In the case of chromatic aberration, a single ray of light in traveling through the lens is divided into about six rays, i.e., red, orange, yellow, green, blue and violet. However, the red and violet rays are the only ones which are distinctly visible because the other colors overlap so much that they are obscured. In some lenses the focal spot of red light is separated from the focal spot of violet light by several inches, but almost any lens disperses red and violet enough so that they are readily found. It will be noticed that the focal spot for violet light is closer to the lens than the focal spot of red light. Then a screen placed at the focus of violet rays would show a small round spot of violet surrounded by red, and if the screen was placed at the focus of red rays it would show red in the center with a violet fringe.

A lens having this defect is not suitable for use in moving picture machines, projection lanterns, microscopes or telescopes, because its images would be fringed with colors. The correction applied consists of combining two lenses, one a convex, the other a concave, making the defect of one lens offset that of the other. Lenses combined in this manner are made of different kinds of glass. For example, one of the lenses is made of crown glass and the other of flint glass. Such a combination does not altogether prevent the dispersion of the colors, but it will generally be satisfactory for most practical purposes.

Spherical aberration is produced by a lens having different focal spots for rays of light leaving the lens at different distances from the center toward the edges. In Fig. 2 it will be seen

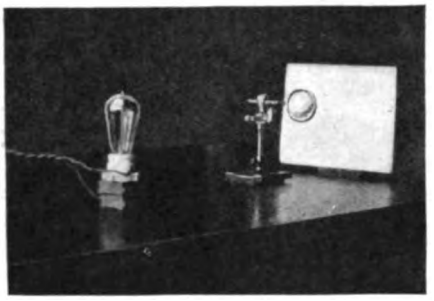


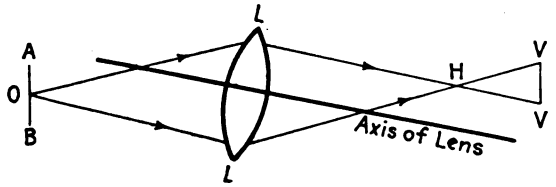
Fig. 1

that rays of light, A and B, diverging from O, reach the lens at widely separated points, and after passing through the lens are converged to different focal spots on the axis. Intermediate rays would also be present, but are not represented for the sake of simplicity and clearness in the diagram. It is clear that these rays would be focused at a succession of spots along the axis of the lens. Therefore, a lens having sperical aberration will produce a badly blurred image of objects placed a short distance away. Not only will the image be indistinct, but there will be a wide circle of light around the image causing it to be highly illuminated. Bright lines will appear dull because of the lack of contrast between these lines and the brilliant illumination surrounding the image.

Spherical aberration makes an electric light bulb very indistinct when viewed through a lens.. Fig. 3 shows a picture of a bulb after the edges of the glass had been screened. To demonstrate spherical aberration procede as follows: A reading glass is fastened into position about 8 in. from an electric light bulb and the image of the bulb is received upon a screen of white paper. The full size of the lens is used, thus admitting rays of light through the edge portion of the lens. This picture shows an indistinct image surrounded by a wide field of white light. Fig. 3 was made by admitting light from the lamp through a small opening in a screen placed in front of the lens, thereby shutting off rays from its edges. Of course, this decreased the number of focal spots along the axis because the edges of the lens were no longer used.

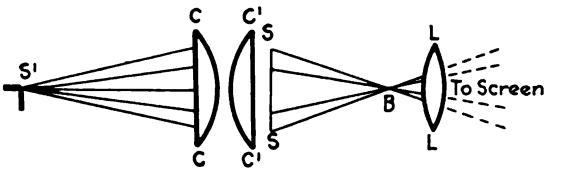
Anyone can easily demonstrate how the image produced by a lens increases in sharpness as the outer portions of the lens are cut off. Nothing is needed for the trial except an ordinary reading glass and an opaque screen which has a small opening through it. Hold the lens in front of an electric lamp and focus the image of the lamp on a piece of white paper. Now place the screen against the lens and focus again. With only the center of lens used, the image will be sharper and more distinct.

The wider the lens, the more necessary it is that it be corrected for spherical aberration, unless the lens is thick at the center, or, in other words, has a short local length. The preceding experiment demonstrates to the reader that a simple way to correct this aberration is through providing a stop either in front of or behind the lens. If one examines a camera which has but one lens, he will find that provision is made for decreasing the blurring of the pictures by using a lens of short focal length. It is also provided with a stop which may be changed in size, making it possible to use almost any width of the lens desired. Such an arrangement proves fairly satisfactory for correcting spherical aberration and is used on the cheaper grade of cameras. The success of these cameras is due to the fact that the single lens is of such shape and thickness that the distance between the focal spots of light coming from its



Shows how the lens "bb" is turned in order to have separate focal spots for vertical and horizontal lines.

Fig. 4



The arrangement of the Arc Light or Lamp, (S') condensing lenses, Slide "SS," and objective lens "BB" is here shown for producing barrel distortion.

Fig. 14

Digitized by Google

edges and the focal spot of light from the center is small. It is clear that this kind of a lens does not form badly blurred images.

Lenses wihch have a large amount of spherical aberration are not suitable for use in cameras, telescopes or optical instruments which require sharp definition in their images. The means of correcting this defect in a camera lens are far more simple than the method used on telescope objectives. A camera lens usually has a short focal length compared to that of a telescope lens. On this account, the loss of brightness of the image formed when the edges are screened does not interfere with the process of picture taking except that a longer exposure is required. Usually this does not inconvenience the operator. But a telescope lens in the objective must be of long focal length in order that the telescope may magnify greatly, and it also must be wide to enable it to gather enough light to illuminate the image. If the lens were narrow, as would be the case if the edges were screened to reduce spherical aberration, the image could be so poorly lighted that it would be seen only with difficulty. The method used on telescopes is too complicated for discussion here.

The presence of astigmatism in a lens, for some purposes, is as objectionable as spherical aberration. Almost any thin lens shows this imperfection, which may be readily observed by looking obliquely through a reading glass lens at the rulings on a piece of cross section paper. Under these conditions either the vertical or the horizontal lines may be blurred, depending upon the distance of the lens to the paper. A far more striking demonstration may be made by projecting the image of a cross ruled slide, made from a fogged photographic plate, upon the screen with the lens turned obliquely to the lamp as shown in Fig. 5, in which AB represents the slide and LL the lens. Light from a point O on the slide is focused by the lens along two lines, H and VV, the line H being perpendicular to the plane of the paper and the line VV in the plane of the paper. It is found by trial that horizontal lines are focused at H and vertical lines at VV. A lens, then, which has two focal spots, one for horizontal lines and one for vertical lines, has astigmatism.

In order to photograph these lines, it was necessary to use a lamp having high candle power and a frosted bulb in order that the slide might be highly and uniformly illuminated. A 100-watt tungsten lamp will answer the purpose. The slide was placed about four inches from the lens. Then the lens was set up about 6 in. from the slide so that the rays passed directly through the lens. Under these conditions the images of both vertical and horizontal lines were well formed. (See Fig. 5, which shows both lines in good focus.) When the lens was turned so that rays passed through obliquely, one or both of the lines became blurred. By changing the distance between the slide and the lens, and by moving the screen forward or backward, a position was found for the screen where the vertical line was well focused, and the horizontal line blurred, or even obliterated, and vice versa. Figs. 6 and 7 were obtained by placing a photographic plate at the focal spot for each line and by exposing for an instant. In obtaining these pictures for the purpose of illustration, the amount of astigmatism was exaggerated by throwing one of the lines completely out of focus.

Lenses having astigmatism cause considerable annoyance to the designer of instruments which are used to form images of straight lines running in different directions. There is no known method of correcting such lenses by combining other lenses with them so that the defect of one lens corrects that of the other, as was the case in chromatic aberration, and neither will the use of a screen to shut off the edges of the lens correct this defect. In fact, the design for a lens system free from astigmatism, called a stigmatic lens system, is accomplished by trial guided more or less by detailed mathematical calculations, the discussion of which is beyond the scope of this article. A stigmatic lens system should be used in projection lanterns, copying lens for maps, architectural plans, etc.

Perhaps one of the most interesting of the imperfections of a thin lens is coma. The most pleasing feature of this defect is the facility with which it may be illustrated. The only difference between astigmatism and coma lies in the width of the band of rays which pass obliquely through the lens. It is not even necessary to use a cross ruled slide. It is found that light from the lamp as arranged for astigmatism except the screen will form at H (Fig. 4), a flare illustrated in Fig. 9, and at VV (Fig. 4) a flare which is shown in Fig. 8. If the reader desires to reproduce these flares, he can easily do so by holding an ordinary reading glass in front of a strong electric lamp so that the rays of light pass obliquely through the lens, and by receiving the flares on a white screen. In order that both flares may be seen separately, he should focus for one and then move the screen until the other flare comes into focus. The presence of coma in a lens is as objectionable as the presence of astigmatism. It must be corrected or the images formed by the lens will be worthless. The correction of coma is as involved as that of astigmatism and is worked out in the same manner.

The image formed by a simple lens is generally distorted. Thus, Fig. 11 represents a square network of lines, and Figs. 12 and 13 are illustrations of two kinds of distortion, barrel and pin cushion. The cause of this distortion is due to the difference in magnification near edges of the field of view and the center. In Fig. 12 the magnification is greatest at the edges of the field of view, and in Fig. 13 the magnification is greatest at the center.

A most striking illustration of distortion may be obtained as follows: A magic lantern is provided with a thin objective lens LL (Fig. 14). The image of a cross ruled slide is projected upon the screen. For this experiment either an arc light or a 250-watt lamp is needed to furnish the illumination.

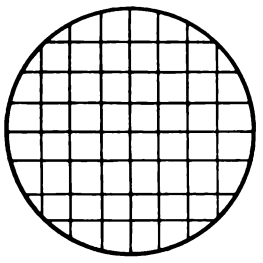


FIGURE 11

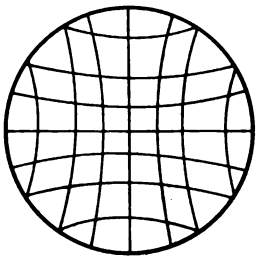


FIGURE 12
Pin Cushion Distortion

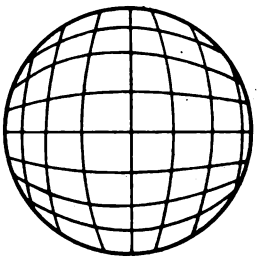


FIGURE 13
Barrel Distortion

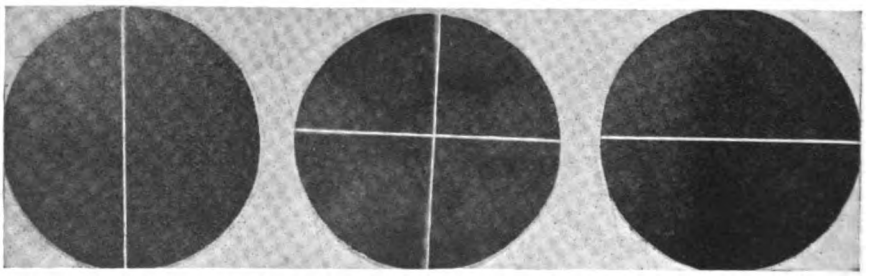


Fig. 6 *Fig.* 5 *Fig.* 7

Digitized by Google

The distance of the lamp from the condensing lenses CCC'C' should be so adjusted that the light after passing through these lenses is concentrated at B, Fig. 14, as if the point B were a small hole in the diaphragm in front of the objective LL. In this case the cross rulings as projected upon the screen appear like Fig. 13. If the lamp is now adjusted so that the light after passing through the condensing lenses is concentrated at B, as if B were a small hole in a diaphragm behind the objective lens, then the cross rulings will appear like the lines in Fig. 12.

These experiments show that one or the other of these distortions will appear according to the position of the diaphragm in front of or behind the objective lens. The convergence and the divergence of the beams of light may be easily seen by agitating small particles of dust in the region both in front of and behind the objective lens.

One can now see in a general way that distortion may be corrected by using two thin lenses with a diaphragm placed between them. Such a lens system is called a rectilinear or orthoscopic lens system. It will produce erect images and is very useful in photographing buildings, or for making accurate copies of drawings. A kodak equipped with rectilinear lenses makes a very satisfactory kodak, and will respond to almost any purpose for which a kodak is likely to be used.

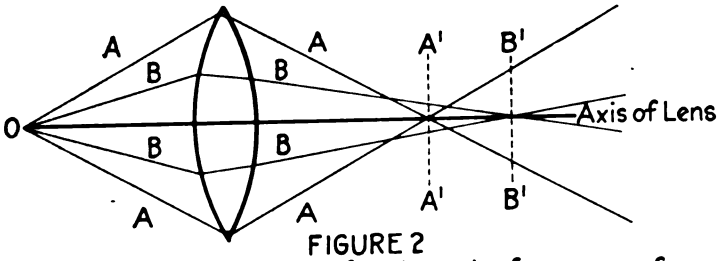


FIGURE 2
Showing the different focal spots for rays of light from different regions of the lens.

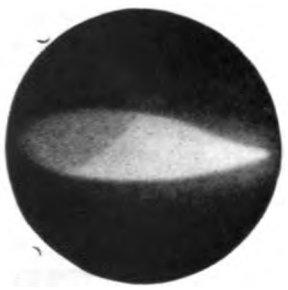


Fig. 8

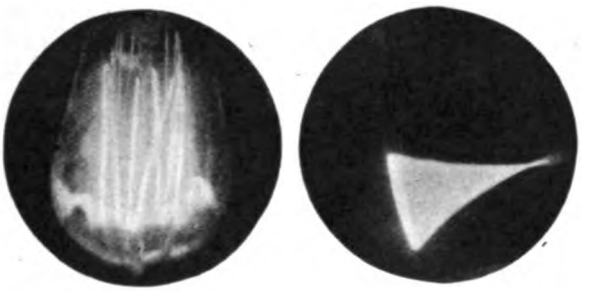


Fig. 9

Dressing an Alundum Stone

OUT of the raw material for bases, and awaiting more, I looked around my workshop for things which wanted doing. An examination of my alundum stone disclosed a distressing condition of that patient sufferer. Exigencies of floor room had located his giddy career in a dark obscurity. In the penetrating light of truthful day I gazed on his war-worn profile. He had gone to service three months ago in his remote station, an honest 4 in. by ¾ in. true and upright abrader; he was now a stale bath cad from which the currants had been stolen by fingers which left their larcenous indenture. Of course, I know now how he could and should have been cured, but star dressers and holders do not grow on the hedges in old Tyrone. Mounted on a mandrel and slowly rotated, the sufferer seemed hopeless, even if I could find means to grind away the superfluities of his constitution-to-be. If steel caused his present state, steel could cause a better state. Alas, for my high speed tool; half a minute's facing with it convinced me that was not the way to get a face on Alundum if I wanted my tool again. Try an old file! So the old file takes its place in the post. That file was ashamed of itself in twenty "whirls" and retired to its pensioned leisure. In assisting its retirement I tumbled on my head a piece of a broken Carborundum stone about 4 in. long and about a square inch section. Not large, indeed, but the material is uncompromising, and falling from a heavenly direction on the top of your thoughtful brow into your mouth, and from my mouth that thought issued, translated into "The very thing!" First repairing the damaged brow with a felt fastener, I bore the offending Carborundum again and "faced." Excellent, till about half in, when the forces of nature expressed themselves in a "jam," followed by a "d—." But something was happening, some dust was flying. Back and try again. No, "jam" again. A third try —worse! No, that is not the way, but apparently it is part of the way. If I could get the hills chiselled off I might get it. A few minutes with the chisel and hammer convinced me I could chisel bits off alundum. Nevertheless, light came into my darkness from this effort; this also was part of the way. So back to my Carborundum stone in the post; feed in, in rapid, short advances and withdrawals. Magic! I get right in to the mandrel, back and give the lead screw a quarter turn and "jab" at the face again. In again; now I am getting a face. Keep at it; in ten minutes I have a perfect face, but, alas, it is a beautiful cone. The Alundum certainly comes away, but, in lesser degree, does the Carborundum, and they face each other beautifully at an angle of nearly ten degrees. "Jabbing" in the tool post cannot cure that evidently. Well, as it is in the post, let us try the periphery of the Alundum. Feed in slowly, feed across rapidly back and forward. Beautiful! But, alas, I have nearly three-quarters of an inch to take off the diameter before I get a ssuare or nearly square corner with the face I have done; but I have a perfect periphery. The other face is then done, with like "coning" result to the first face. How is this to be cured? Well, I think I have learned that to dress Alundum I must hit it whilst it runs, and runs fast. Accordingly, I take the Carborundum stick, or stump, in my hands, get the tool post out of the way, and rub it vertically up and down, much as I see the harvester sharpening his scythe, against the coned face as it revolves, feeding in to the mandrel. Remarkable; in two minutes I have a true face, and in four minutes (will say six, if you like; time was made for trades unions) I have a perfect stone. In a minute more the calipers verify my eye, and the rule persuades me I have a stone now 4¼ in. by 7/16 fit for the front again.

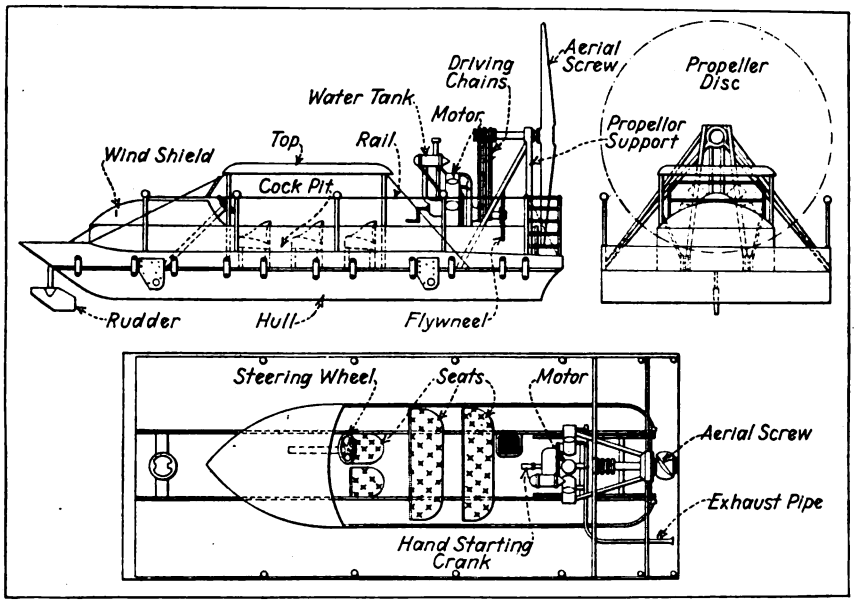
All very painful to him who knows, of course, but I took more pleasure in that little stone regenerated out of my sheer ignorant perseverance than in getting a dozen new ones on credit. I now know all about the star dresser, and also the inertia stone dresser, and I know their working principle from my painful progress, but I also know now I can do without either and produce as good a job with a piece of another abrader rescued from the scrap heap to bring salvation to another erring spinner.

From "The Model Engineer and Electrician," London, England.

Digitized by Google

A SEA-SLED ON THE TIGRIS RIVER

THE names Tigris River and the city Bagdad bring one's thoughts at once to the "Arabian Nights" and to the great World War. It is on the waters of this river that the craft illustrated has been most successfully employed. The diagram with the legend tells the story of its construction in general. It weighs 5,500 pounds and is driven by a 250 h.p. Salmson gasoline engine, which actuates an aerial propeller at the stern of the boat. Up to a power rendition of 120 h.p. its efficiency is low, but as the power increases it gathers speed, and at 19 miles an hour begins to plane, and at 130 h.p. the speed runs up to 37 miles an hour and at 160 h.p. it shows 43 miles per hour. When it reaches a speed of 56 miles an hour the air resistance becomes the controlling factor. The aviation motor used to drive it is never put to more than half its rated power, and hence lasts very well. It takes about half the power of an ordinary speed boat. It is said that the French Government proposes using this type of boat quite extensively in their colonies. Its light draught is a most important feature on many rivers. At full speed or above the critical point the resistance sums up to that of the air added to that of a mixture of air and water against the bottom of the hull. The official report says that many and excellent trips were made by it on the Tigris. It has gone from Bagdad to Baidji in five and one-half and in six hours, a distance of 180 miles. The sea-sled principle, as it may be termed, is no new one; Lambert, in 1904, got over 22 miles an hour and Tissandier, in 1913, with 160 h.p., attained a speed of nearly 60 miles an hour. In comparison with Tissandier's record a 1,200 h.p. speed launch of the displacement type is cited which could only give a mile and a quarter better rate per hour.



French sea-sled propelled by aerial screw used on Tigris River

CURRENT REQUIREMENTS IN DENMARK

DENMARK is at present supplied from 497 central stations having a total output of 108,000,000 kilowatt-hours per annum. The net sale to 205,000 consumers is 30,800,000 units for light and 54,700,000 units for power. The average net cost per unit in 73 towns is 4½d., in 387 villages 7½d., and 37 agricultural district 3¾d. The high cost in the villages is chiefly due to the load factor, which seldom reaches 0.10, and in a smaller degree to the high cost of fuel. With regard to future developments, it appears, according to the *Technical Review*, that a scheme is being considered which will enable a supplementary supply of electrical energy to be obtained from Norwegian waterfalls. The distance from the nearest suitable falls to Copenhagen is about 75 miles, and it is proposed to send 26,000 kilowatts at a pressure of 50,000 volts by an overhead transmission line running through Sweden to Malmô, and thence by submarine cable across the Sound to Copenhagen. The engineering difficulties in connection with this proposal are easily overcome, but the economic question presents some difficulty, as a low load factor would require a very expensive transmission line, and necessitate high prices to consumers. The estimated requirements of the country, provided cheap energy can be supplied, are about 450 million kilowatt-hours per annum.

PREVENTION OF DOPE POISONING

WORKMEN who apply dope to wing fabrics find it difficult to avoid the occasional splashing of dope upon their hands. When protective gloves are not worn the dope dries upon the skin to a film that is removed only through the use of strong solvents. Some workmen soak their hands in dope thinner (acetone, benzol, methyl acetate, etc.) in order to remove the dried dope films. As a result, cases of so-called "dope poisoning" have been observed. In some instances the hands may become greatly swollen and covered with an eruption.

It has been found possible to largely eliminate such trouble by having the workmen rub vaseline, glycerine or similar emollients upon their hands previous to starting work. The dried dope does not then readily adhere to the skin and may be removed at night by rubbing the hands with further quantity of emollient followed by washing with soap and water. A further application of emollient will serve to keep the skin from becoming dry and cracked.

Dopes containing tetrachlorethane, a toxic volatile solvent which causes pronounced jaundice to those inhaling it for protracted periods, is not approved in dopes used by the Navy Department. The solvents now used are relatively non-toxic. Their vapor, however, should be removed from dope rooms as rapidly as possible in order to provide plenty of fresh air for the workmen. This may be accomplished by the use of revolving ventilating fans placed at the floor level in order to rapidly withdraw the vapors, which are heavier than air. The inlet vents for the fresh air should be about 12 ft. from the floor level. Provision should be made for cleaning the incoming air and passing it over temperature regulating coils so that the temperature of the dope room should be approximately from 68 to 72 deg. Fahr.—*Bureau of Construction and Repair, Navy Department.*

ADHESIVE FROM SNAILS

MANY of the larger kinds of snails have at the extremity of their bodies small white bladders filled with a gelatinous substance. The *Scientific American* claims that this is the strongest adhesive known for the repairing of porcelain, glass, etc. The substance is applied thinly to both sides of the fracture and the broken piece is tied firmly together so that all is held in place. A rather longer time for drying should be given than in the case of ordinary adhesive so as to allow the natural glue to acquire the greatest degree of strength. When it is once really set the tenacity of this remarkable adhesive is astonishing.

Digitized by Google

The Gear Shaper and How It Works

A Description of the Principle Involved in Generating Gears by a Special Shaping Machine Using a Very Simple Cutter that Is Capable of Doing a Wide Variety of Accurate Work

WHEN one mentions gear cutting to the average machinist or mechanical man, the conventional milling machine, index head and revolving, formed milling cutter comes to mind. There are other ways of cutting gears that have advantages besides milling the teeth on the blanks by a formed cutter that removes the metal by a modified sawing action. The student or apprentice machinist will be interested in the description of gear shaper operation that follows and the more experienced machinist will readily perceive some advantages of the shaping process especially in making shoulder and internal gears.

The Fellows gear shaper, shown in an accompanying illustration, represent a type of gear-cutting machine that works on the generating principle, as it employs a gear-like cutter which generates the teeth of gears by a shaping action. The principle upon which this machine works is comparatively simple. Essentially, it is similar to the action of two gears in mesh, one the blank being cut and the other the cutter. The cutter is similar to an ordinary gear, except that it is provided with clearance on the teeth to permit of free cutting. This cutter is reciprocated up and down by means of a shaper ram, and at the same time work and cutter are slowly rotated in unison with each other.

Features of the Gear Shaper

The gear shaper has many interesting features embodied in its design. One of these, which is worthy of special attention, is the work-spindle and illustrates the principle of construction. The work-spindle is held in an apron which is hinged to the cabinet and is operated by a relieving mechanism which withdraws the work from the cutter on the return stroke of the latter. This work-spindle is of the reverse taper type. In other words, the work-arbor on which the blanks are held has a reverse taper and the more tightly the blanks are clamped to the work-spindle, the more tightly the arbor is held in the spindle; this forming a very rigid construction. In addition to this rigid support in the work-spindle, the work is also additionally braced by a work-support, which resists the thrust of the cut and greatly assists in eliminating all cutting strains.

Indexing Mechanism

It can be truthfully stated that a gear-cutting machine stands or falls on the merits of its indexing mechanism. It is the critical point in its design. The diagram, Fig. 3, shows the indexing mechanism employed on the Fellows gear shaper. It is of the continuous indexing type. It will be noticed in this diagram that both the upper and lower index wheels are tied together by change gears, and are entirely independent of the cutting mechanism. This feature on the gear shaper greatly assists in the production of accurate work.

Productive Capabilities

From the standpoint of production there are certain features about the gear shaper that are worthy of attention. One is that when compared with the hob or milling cutter, it is a much more efficient remover of stock. As is shown in Fig. 4A, the hob or milling cutter re-

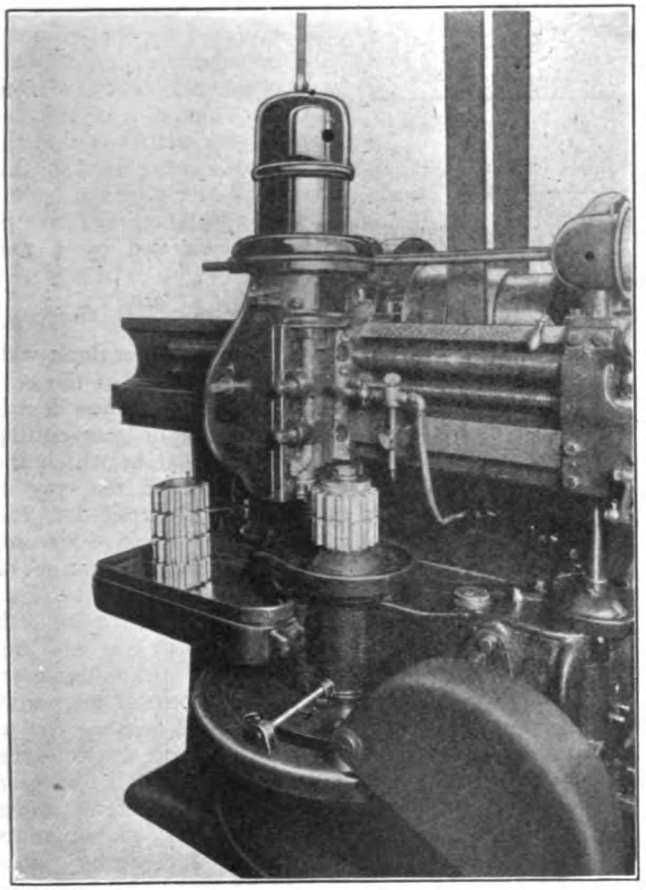


Fig. 1—Gear shaper cutting two 7/8-pitch stub tooth pinions for tractor work

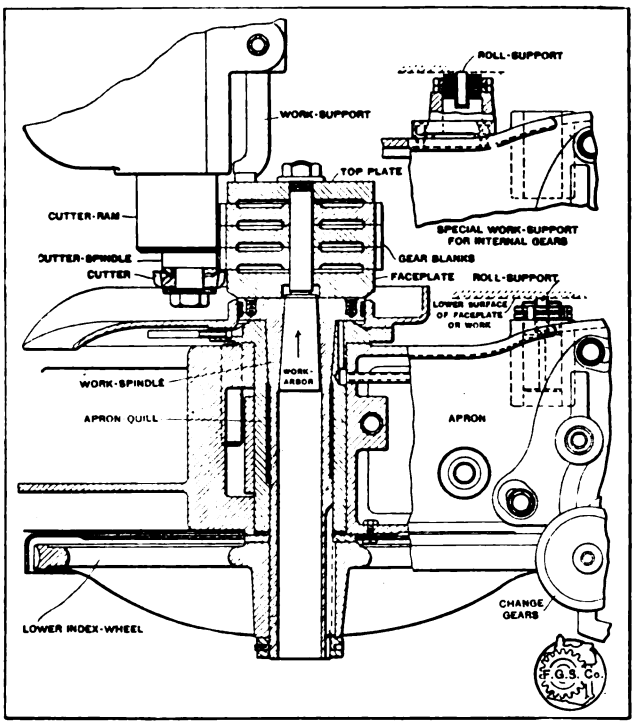


Fig. 2—Sectional diagram showing work-support and cutting ram of gear shaper, also design of work-arbor

Digitized by Google

moves a chip of varying thickness. It starts with a paper thickness and finishes at the top with a chip of greater thickness. The case is otherwise with the gear shaper cutter. Here, as is shown at Fig. 4B, the chip has its full thickness for the entire length of stroke. The gear shaper cutter in making a chip has a two-fold advantage. In the first place, it starts in at maximum thickness and keeps it up to the end of the stroke. In the second place, it gets under the metal at once, and in addition, owing to the rigidity of the cutter-slide, deflection of the cutter once it is buried in the work is impossible. This is very important, especially when cutting hard alloy-steel gears.

Another feature of the gear shaper is the small amount of excess travel necessary as compared with the milling cutter or hob. The milling cutter or hob has to travel the distance X before getting into full depth as shown in Fig. 4C. It therefore must be fed that much more than the width of the gear being cut. With the gear shaper cutter, the excess stroke need never be more than 3/16 of an inch greater than the width of the gear; just enough to allow for relieving the cutter and returning it at the end of the next cutting stroke. This is shown at Fig. 4D.

Coarse Feed and Fine Finish

Coarse feed and fine finish is another advantage of the gear shaper cutter as compared with the hob or milling cutter. The gear shaper cutter and the work rotate together, as indicated by arrow in Fig. 4E, while the cutter is reciprocated as a shaper tool in a direction at right angles to the illustration. The successive outlines in the figure show the position that the cutting edge occupies for each successive stroke. The distance between any two adjacent outlines indicates the thickness of the chip at that point. One of the chips has been cross-hatched to show its shape. Here it will be noticed that the thickest part of the chip comes in the middle of the tooth space away from the finished surface. As the chip approaches the finished surface it runs out to a thin edge, which is just the right condition for a fine finish. This illustration is greatly exaggerated so that conditions are much better than they appear in the illustration.

Cutting Helical Gears

The description, previously given, has referred to the gear shaper as it is built for the cutting of spur gears. The gear shaper is also adapted to the cutting of helical gears, and accomplishes this in a very unique manner. The principle of the machine is similar to that used for cutting spur gears, with the one exception that a different form of cutter-slide is used and a different type of cutter. Fig. 5 shows cutter-slide, cutter-spindle and cutter assembled, but removed from the machine. Here it will be noted that the cutter used, instead of having teeth like any ordinary spur gear, resembles a helical gear with the one exception that the cutting face of the teeth are located at right angles to the helix angle of the teeth.

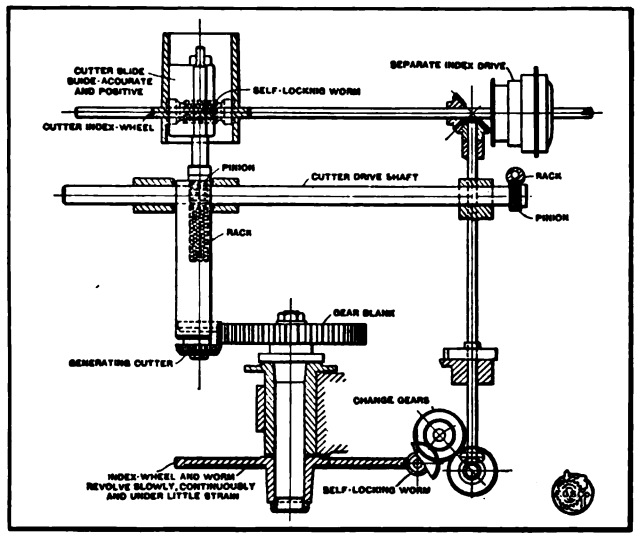


Fig. 3—Diagram explaining action of gear shaper indexing mechanism

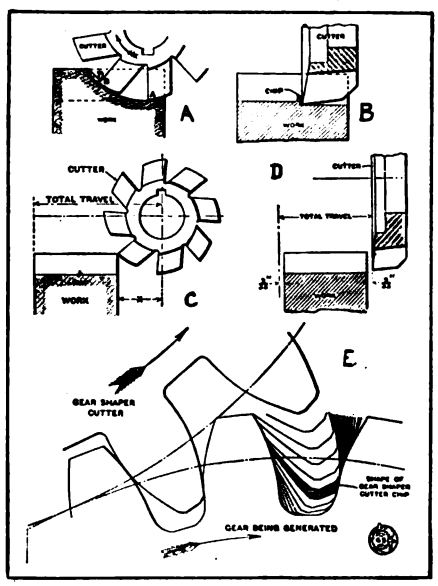


Fig. 4—Diagrams showing advantages of gear shaper cutter

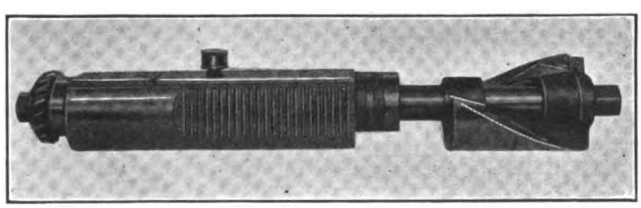


Fig. 5—Cutter-slide, cutter and cutter-spindle of gear shaper for helical gear work

It will also be noticed that the guide is of twisted form. This guide has the same helix angle as the cutter and by means of a shoe in the worm-wheel housing controls the action of the cutter as it is reciprocated back and forth past the face of the work. In other words, the helical guide controls the helix angle of the gear that is being produced, and it is in this one feature that the gear shaper differs from all other gear-cutting machines used for cutting helical gears. In other words, the helix angle of the gear being produced is under absolute control, because it is not accomplished by change gears and the setting of index heads which are not easily so controlled. Another feature of the helical gear shaper is that the gear shaper cutter used for this work is ground all over after hardening, including the involute curves of the teeth which are generated by a precision process.

Adaptability of the Gear Shaper

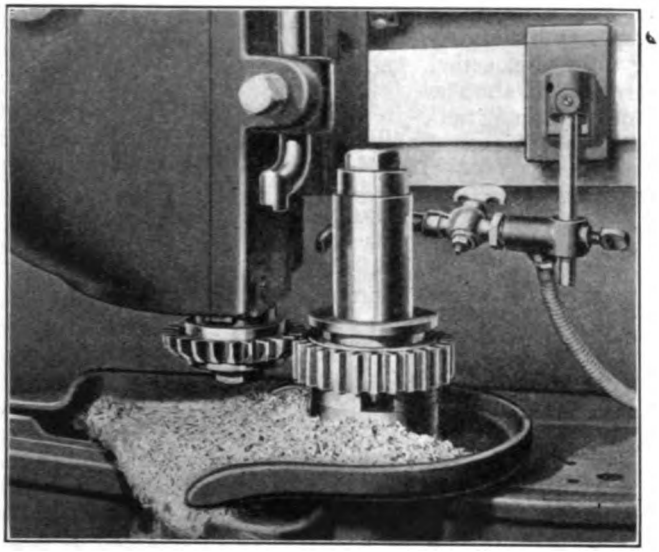
The preceding description dealt with the features of construction of the gear shaper, and we have shown how it differs from other types of gear-cutting machines in the method in which the cutter works, and also in the way in which the cutter is controlled. The gear shaper has other exclusive features which give it considerable range of adaptability. Fig. 1 shows the gear shaper cutting two 7/8-pitch stub tooth pinions for tractor work, whereas Fig. 6 shows the cutting of a shoulder gear. In order to cut this form of gear with a rotary cutter it would be necessary to have a much wider space between the flange and the gear teeth. The gear shaper can be operated into a narrow recess, and is thus adapted to the cutting of this form of gear.

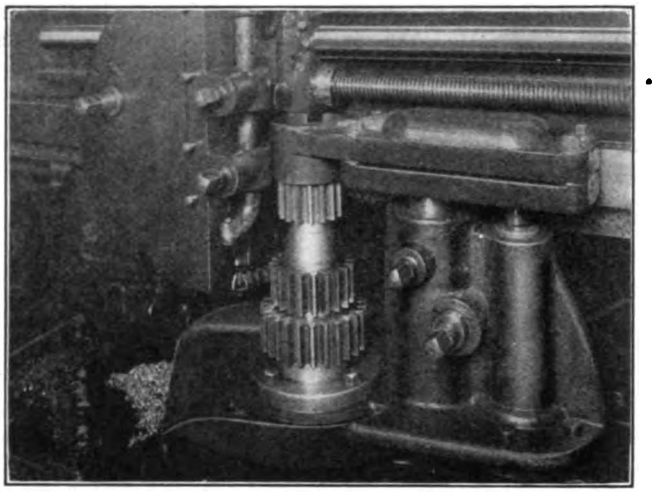
Another form of gear which shows the range of the gear shaper is illustrated in Fig. 7. This three-step gear for a gas engine transmission is made in one piece. The gear shaper cutter can be used for generating all three steps with ease and precision. This form of gear cannot be generated on any other type of gear-cutting machine.

In connection with the description of the helical gear shaper, previously given, it was stated that the cutter was controlled in its action on the work by means of a helical guide, but no men-

Digitized by Google

tion was made of the range of this type of machine. Fig. 8 shows the helical gear shaper generating a combined internal and external helical gear the same cutter being used for both external and internal gears. The helical cutter can also be worked into a narrow recess, which is a feature that is of prime importance to designers desirous of producing compact mechanism.





Figs. 6 and 7—Examples of work that can be done on the gear shaper

RENEWED INTEREST IN AIR-COOLED ENGINES

THERE is a renewed interest in the air-cooled cylinders that points to a return to the earliest experience with light internal combustion engines, for it is a fact that the first specimens beyond the experimental stage were unjacketed, and it is also noteworthy that, when indirect or water cooling was first applied, it was limited to the regions of the cylinder head and valve chambers. De Dion and Aster, in France and Lanchester and Holden, in England, Franklin and Cameron in this country went through a full range of experiments with air-cooling, followed by water-cooling in the case of the European manufacturers and early users of the products of some of these pioneers recall that they failed rather because of lack of the materials now available than for lack of the specific knowledge based on experience which is now found in so many text books.

The problem of materials which combine higher conductivity with freedom from distortion and which are capable of withstanding prolonged spells of a high working temperature, is still formidable, but it may be that its solution will be found rather in improved foundry methods than in some new grade of material. On this score, it may be well to note that the "whirling" method—American by the way—of casting, now being used with some success for casting piston rings almost ready for use and in making pipe may prove to be applicable for fin-jacketed cylinders of plain concentric form, with removable head. Tungsten irons have been used for air-cooled cylinders and in the field of aeronautical engineering, we see a number of examples of aluminum cylinders with steel or iron liners, the aluminum having greater heat conductivity than either iron or steel. The use of alloy steel air-cooled cylinders machined from the bar or forging and having flanges machined therein is too costly for automobile engines. The Franklin automobile engine and the various motorcycle power plants prove that air-cooling is practical when properly carried out.

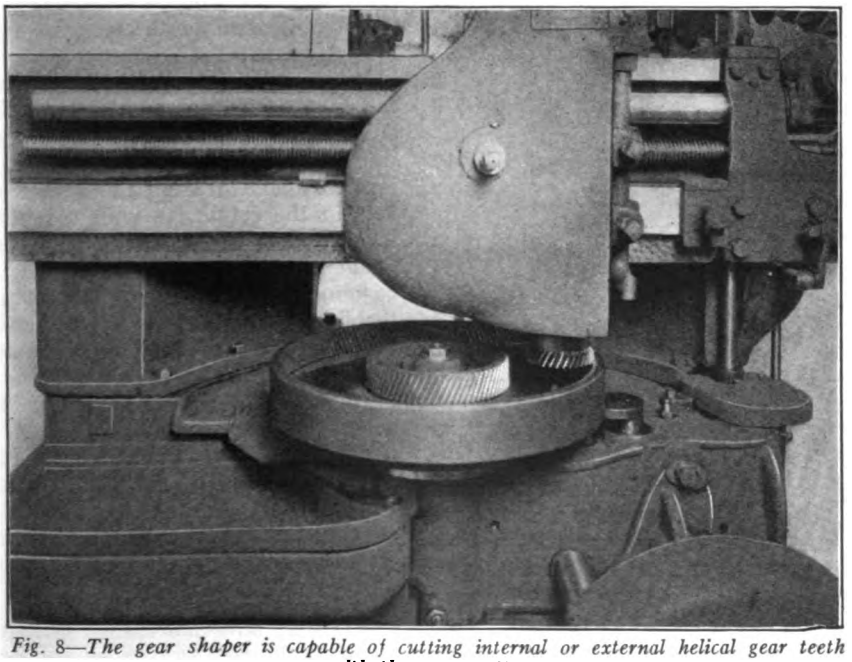


Fig. 8—The gear shaper is capable of cutting internal or external helical gear teeth with the same cutter

---

General Squier's report on the work of the United States Signal Service Corps states that of all electric apparatus regarded as adequate at the beginning of the war, hardly a single piece was in operation at the armistice. The *London Electrician* comments with great favor on the document and is especially pleased at its early issue. Whatever good has been done by the corresponding English department is unknown for lack of a report. The American department drew men in from telegraph and telephone companies. A million batteries were produced, and over a hundred thousand telephones, and over eight thousand sets of one single type of wireless apparatus were sent to France. Seventeen hundred miles of pole lines were erected in France and 37,950 miles of wire were laid.

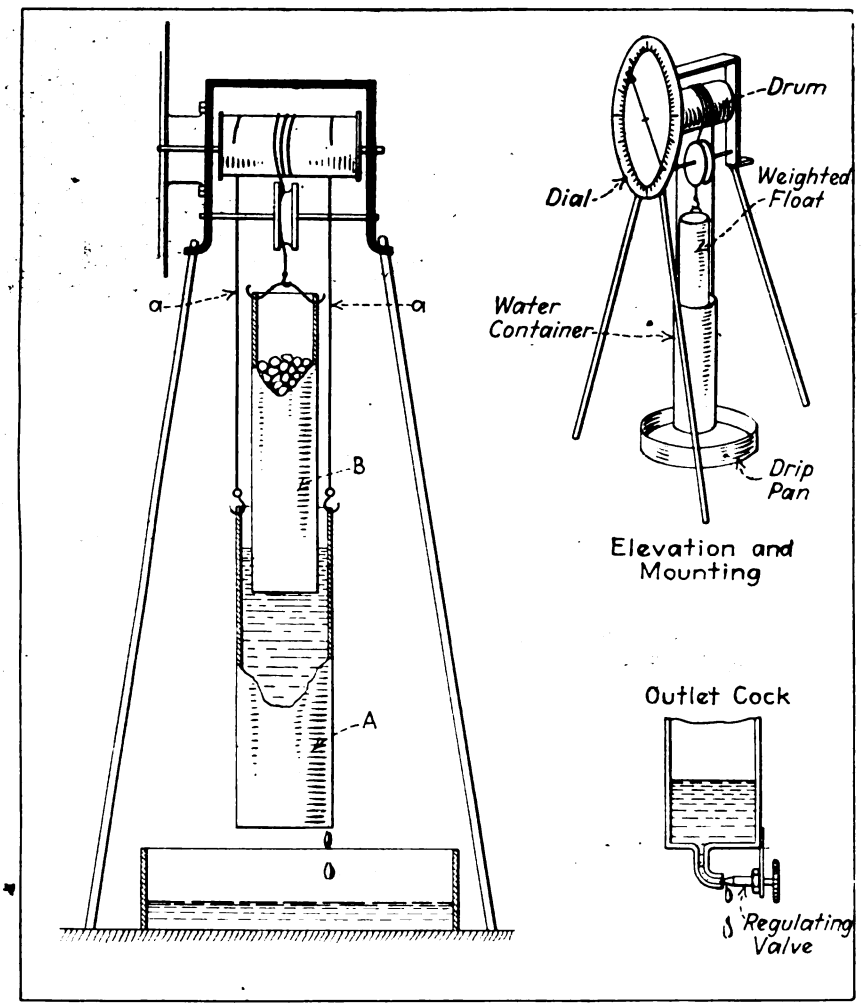
In France a company is going to make artificial fuel from lignite and peat by a special process. In the same country fine refuse coal is saved, often on the smallest scale by householders, by mixing clay with the culm as a binder. It is said that the process has been known in Wales for centuries. From South Africa come reports of enormous coal deposits in the vicinity of iron beds. The coal situation of the world is far from acute apparently.

Digitized by Google

A SIMPLE WATER-CLOCK

A CLOCK, whose movement is produced by the escape of water from an orifice, represents one of the earliest mechanisms for the indication of time. In the cuts are shown a very simple construction of clock in which one of the difficulties incident to such devices, irregularity of movement due to the changing level of the water, is almost completely obviated.

At the top of a frame is carried a drum, to the front extension of whose axis is attached a clock-hand. A dial, marked with the hours of the day, is also there, the axis of the drum passing through it, thus bringing the index or hand in front of the dial, as in any clock. To two cords, a, a, wound on the drum, both in the same direction or sense, is attached the cylindrical vessel, A. When the clock is wound up the vessel, A, is at its lowest point and is full of water. Suspended by another single cord is a second cylinder, B, nearly of the same diameter as the other. A guide pulley, b, over which its suspending cord passes, keeps it in line with the other cylinder, into which it descends as the first one rises. This reverse motion of the two cylinders is brought about by the suspending cord of cylinder, B, being wound in the opposite sense to that of the cord of cylinder, A. An opening at the bottom of the cylinder, A, permits the water, with which it is charged when the clock is wound up, to escape. It is here that the distinctive feature of this clock appears. As the water escapes from A it tends to rise because the cylinder, B, weighted with shot, pulls it upward. But as it rises, the cylinder, B, descends into it and acts to maintain a nearly constant water level within it. The result of this is that the water escapes with a nearly uniform rate, giving a uniform action to the hand on the face of the dial. The small cut shows a construction of adjustable outlet for the escape of water.



Diagrams showing construction of simple water clock

WHALE'S LIVER FURNISHES PERFUME

AMBERGRIS, which forms a basis for the best quality perfumes and scents, is found as an unattractive looking mass floating on the sea or lodged on the shore. History does not record how such an unlikely substance suggested itself as a perfume, but it has been in use for centuries. Its origin, however, has been known for a comparatively short time. It is a morbid secretion of the liver of a sick sperm whale, and ashen-colored and waxy in appearance. Although unpleasant in sight and touch, it gives off a fragrant musky odor when warmed, even in the raw and unprepared state. It is subjected to chemical action to extract the active principle, called amberine, from which the perfume is actually derived. This material is also used as a remedy for catarrh and nervous diseases and is very valuable. The largest pieces on record weighed 130 pounds.

REMOVING GASOLINE FROM NATURAL GAS

THE belief which has prevailed in more than 2,100 towns and cities in the country where natural gas is used that it was being robbed of a portion of its heat value by the gas companies through taking the gasoline from the gas has been upset by the result of a series of investigations made by the Bureau of Mines. These showed that the natural gas consumers, which are in excess of 2,000,000, lose practically no heating value through the process. In fact, the Bureau claims that the taking of the gasoline from the natural gas is a benefit to the consumers and to the country as a whole rather than a detriment.

The heat value of 1 gal. of gasoline in natural gas is approximately 1¼ cents, while this same quantity of gasoline is worth from 25 cents to 30 cents to the automobile user. By removing the gasoline from the gas 1 gal. will equal 35 cu. ft. of gas, but this is not taken from the consumer since the gas is measured at the meter in his residence or place of business and he actually obtains 1,000 cu. ft. of gas irrespective of whether the gasoline is removed or not.

When the gasoline was not removed the gas companies experienced difficulty due to the condensation of gasoline and water in the pipe lines, the mixture disintegrating the rubber gaskets in the couplings with a resultant large leakage of gas and the consequent lowering of the pressure. If this gasoline were not taken from the pipes the Bureau states that several hundred million gallons of gasoline of the highest fuel value and adaptability would be practically wasted instead of being added to the country's supply. All of the gasoline obtained in this way has a low boiling point, that is, it vaporizes easily, which makes it valuable for starting automobiles, especially in cold weather.—*U. S. Bureau of Standards.*

In testing aeroplane engines in England, trouble was found in reaching accurate results on account of the different sizes and inaccuracies of the carburetor jets. Eventually they were tested by measuring the rate at which gasoline would flow through them and this was found to be far superior to any attempt at gauging. It was found to be so accurate that when an airplane was shipped without its carburetor one could be picked out by this simple test which would fit it.

Digitized by Google

Systematic Location of Carburetor Faults

Where Defects Are to Be Looked for in Modern Float Feed Carburetors and How They Can Be Located by a Systematic Inspection and Knowledge of Symptoms Denoting Trouble

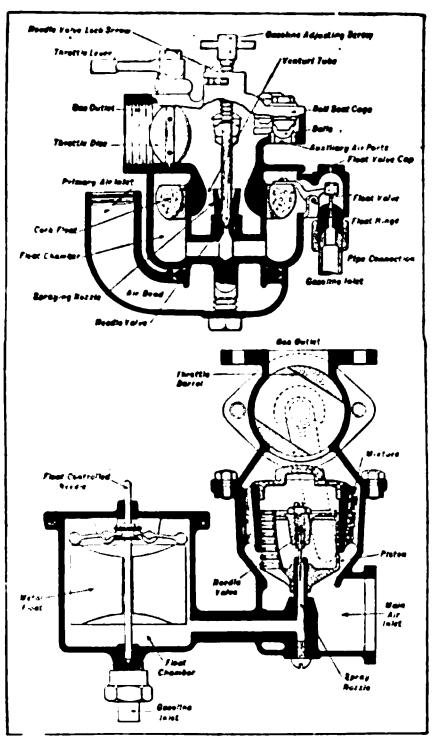
By Victor W. Pagé, M.S.A.E.

HAVING once learned how to adjust a carburetor to supply the properly proportioned mixture for different operating conditions from instructions in last issue, the motorist will realize that he has found a remedy for many motor ills, because a large proportion of motor troubles, such as misfiring, backfiring in the carburetor, loss of power, etc., are generally due to some faulty carburetor adjustment. There are, to be sure, a number of other troubles likely to occur, and while the symptoms are similar to those caused by ignition system faults, the operator who is familiar with carburetor action should have no trouble in locating them quickly and ascertaining positively if they are the result of faulty carburetor action or due to the ignition system.

Taking up the various causes which contribute to loss of power, misfiring and trouble in starting the motor, we have: Dirt or water in the carburetor, clogged fuel pipe, obstructed spraying nozzle, clogged gasoline filter, leaky metal float or fuel logged cork float, poor or stale gasoline, a loose throttle valve or connection and air leaks in the inlet manifold. If the motor refuses to start and the ignition system is known to be in good condition, the fuel tank may be emptied, the gasoline line shut-off valve closed (it may jar partly or wholly in the "off" position), there may be dirt or water in the carburetor or a choked fuel pipe, or perhaps the fuel level is too low in the float chamber. As a cold motor and stale fuel are the most common hindrances to prompt starting, the first step is to prime the carburetor and fill the float chamber with fresh gasoline. Almost every carburetor is provided with a "tickler" and in most cases priming is all that is needed to supply gasoline enough to insure prompt starting of the motor.

Start a Systematic Search

However, if the motor still refuses to operate, the trouble is deeper seated and should be found by a systematic search. To locate the trouble without undue delays the various parts of the fuel system should be examined in turn. First, the tank should be looked into to see if it contains sufficient fuel. The filter screen of the carburetor should be removed and cleaned, since the fine mesh is very likely to become clogged with dirt or lint filtered out of the fuel. If the wire gauze is in good condition, examine the pipe line for obstruction. Test the supply pipe by opening the drain cock under the float bowl of the carburetor; if the pipe is constricted, but little or no fuel will be forthcoming. If no gasoline issues and there is plenty of fuel in the tank and one is sure the drain cock is not stopped up,



Sectional view at top shows concentric float carburetor with cork float. In the design shown below, the float chamber is at one side of the mixing chamber and a metal float is used

it is reasonable to assume that the supply pipe is choked and it should be removed and cleared out as previously described. If the obstruction is not in the pipe it may be located in the shut-off valve, or perhaps in the fuel line filter.

Obstructed Spray Nozzle Common Fault

An obstructed spraying nozzle or jet will sometimes be found the cause of trouble, as the opening in this standpipe is very small, even a tiny particle of foreign matter will be enough to constrict the orifice and so deprive the motor of the proper amount of fuel. Flooding the carburetor will sometimes dislodge the obstruction but if it does not the spray nozzle should be removed and a fine wire poked through from one end to the other. Compressed air may be used as outlined in an accompanying illustration. Fine particles of lint sometimes work through the strainer and collect into a ball, which floats about and is drawn into the nozzle by the suction of the engine. In cases of this sort the motor will start easily but invariably commences to misfire, slow down, and finally come to a stop. This peculiar behavior is caused by the greater suction at high speeds, which draws the foreign matter in the jet and so chokes the bore, but as the motor slows down and the suction decreases the obstruction will fall away from the jet opening. It is sometimes possible to remedy this trouble by racing the motor and opening and closing the throttle valve quickly, which will give momentary increased suction, often sufficient to suck the particles of rust or lint or drop of water through the nozzle opening.

Fuel Level Adjustment Important

It may be observed that in those carburetors where no fuel regulating means is provided, that the height of liquid in the spraying jet is an important adjustment. The repairman should not be too hasty about altering the position of the spray nozzle in the mixing chamber. If the jet is placed too high the fuel level will be considerably lower than it should be, and while the nozzle will then feed enough gasoline for high speeds, owing to the increased suction, the vacuum created at low velocity will not be sufficient to draw up the required quantity of fuel. On the other hand, if the nozzle is placed too low, the fuel level will be raised unduly and the carburetor will show a tendency to flood. As the proper adjustment can be determined only by experimenting, when the nozzle is so adjusted that the motor will get the proper amount of fuel at both high and low piston speeds, the spray jet should not be disturbed again. The only way possible to raise the nozzle is by inserting thin washers made of brass or copper shim stock between the spray nozzle and its seat. The only way the nozzle can be lowered is by removing the packing washers, sometimes placed between the nozzle

Digitized by Google

and it seat in the mixing chamber. Alteration of nozzle position is work for the carburetor expert only.

Two Parts of Conventional Carburetor

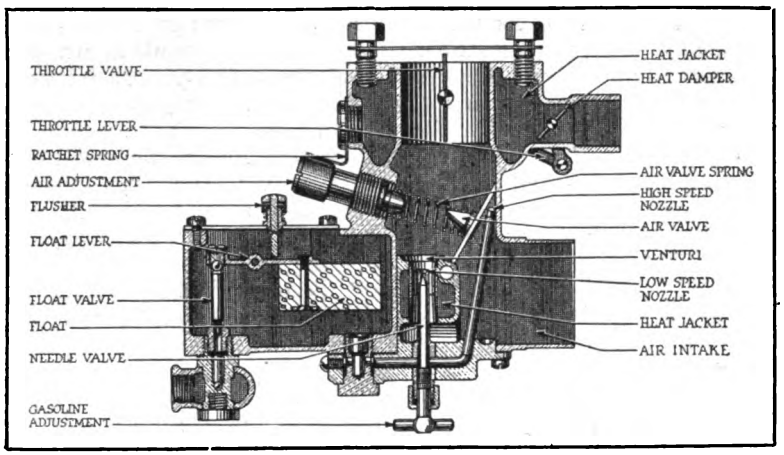
There are two parts to the usual float feed carburetor and either of these is apt to cause trouble. In the float chamber any defective condition that will prevent the float control valve from seating properly will result in flooding, which will be evidenced by a rich mixture. If the passage the valve controls becomes clogged up then there will not be sufficient liquid in the float chamber and the engine will misfire on account of the deficiency in the fuel supply. If the float needle valve is adjusted in such a way that it will close too soon the mixture will be deprived of gasoline on account of the level being too low in the float chamber.

About the only trouble that can materialize in a mixing chamber is clogging of the spray nozzle with dirt or water and failure of the auxiliary air valve to open properly. If the spray nozzle is constricted, not enough gasoline will enter the mixture. If the auxiliary air valve opens too much an excessive amount of air will be admitted in proportion to the gasoline, whereas if the valve does not open enough, the mixture will be rich.

Connecting Union Coupling

The repairman or motorist often finds it necessary to remove the fuel pipe from the carburetor and it is often noticed that after this is replaced a slow leak will develop around the joint. It is not difficult to connect the coupling if this is properly done, but it is important that the nut of the coupling is started evenly on the threads of the joints. The nut is often tightened when it is cross threaded and sometimes, even when successfully started, it must be screwed all the way home with a wrench, due to cramping of the pipe. The secret is to secure proper alignment of the components before making a connection. If after having properly aligned the parts and screwed the nut fairly tight, the joint should leak slightly, do not exert undue strain on the union in an endeavor to make a tight connection, but loosen it and apply common yellow laundry soap to the threads and screw it back in place.

If a pipe is a short one and there are two couplings, it is well to loosen both unions and start the nuts at each end at the same time, screwing them down together. In this way a tube bent in several places, which tends to shorten it, may be straightened without straining any of the threads on the joints and besides, it is always easier to center a loose pipe and start the nut correctly on the thread than to try and line up a pipe fastened rigidly at one end.

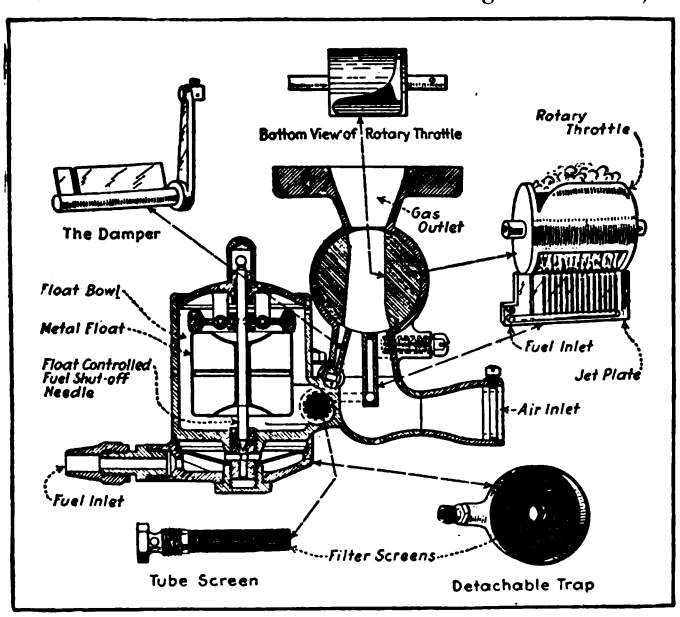


Sectional view showing construction of Marvel-Buick carburetor

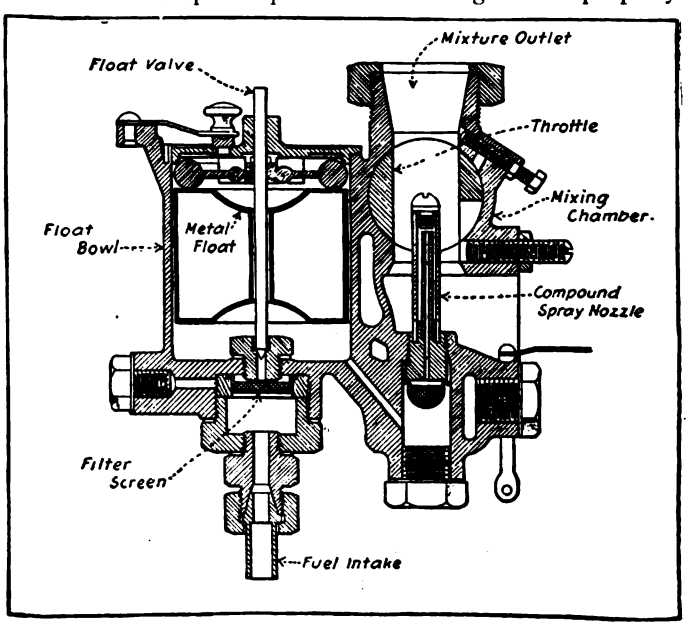
Cause and Repair of Flooding

If the repairman notices continuous flooding or dripping of the carburetor, this indicates either a badly seated needle valve, a leaking metal float, or a fuel-soaked cork float. If the float control valve itself is at fault, this is probably due to poor seating. The valve should be carefully ground in by using a small amount of powdered grindstone dust and oil. When doing this work, care should be taken to keep the valve stem in a vertical position, and when finished both the valve and its seat should be smooth and bright.

If the valve spindle is bent, remove the float, place the bent spindle on a block of wood, carefully straighten it with a few taps from a light hammer. In cases of continual flooding examine a metal float for minute holes or leaky seams, which must be soldered up. Owing to the extreme thinness of a hollow metal float, care must be taken to heat the metal as little as possible. As instructions will shortly be given for repairing metal floats and finding the leak, no trouble should be experienced in making repairs to this member. The use of hard or silver solder, which requires a blow-pipe or torch, should be left to those sufficiently skilled to manipulate the heating flame properly.



The Master multiple nozzle carburetor parts and how they fit in the assembly of the mixing chamber



The Claudel carburetor is an efficient device of French design having a compound spray nozzle of distinctive construction

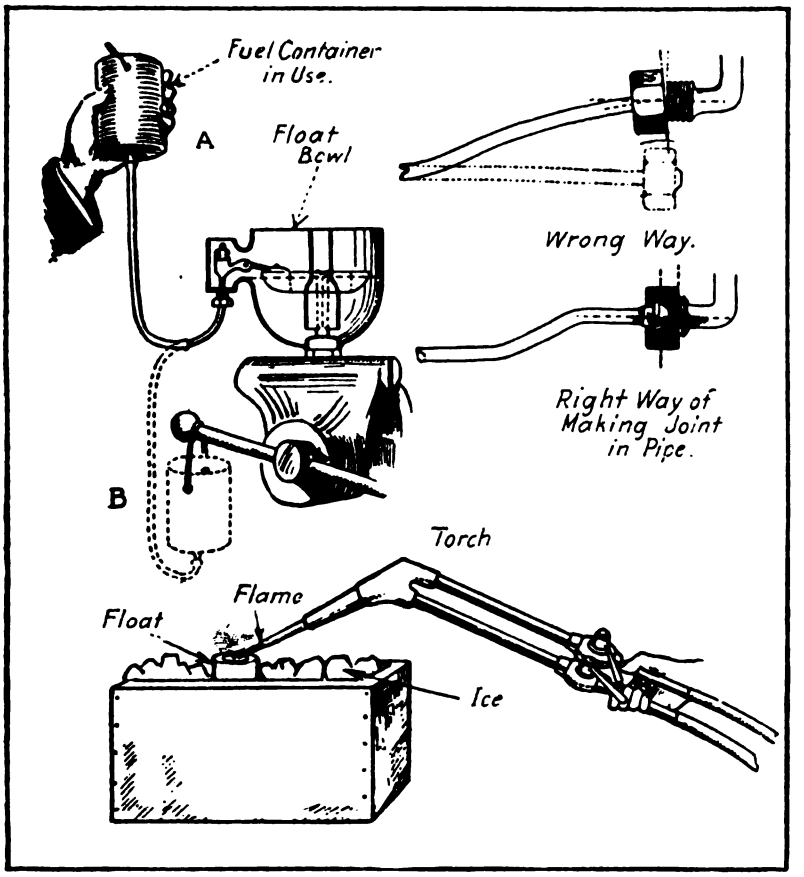
Digitized by Google

In order not to disturb the balance of the float, only a little solder should be used, and care should be taken that none drops inside the float itself.

Cork Floats Absorb Liquid

Mention has been previously made of the way a cork float will gradually absorb the liquid owing to its porous nature and how it will lose its buoyancy when it is fuel soaked. The remedy is a simple one, the cork being placed in a moderate oven so it will be thoroughly dried out and afterward it is given a couple of coats of shellac to make it liquid proof. It will be found that shellac dissolved in grain alcohol will resist the action of gasoline better than that dissolved in wood alcohol. In some carburetors the float is carried directly by the needle valve spindle, which has the valve at the top so that it may close the fuel opening when the gasoline reaches the proper level. If the level is too low the float may be shifted on this spindle to ride at a slightly higher level, which permits the float chamber to fill up more. If the float level is too high the float may be lowered on its spindle in order to close the valve sooner or when the float chamber has less gasoline in it. When leverage is used, the lever may be bent to change the position of the needle valve relative to the float. If toggle levers are used, as is the case with a metal float, shift the collar on the valve stem.

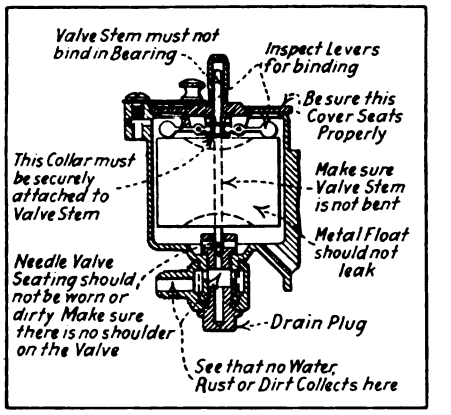
A cause of trouble in which no control of the motor may be had by moving the throttle lever is due to loose throttle connections. It sometimes happens that the set-screw used to fasten the butterfly or disk valve in the inlet pipe to its spindle becomes loose and allows the shutter to shift about and thus partially or wholly close the opening. In this case the motor cannot be speeded up. If the valve is loose and drops into the pipe in such a way that it does not obstruct it to any extent, it will be found impossible to slow down the motor as there is no means of cutting off the supply of gas to the cylinder. If the mixture volume is controlled by a sliding shutter or barrel throttle, this may stick in either the open or closed positions, in one case permitting the motor to speed up to its limit, in the other extreme it will prevent speeding up. Troubles with the throttle valve or connections are easily recognized because the motor will refuse to respond to the movement of the hand lever. An uncommon source of trouble may be a bit of stray waste left near the intake opening or the primary air supply when cleaning the motor. This waste may be sucked into the air opening and will cause trouble by reducing the amount of air supplied for mixture. Air screens also clog with dirt at times.



Illustrations showing how to test for fuel level, methods of coupling fuel pipe and suggestion for brazing a hollow metal float

Soldering a Metal Float

In repairing or making sheet metal floats, such as are used in the gasoline chamber of the float feed carburetor, one often experiences some difficulty in sealing up any small vent which makes the float air and liquid tight. When a metal float fills with gasoline, it becomes heavier and the float level is altered so it is imperative that the fuel be expelled from the interior and the hole sealed. The usual way to do this is to first locate and enlarge the hole through which the fluid reached the float interior.



What to look for when inspecting float chamber

To locate a leak, the float is held under the surface of boiling water, which evaporates some of the gasoline inside the float and evolves a gas which indicates the hole by escaping through it because of the pressure inside the float. The hole is then marked and made larger with a needle drill. Another small hole is made in the float so the interior can be thoroughly cleared out by air pressure or by placing the float in an oven where the heat will evaporate the gasoline. After the float is emptied, it is necessary to close up the openings. This may be done with an ordinary soldering iron, though most mechanics having the facilities prefer to braze the opening, because by this means one can seal it and use a minimum of metal, which is not liable to upset the balance of the float and interfere with the level in the spraying tube.

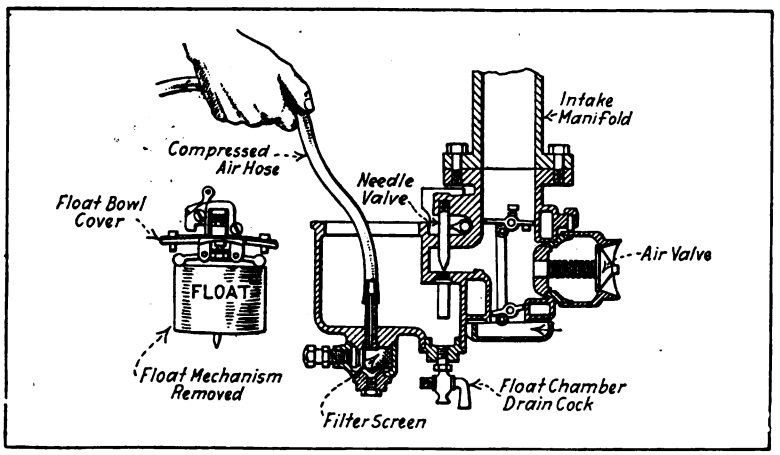
In brazing a joint or vent in a perfectly tight receptacle, the job is often a failure because the air contained in the float becomes heated and produces a pressure that may result in having bubbles in the brazed seal. To make it possible to close the opening in a positive manner, the copper or brass float may be placed in a box of ice, as shown in accompanying illustration, this tending to keep the air contained in the float cool despite the heat imparted to the float by the brazing flame.

How to Test Fuel Level

After a carburetor has been in use for some time, wear may exist at the point of the needle valve or at the needle valve seat, or there may be some depreciation in the fulcrum joint of the

Digitized by Google

lever connecting the float with the needle valve. A good way of testing the float level is shown in cut herewith. The float chamber of the vaporizer is held in a vise and gasoline is allowed to flow from a small can which is joined to the fuel inlet pipe by a piece of rubber tubing. The gasoline will flow from this can into the float bowl and raise the float as the chamber fills. The level of the gasoline should be just a little below the top of the stand pipe in the mixing chamber. If the level is too high, this will be evidenced by a liquid overflowing at the stand pipe, if it is too low this condition may be easily ascertained by inspecting the height of liquid in the jet. If one suspects that the jet is clogged or that the gasoline feed connection on the float bowl is constricted by dirt it is a simple matter to clean the passages out by using a compressed air hose as shown in cut.



How to use compressed air for clearing out fuel supply nozzles in either float or mixing chamber

A ONE MAN TORPEDO BOAT

A PARTICULARLY practical weapon of offense and defense in war is the one man torpedo boat illustrated herewith which is designed to carry a full-size 21-inch torpedo loaded with as much as 500 pounds of gun cotton. It is the invention of W. Shearer and has a number of features we feel sure will interest those of our readers who are boating enthusiasts. It is capable of a speed of 30 miles per hour and is powered with an eight-cylinder engine of 5¾-in. base and 6 inches stroke, rated at 200 horsepower. The torpedo is carried in a special compartment forward which can be flooded by opening a hinged door forming the bow, and when the latch is released the torpedo leaves its chamber and speeds away under its own compressed air power of 2,250 pounds, which gives it a speed of 40 knots. As soon as the torpedo is discharged, the door is closed and the compartment is pumped clear of water in less than a minute by the powerful centrifugal pump provided for that purpose. When the front end is lightened the boat can make a quick get-away and there will be very little chance of it being hit by enemy gun fire. When submerged, the craft offers an extremely small target, which compensates to some extent for its reduced speed.

METAL CLEANING POLISH

TO prepare a metal polish that will form an emulsion of cream consistency, and which will not precipitate, use the ingredients listed below and in the proportion specified.

Water	10	pounds
Pine Oil	2	"
Sodium Olegate (Soap)	2	"
Silex	5	"

Heat the water in a large boiler, when the water is hot, but not boiling, add the sodium oleate, in small quantities at a time and continue to stir constantly while adding. When the mixture becomes creamy or thick, add the silex in small amounts, until all of it has been placed in the mixture, constant stirring is also necessary when adding the silex to insure uniform intermixture. The mixture should now be removed from the heat, but while still warm add the pine oil, and stir well while adding. After the oil has been added the polish is allowed to cool, and after cooling can be poured into suitable containers.

TO REMOVE BURNT OIL FROM STEEL

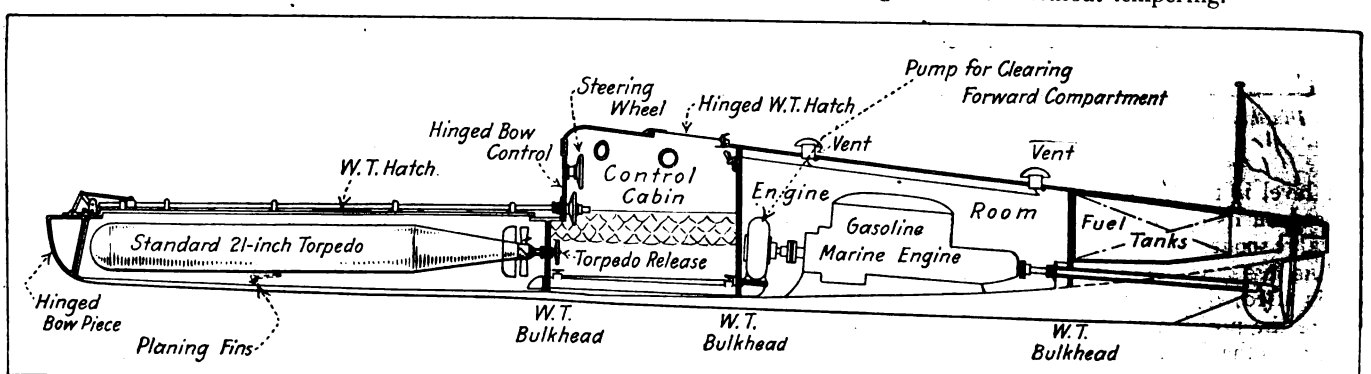
TO remove excess oil from parts that have been hardened in oil, place the article in a small tank of gasoline which, when exposed to the air, will dry off immediately, allowing the part to be polished and tempered without the confusion and unsightly marks of burnt oil.

BATH FOR HARDENING HIGH-SPEED STEEL

AN excellent bath for hardening high-speed steel consists of a mixture of table salt and paraffin oil in the proportion of one pound of table salt to each gallon of pure oil. The steel is heated to a lemon color and plunged into the bath, being kept in motion until it has thoroughly cooled. The steel should come out of this bath gray in color and nearly free from black spots. The bath referred to can be used for almost all brands of high-speed steel with good results. It has been used to great advantage for the Midvale steel and also on a large number of tools made of Novo, Simeteora, Rex, Jessop, High-Speed and Blue Chip steel. On all these, good results have been obtained, but it may be added that this bath seems to give the best results with the Midvale steel.—*American Blacksmith.*

TO HARDEN DRILLS FOR CUTTING GLASS

TO harden drills for cutting glass, dissolve zinc in muriatic acid to saturation, then reduce the solution by adding an equal volume of water. Dip and use without tempering.



A one-man torpedo boat that can be easily controlled and that is capable of great speed is a good means of naval offense and defense

Digitized by Google

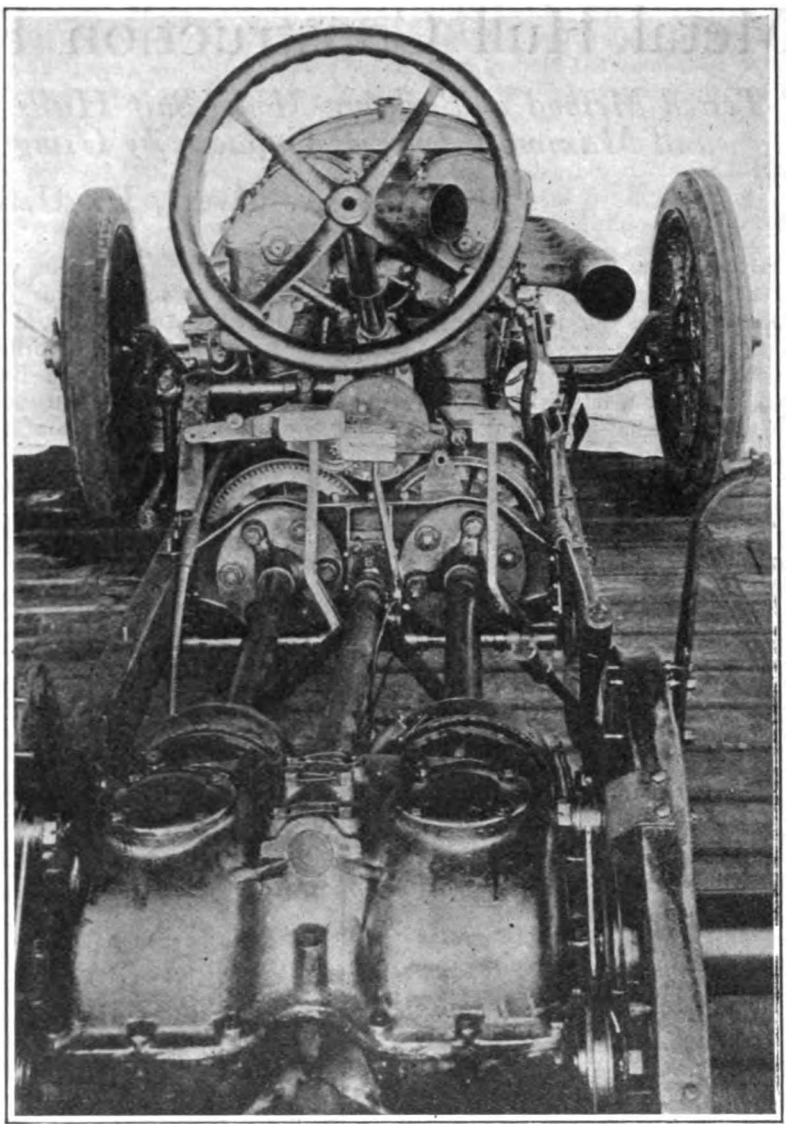
RECORD-BREAKING RACING CAR

ABOUT ten years ago Glenn Curtiss broke speed records with a special motorcycle at Daytona, Florida, and was reputed to be the first to make a mile at a speed of more than two miles per minute in a wheeled vehicle by covering the distance in 26 2/5 seconds. This very high speed was attained by using a freak machine he had built to try out an eight-cylinder, air-cooled motor that Charles Kirkham had designed for airplane work and for use on a machine that was the pioneer of the present long line of Curtiss craft. Specially built steam cars have also covered the famous beach sand course at speeds exceeding 120 miles per hour. Tom Milton, a well-known racing car driver, driving a special freak car propelled by two engines, is credited with having broken all world's records for the mile and two-mile recently at Daytona by covering the former distance in 23.07 seconds or at the rate of 156 miles per hour, and the latter space in 46.24 seconds.

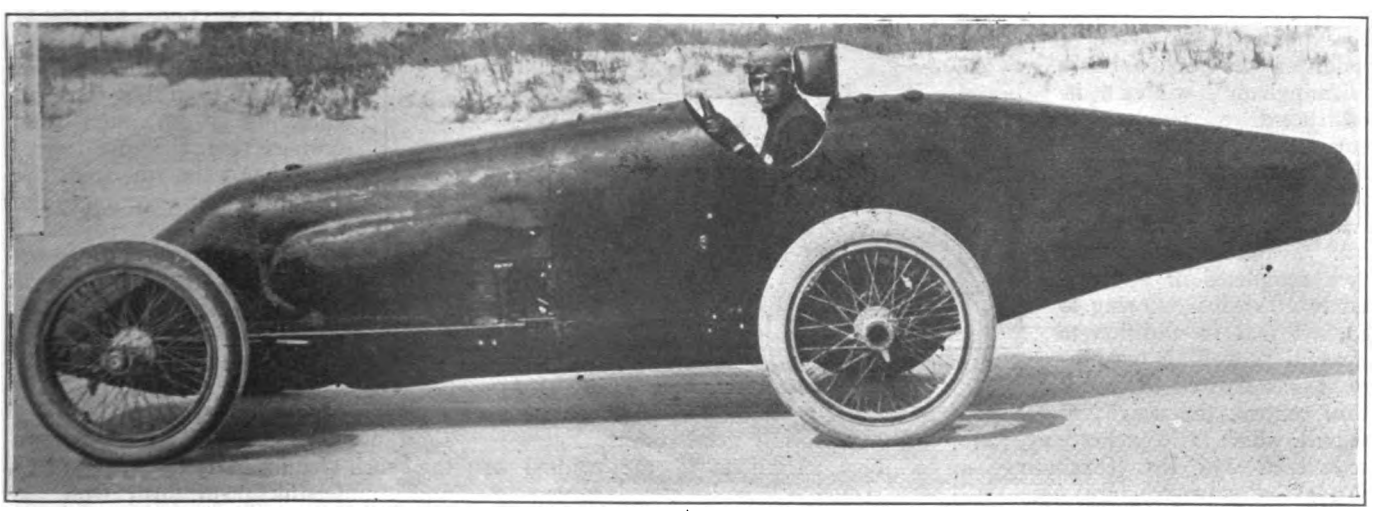
Students of aviation know that to obtain this high speed it is important to reduce the air resistance by stream-lining the car in just the same manner as an airplane fuselage is and for the same reasons. As the illustration shows, all parts of the mechanism except the wire wheels are enclosed and even the disturbance in air flow that might be produced by the driver's head is provided for as it is in the fastest scout planes by using a small sloping windshield in front and a tapering aluminum headpiece, well padded with an air cushion, back of the driver, so the continuity of air flow is not disturbed by eddies produced by the projecting parts of the driver's body.

The streamline enclosure of the chassis is not new, as attempts were made years ago to overcome the air resistance by this means, so the most interesting point and one that is a radical departure from conventional racing automobile design practice is in the engine installation. Reports are that the engines are eight cylinders each, the two combined making a sixteen-cylinder powerplant. The engines are placed side by side at the front end of the chassis as is usual practice. The engines deliver their power to a special rear axle construction, each engine having its own clutch and driving through flexible fabric universal joints and independent shafts to gearing in the rear axle. Each propeller shaft has a brake

(*Continued on page* 246)



Unusual arrangement of twin engines and dual drive on record-breaking racing car



Record-breaking twin engine racing automobile has carefully designed stream-lined body to minimize air resistance

Digitized by Google

Metal Hull Construction For Ship Models

A Tested Method of Building Model Ship Hulls to Secure Strength, Lightness and Maximum Interior Capacity by Using Metal Sheet and Wire

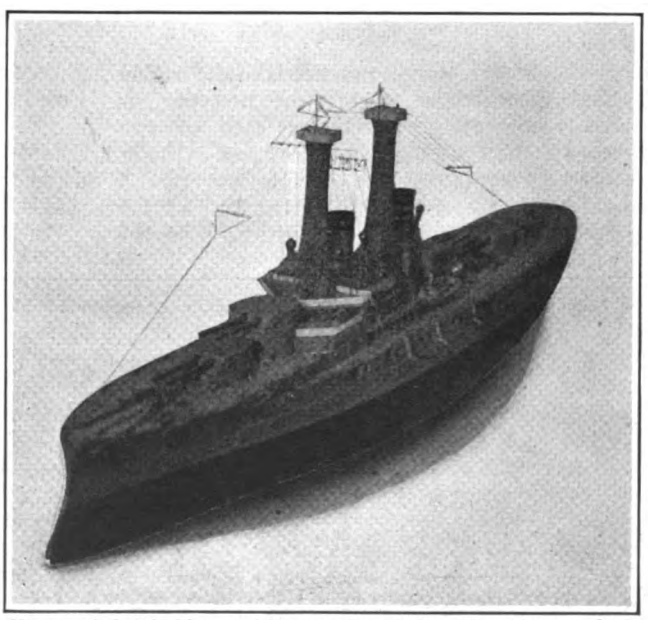
By Chas. A. Myers, Jr., U. S. N. R. F.

THE writer, as described in a recent issue of EVERYDAY ENGINEERING, has for a number of years been building model ships and in this work improvement in the construction of hulls has naturally been an item to which he has devoted a great deal of time and effort. As a beginner he was satisfied with the wooden hulls made by the time-honored method of hollowing out a block of wood which had in its outward form been made to correspond with the measurements of the ship itself; or perhaps the somewhat more desirable "bread and butter" method. Wooden hulls, however constructed, represent a tremendous amount of work, and when finished they have so many disadvantages that they hardly repay the effort expended in the making.

Chief among these are their tendency to split, warp and rot and the difficulty of properly securing machinery and fittings in place. Then, too, in shaping the outside it is a mighty simple thing to slice off just a little too much—an error that it is not easy to correct by any means—and to get from the solid block type a hull that is thin-walled enough to be sufficiently light requires very careful handling of the tools. If the model shipbuilder happens to be a good carpenter or cabinet-maker, these difficulties may not be important, but if, like the writer, he is instead a metal-worker and only an indifferent kind of a wood-butcher, he will find himself very much out of his element.

The writer had this situation brought before him to the extreme in the case of a model of the scout cruiser "Birmingham", which he constructed a number of years ago. Here was a model built on the scale of ⅛ inch to the foot which as calculated from the plans would have a total displacement when completed of approximately 10½ lbs. Owing to the fact that in addition to powerful propelling machinery it was desired to install radio control, the weight of the hull, which is 53 inches long, could not exceed 2½ lbs. (excluding, of course, the superstructure) and still have the completed ship weigh within the allotted displacement. The writer was unable to accomplish this result with wooden hulls and he built at least half a dozen metal hulls of different forms of construction before hitting upon one that gave entire satisfaction. Since building the "Birmingham" (over ten years ago) the same method has been used in all subsequent models with uniformly good results.





Views of battleship models constructed by Mr. Myers which have a built-up metal hull as described

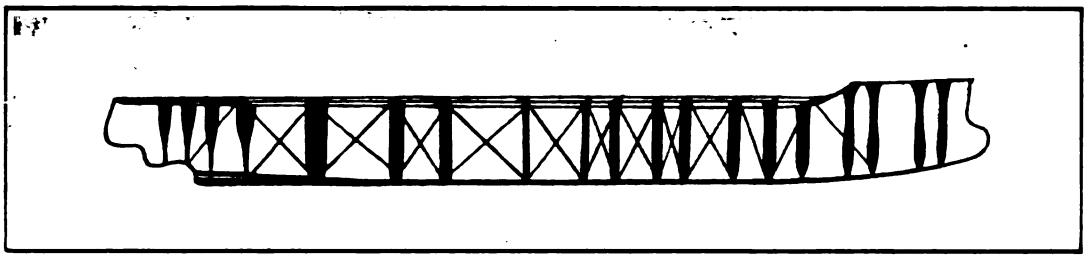
Two variations of the method of construction have been evolved depending upon the type of ship and the shape of the hull. Where the ship's bottom has a modified "V" shape (that is a pretty sharp rise to meet the turn of the bilge) and the length is fairly great compared with the beam it will be found possible to dispense entirely with athwartship frames in the completed model. In this case the cross-sections are reproduced from the plans to the proper scale from fairly heavy sheet zinc. At certain distances beginning on each side from the keel as a starting point semi-circular cuts are made in the edge with a fine round file. The distances at which these cuts should be spaced is determined by the width of plating desired and this, of course, is decided by the plans. In absence of definite information on this point, however, it may be said that plating wider than ¾ inch should not be used, and where the ship has a sharp turn at the bilge it may be necessary to make the plating considerably narrower and consequently the cuts closer together.

The zinc cross-sections being all ready, a hole about ⅛ inch diameter should be drilled at the center-line of each cross-section a definite distance, say 3 inches, from the keel. The cross-sections should now be strung onto a piece of straight ⅛ inch brass rod, or if this is unprocurable, ⅛ inch steel drill rod may be used. They should then be properly spaced and soldered in place, care being taken that they are all in proper vertical position, as otherwise the deck of the ship would be wavy instead of flat.

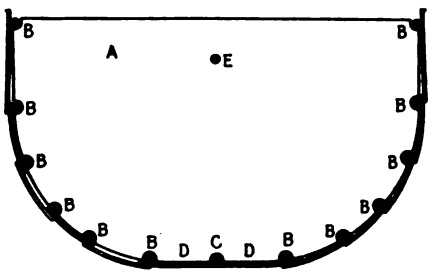
In the semi-circular cuts which have been made in the zinc cross-sections, starting at the keel, lay 3/32 inch diameter hard drawn straight brass wire from bow to stern, soldering it to each zinc cross-section. Cross wires should now be run from the top of one cross-section to the bottom of the next adjoining one, bracing them firmly together and in this process it is well to lay the whole set of frames on a bench to which the keel-wire should be firmly fastened. A good way to do this is to drive short nails with large flat heads into the bench along a perfectly straight line and countersink them flush with the top of the bench. The keel wire may

Digitized by Google

then be temporarily soldered to these nail heads which will hold the frames in position until they are properly braced and trussed together and all the wires have been run from stem to stern on both sides of the keel and right up to the deck line. The reader will, of course, understand that the round file used in making the semi-circular cuts in the cross-sections should not be larger in diameter than the longitudinal wires else the latter will not fit snugly in place in the cuts. At the first cross-section a stem piece is soldered perpendicularly to it and the wires are run to their proper positions at this point, cut off, and soldered to the stem and a similar procedure followed at the stern, the outline of which should also be faithfully reproduced in zinc from the plans. When all the wires have been soldered in place, the keel-wire may be unsoldered from the nails in the bench after which the hull skeleton is ready for the plating. If the cross-bracing has been properly carried out the framework should be so stiff that it may be supported at one point amidships without either end sagging down; and if the reader will refer to two of the accompanying cuts he will see the framework of the "North Dakota" with the bow piece (which in this case was made of heavy brass wire instead of sheet zinc) in position and a few of the longitudinal wires fastened in place. Another cut shows the various frames as viewed from dead ahead. The method of cross-bracing referred to above is very clearly shown in the broadside view.



View of partially completed metal hull frame



The right half shows the clinker method of construction, whereas the half on the left shows the other system described in this article: A = zinc frame (or cross-section), B = longitudinal wires, C = keel wire, D = first strake of plating, E = upper longitudinal wire

The framework of our model now being complete, we are ready to proceed with the plating. In this the writer has developed two or three "kinks" which may help in making the finished model better able to withstand wear and tear. While ordinarily the plating would start at the keel and proceed on each side, it is a good plan to make the first strake (as the strips of plating are termed) of a V-shape so that the keel itself will fit in the angle of the V and the two sides will proceed up to and meet the first of the brass wires on each side of the keel to the outside of which, of course, they will be soldered. This presents a homogeneous sheet of metal to any rough obstructions on which the model may be placed—for instance, a pebbly beach; but on the other hand when the plating starts on each side of the keel and is soldered to it, a sharp stone pressing against the bottom strake close to the point where it is soldered to the keel would have a shearing effect and be liable to break the plating away from the keel.

The material to be used for the hull may be varied as desired, and if cost is of no moment, probably tinned copper or tinned brass will prove most satisfactory from the standpoint of resistance to corrosion. If the model is not to be placed in water very often, ordinary "tin" plate will be found to work very well indeed, and consisting, as nearly everyone knows, of nothing more or less mild steel which has been tinned (to make soldering easier) it is stronger and lighter than either brass or copper and is in addition the very material of which large ships are built.

The thickness to be used will depend upon the size and type of vessel and the kind of treatment to which it will be subjected and is therefore a matter for the judgment of the builder to determine. No hard and fast rule can be laid down as there are a number of considerations according to circumstances which should be given thought. In a general way, it may be said that the thickness known in the metal trade as "One Cross" should be used on the larger models (say from 24 to 60 lbs. displacement), whereas a somewhat thinner sheet should be used on smaller ships. On destroyers or scout cruisers, where everything is to be sacrificed for high speed, metal almost as thin as a sheet of paper and known to the trade as "taggers tin" may be employed.

Before cutting the metal strakes, patterns should first be cut in cardboard and it is well to call in outside assistance to hold the cardboard close to the wires while it is being marked as it is desirable to make the strakes as long as possible and it is absolutely essential that the cardboard conform exactly to the curves of the hull.

In fastening the plating to the longitudinal wires two methods may be used. The second strake (counting from the keel) may be laid on top of and soldered to the first strake and the third strake on top of the second and and so on up the side of the boat, which will produce a form of construction akin to that in a clinker-built wooden hull; or, a method in many ways preferable may be adopted. This consists in soldering the first strake in place, skipping the second strake altogether, soldering the third strake and then soldering the second strake on top of the first and third so that it overlaps them both. Thus the even numbered strakes will overlap all of the odd numbered ones. This is the method of construction used in building large steel ships and it has a number of advantages over the other. Both systems are clearly shown in the accompanying drawing.

As indicated at the beginning of this article the zinc athwartship frames may be removed either in whole or in part when the plating of the model has been completed up to the gunwale; but as previously stated they may be removed *completely* only in vessels having a sharp rise of the floor to the turn of the bilge. On ships with a fairly flat bottom (battleships, for example) most of the frames should be left in place in the finished model. In order to install boilers, engines and other parts of the machinery, holes may be cut in the frames, but it is strongly recommended that at least ½ inch of the amidships frames be permitted to remain attached to the longitudinal wires as they add comparatively little weight to the finished hull and give a really great strength to it.

To cut out the center of the frames the writer has employed the electric arc method very satisfactorily. One pole of the ordinary house current is grounded to the hull and the other pole, connected through suitable resistance permitting a flow of 5 to 10 amperes ends in a steel pencil. The pencil being touched to the zinc frame where it is desired to cut it away, the tremendous

Digitized by Google

heat of the arc melts through the metal almost instantly, very much after the manner of an oxy-acetylene cutter; and it might be added here that after the zinc bow and stern pieces have served their purpose of giving contour to the ends of the ship they may be entirely removed, as they will then no longer be of service.

The hull of our ship being now completed, it is necessary to add the propelling machinery and the deck and superstructure fittings; and an early number of EVERYDAY ENGINEERING will describe some of their constructional details.

STIRRING PAINT BY AIR

A WRITER in a recent issue of *Factory* calls attention to an important use of compressed air in large paint shops. Nearly all large plants, he says, have paint rooms of their own. Here is stored the paint supply of the whole factory. Because of the tendency of the paint to settle, it must be stirred up each time any quantity is withdrawn. As a rule, the stirring of paints by hand is done to the accompaniment of aching muscles and breaking backs. One good-size factory, however, performs the whole operation by the turn of an air-cock. There happens to be a high-pressure air supply handy to the paint room. Paint is kept in barrels, each containing a double wooden paddle. When the paint requires stirring, a pneumatic reaming tool is slipped over the end of the paddle shaft which projects above the barrel top. This shaft is held in place by two crossed pieces placed across the barrel head. By using the shaft in place of a reamer shank, the paddle is whirled rapidly and the paint mixed in a surprisingly short time. After one barrel of paint is mixed thoroughly the reaming tool is slipped over the paddle shaft in the next barrel. Thus the whole job is done quickly and with little labor.

CONCERNING TRUCK LOADS

LOAD distribution is of the highest importance. The motor truck is designed to carry a certain proportion of its load on the front axle and the remainder on the rear axle. If the body is not chosen properly for the sort of load to be carried, it will result in the load being concentrated at the wrong point. This gives the same effect as overloading, because if too much of the load is placed on the rear axle, it will not make any difference if the total load is under the normal capacity of the motor truck. The fact that bodies must be chosen not only to carry the load conveniently, but also to concentrate the load at the proper point, leads to some unusual constructions to meet unusual operative conditions.

Electricity Combats Smoke Nuisance

THE abatement of the "smoke nuisance," whether from industrial plants in large cities or smelters and similar industries in more or less isolated districts, is a problem that is almost as old as the industries themselves, yet, like many other problems, it is being solved electrically. The time may indeed come when Pittsburgh will be as clear as Washington, D. C.

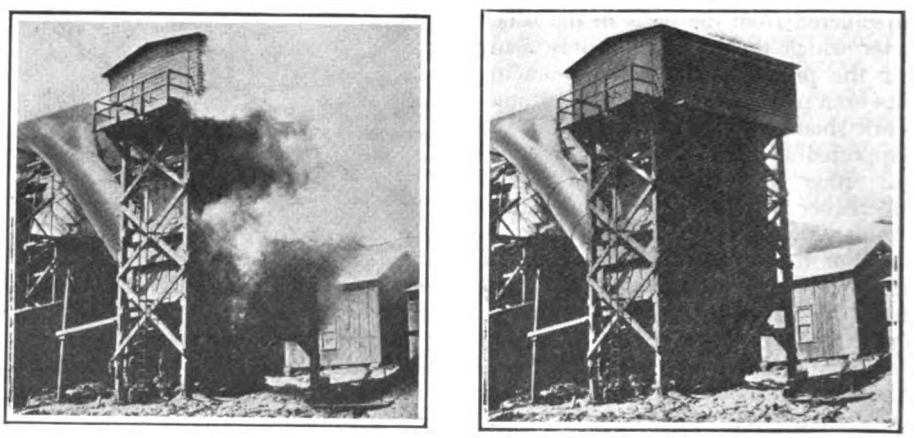
The Cottrell electrical precipitation of noxious fumes, objectionable smoke, etc., is a process which, stripped of its engineering technicalities, holds no small degree of interest for the general reader. The basic theory of operation of this electrical process is simply that any insulated body coming between an electrically charged point and an opposite charged plate receives the same electrical charge as the point, and since like charges repel, the body is thrown to the plate. This is also true of the particles of invisible gases, as is proved by the old physical experiment of blowing out a candle flame by putting it between a charged needle and a smooth, charged plate. In its simplest form the Cottrell apparatus consists of a metal pipe or flu through which the gas to be cleaned passes; connected to one side of a high-voltage direct-current circuit, and a wire along the axis of the pipe, which is connected to the other side of the same circuit.

Since it is not practical to generate diret current at the high voltages—between 100,000 and 25,000 volts—demanded by this process, the electricity is generated as alternating current and rectified into direct before reaching the flue.

What happens is simply that the small particles of fume and smoke which are held in suspension by the gas passing through the flue receives the same charge as the wire and are either attracted to the pipe and held there or are attracted to each other, forming masses which are heavy enough to fall by gravity to the hoppers underneath. The pipes are relieved of their load by being periodically beaten with hammers, either electrically or by the hand.

This process will not precipitate pure gases, but many chemicals are in a gaseous state at high temperatures are either liquids or solids when sufficiently cooled. They can then be removed by the Cottrell process, as is actually done with arsenic in a Western smelter, whereby large amounts of this valuable element are recovered in a high state of purity. A large cement plant recovers many tons of potash dust per day which was hitherto pure loss but which now can be sold for fertilizer at almost as good a price as the cement itself.

In fact this process is applicable to all sorts of industries, such as smelters, blast-furnaces, chemical pants, and is used for the removal of the objectionable features from the smoke of incompletely burned oil and coal. Before its development many smelters in the West were forced to shut down by the Government because their fumes were destroying the vegetation for some distance around them. This Cottrell process has proved valuable, not only in abating smoke nuisances but in recovering valuable materials that have hitherto gone up in smoke and been completely wasted.



The view at left shows dust coming from a cement plant and how it was prevented by Cottrell process is made clear in the other picture

The pictures illustrate the electrical equipment built by the General Electric Company to meet the requirements of this process and also how the electric current eliminates the dust normally coming from a cement plant.

It is said that in Canada 50,000 ounces of platinum are lost annually by faulty placer mining. This does not say how much is left undisturbed in the ground. It is thought that Canada may become one of the world's greatest producers of this metal, now so scarce owing to the condition of Russia.

Digitized by Google

A NEW THERMOSTATIC METAL

A NEW, built up metal strip that bends when it is heated has just appeared. It is called thermostatic metal, and is a British invention. It is prepared by permanently uniting, throughout their length, strips of the two metals having widely different coefficients of expansion with heat, so that under a change of temperature the combined strip bends one way or the other. The reaction is stated to be always the same, in a strip of given length and thickness, for a given temperature change and thus to provide a reliable basis for temperature indication, control, or compensation in oven thermometers, electric heaters, ice machines, and other apparatus, including scientific instruments of high precision. The component metals will not corrode under ordinary conditions, and they may be used in any reasonable situation, without fear of deterioration or change in their operating characteristics. They will not separate, no matter how much the strip is bent, twisted or hammered, and even with heating the bond between them will not be broken down at a temperature below the melting point of the softer of the two. They can be formed into any desired shape and annealed after formation, and they can be safely employed at any temperature below 500 degrees Fahrenheit.

SOLDERING OF ALUMINUM BRONZE

TO solder aluminum bronze with ordinary soft solder, thoroughly cleanse from dirt and grease the parts to be joined. Then put the parts to be soldered in a strong solution of sulphate of copper and place in the bath a rod of soft iron touching the parts to be joined. After a while a copper-like surface will be seen on the metal. Remove from bath, rinse clean and brighten the surface. These surfaces can then be tinned by using a fluid consisting of zinc dissolved in hydrochloric acid in the ordinary way with common soft solder.

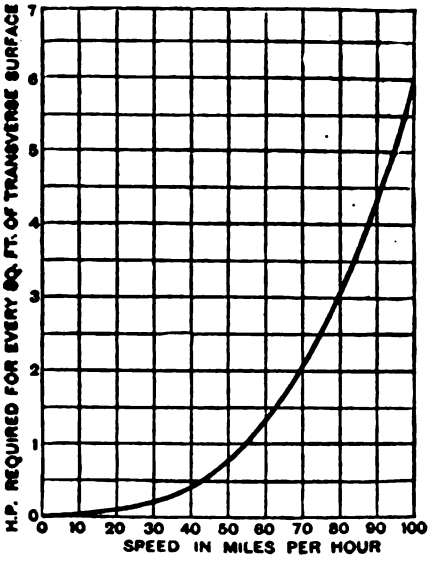
HEAT TREATING HIGH-SPEED STEEL

IF it is desired to treat tungsten or high-speed steel, the proper method is to pre-heat the tool to a bright red (1500 Fahr.), then bring to a white heat quickly (1975 - 2100 Fahr.), quenching in oil until cold; next replace in the fire and bring up to a very dull red (900 Fahr.) and allow tool to cool off in the open air. This makes a very hard, tough tool with unexcelled cutting qualities, and while the better grades of high-speed steel cost from five to ten times more than carbon steel it is more economical for some classes of work, as a properly treated tool made of it will hold an edge when smoking hot and is capable of doing a tremendous amount of work.

CALCULATING AIR RESISTANCE OF TRAINS

IN a recent isue of the *Engineer*, London, Mr. C. F. Dendy Marshall discusses the subject at some length, and states that, thanks to the work which has been done in connection with aeronautics, it is now possible to take the matter up and study it on a scientific basis, with a promise of substantial improvement.

The importance of the front wind pressure on the engine is not fully appreciated. The horsepower required to overcome it increases with the cube, not merely of the speed of the train, but



with that of what is called the "created wind," which in the case of an express train may easily exceed eighty miles per hour.

It may now be taken as established that, for speeds within and even far beyond the range of railway speeds, the resistance of the air to a surface moving normally to itself is represented by the expression KAV^2, where A is the area exposed, V the speed and K a constant. If A is measured in square feet, and V in miles per hour, $K = .0033$.

The constant .0033 applies to the total resistance and includes the now well-recognized suction on the back of a moving body. For plane surfaces normal to the wind M. Eiffel found in his famous experiments that the suction accounted for one-third of the total. The frontal pressure alone may, therefore, be taken as $.0022AV^2$, and the horsepower required for every square foot of exposed surface is

$$\frac{.0022V^3}{375}, \text{ or roundly } \frac{6}{10^6}V^3.$$

The value of this expression at 60 miles per hour is approximately one and one-fourth horsepower, and at 80 miles per hour three horsepower.

If we know the "all out" speed in a calm, say 70 miles per hour, numerical limits can be assigned between which the speeds will lie for any ratio of train to wind speed. These limits are shown in the diagram.

It will be readily understood without entering into calculation that the speed of the created wind creeps up as the strength of the natural wind increases, and that 80 miles per hour is quite a moderate figure to take for it, while the diagram shows how sharply the demand for power runs up with any increase of speed in that neighborhood.

We now know fairly well what should be the best shape for a body which is to be driven through the air at speeds of the order under consideration. The front should be quite "bluff," a sharply conical or wedge-shaped form not being at all the ideal to be aimed at. What is required is to eliminate every square inch of transverse flat surface that can possibly be dispensed with, smoothing off projections and putting in gentle curves parallel to the natural flow of the air.

RESISTANCE OF STRUCTURAL STEEL TO FIRE

SOME interesting figures relating to the behavior of structural steel at the high temperature of ordinary fires have been given by the United States Bureau of Standards. Naturally, the strength of steel at high temperatures has a very important bearing upon the stability of a structure which may be subjected to fire. Without any protective covering, steel columns fail after only ten or fifteen minutes of exposure to temperatures such as are reached in ordinary fires. Resistance can be greatly increased by the use of coverings of brick, concrete, plaster, tile, etc., to such an extent that columns so protected are unaffected after several hours' exposure to intense heat.

Tests have been made to determine the compression strength of specimens of structural steel when heated in an electric furnace to temperatures corresponding to dull-red heat (1100 degrees Fahrenheit) and loaded up to 20,000 pounds per square inch. It was found that structural steel loaded to 10,000 pounds per square inch fails at about 1075 degrees Fahrenheit, and under a load of 20,000 pounds per square inch failure occurs at about 925 degrees Fahrenheit. For practical consideration, however, the limit of utility may be regarded as reached at temperatures of about 130 degrees below those given above.

During the war, the number of carbon filament lamps made in the United States rapidly decreased until in 1918 only 12 millions were sold. They are very much less efficient than tungsten filament lamps and it is calculated that 24 millions of them would use a million tons more of coal per annum than would be required for the same number of tungsten lamps.

Digitized by Google

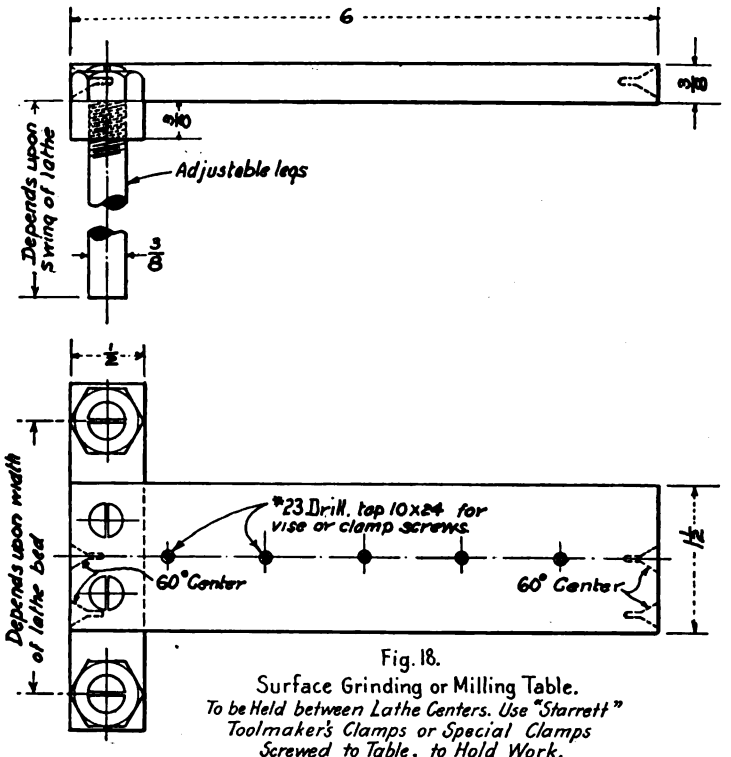


Fig. 18.
Surface Grinding or Milling Table.
To be Held between Lathe Centers. Use "Starrett" Toolmaker's Clamps or Special Clamps Screwed to Table, to Hold Work. All Parts C.R. Steel.

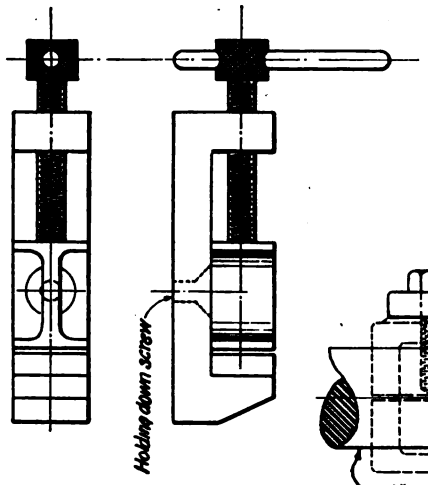


Fig. 19.
"Starrett" Toolmaker's Clamp #106.
Used to Hold Shafting, Bars, etc. on Plate ( ) for Milling. Use 10-24 M. Screens. Milling Cutter Held in Lathe Spindle. Also Used on Surface Grinding Table ( )

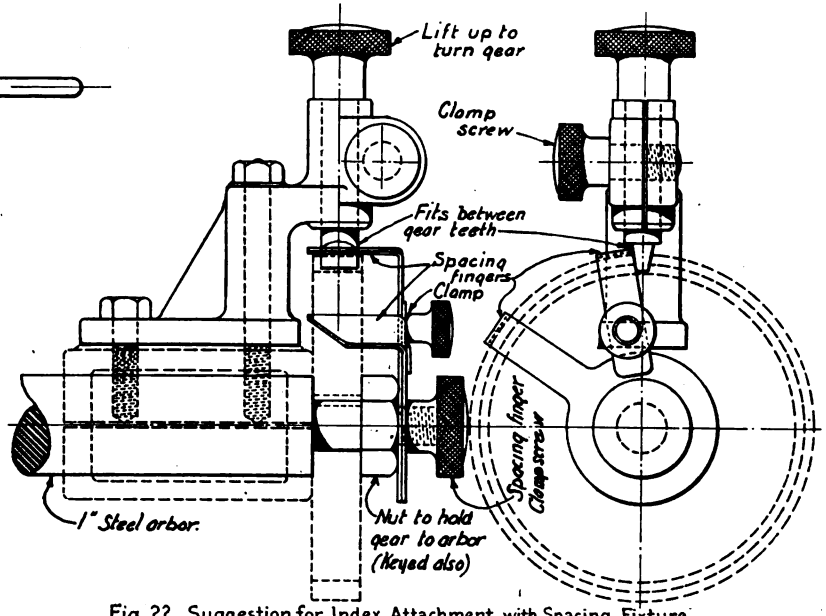


Fig. 22. Suggestion for Index Attachment, with Spacing Fixture.
Use 48-Tooth Gear as Index Plate. Attachment Screws to Boss on Slide. Other End of Spindle Threaded for Chuck, or any Special Work Holder.

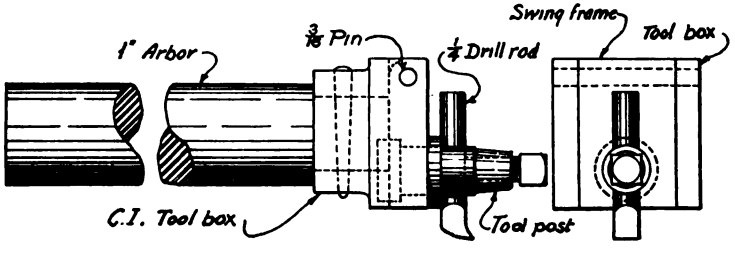


Fig. 21.
Shaper Head Assembly.

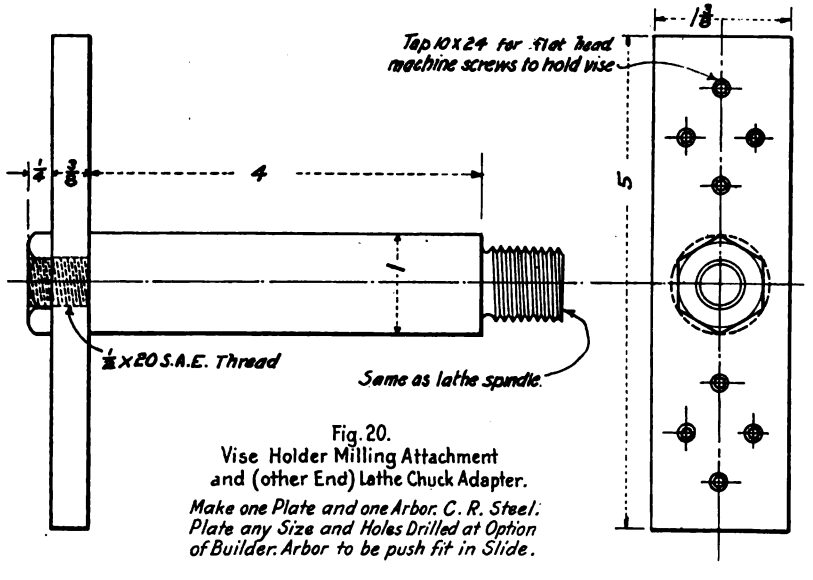


Fig. 20.
Vise Holder Milling Attachment and (other End) Lathe Chuck Adapter.
Make one Plate and one Arbor. C. R. Steel. Plate any Size and Holes Drilled at Option of Builder. Arbor to be push fit in Slide.

Digitized by Google

A Universal Lathe Attachment

By H. H. Parker

Drawings by the Author

PART II

Milling, Cutter in Lathe Live Center

ANOTHER way to perform milling operations is to hold the cutters in the live center of the lathe and the work in the attachment itself. Fig. 20 shows a flat steel plate bolted to a one-inch solid arbor which slips into the vetrical slide in place of the grinding or milling spindle sleeves and is clamped there. The work is bolted to this plate or held in one or a pair of the toolmakers' clamps screwed to it. Some kinds of work could be best held on an angle plate bolted to this arbor in place of the flat plate. The other end of the arbor is turned down and threaded the same as the lathe spindle, which allows of work being held in the lathe chuck screwed to the arbor, or to the lathe face plate. By the use of these various attachments, work of almost any shape may be operated upon; the feed can be by hand or power, longitudinal or crossfeed, and if the lathe is provided with a compound rest a still further variety of manipulation is possible. Fishtail cutters for slotting or keyways, end mills and side mills and angular cutters are used in the lathe chuck or the vertical slide spindle and ordinary twist and other drills are frequently brought into service for special off-center drilling operations.

Shaping

Still another use for the lathe attachment is for light shaping, the tool being mounted in a miniature swing frame on the end of an arbor or "ram" which fits into the horizontal hole in the vertical slide. Fig. 21 illustrates the general arrangement, though no dimensions are given, for the builder would be able to build a tool box to suit his own ideas without any difficulty.

The box is made either of cast iron or sawed from a block of steel and the groove may be milled or ground to shape by some of the devices described above. A rectangular block is pivoted to the box and should swing out and back easily, but without shake or lost motion, either at the pivot pin or between swing frame and sides of tool box. A half-inch hole is drilled in the lower end of the block and counterbored underneath for the tool post. This is made like the lathe tool post, only much smaller and provided with a quarter-inch slot for the shaper tool, made of a piece of quarter-inch drill rod with the lower end forged and filed to shape and then hardened. Square tool steel could also be used or an old square file broken up and sharpened. The tool box is either set screwed or pinned to the ram with a taper pin; the ram being cylindrical, allows of the tool being set at any angle. No attempt was made to give a feed to the swing frame itself, as in the case of large shapers; this might be practicable, but the regular vertical slide feed answers the purpose well enough.

The size, shape and character of the work determines its mounting—whether between centers, on the face plate or lathe chuck, on the little table shown in Fig. 18 or clamped to an angle plate on the lathe bed or directly to the bed itself. If on the table between centers the width that can be machined depends upon the width of the work or upon the amount the ram overhangs the table when parallel to it. With a very short stroke it might be possible to face the ram around at right angles to the lathe bed and use the cross feed screw. Ordinarily the lathe carriage is run back and forth by means of the longitudinal feed handle and rack, and while power feed might be used in some cases, the character of work suitable for such a small device makes hand feed the most practicable. By lengthening out the ram and clamping the work to a small table of some kind resting on the lathe ways, the transverse feed would be only limited by the width of the cross slide and the length of stroke by the length of the ram (within limits) and length of the work.

The builder will soon discover a great variety of operations which can be carried out to advantage by means of the various devices which have been described.

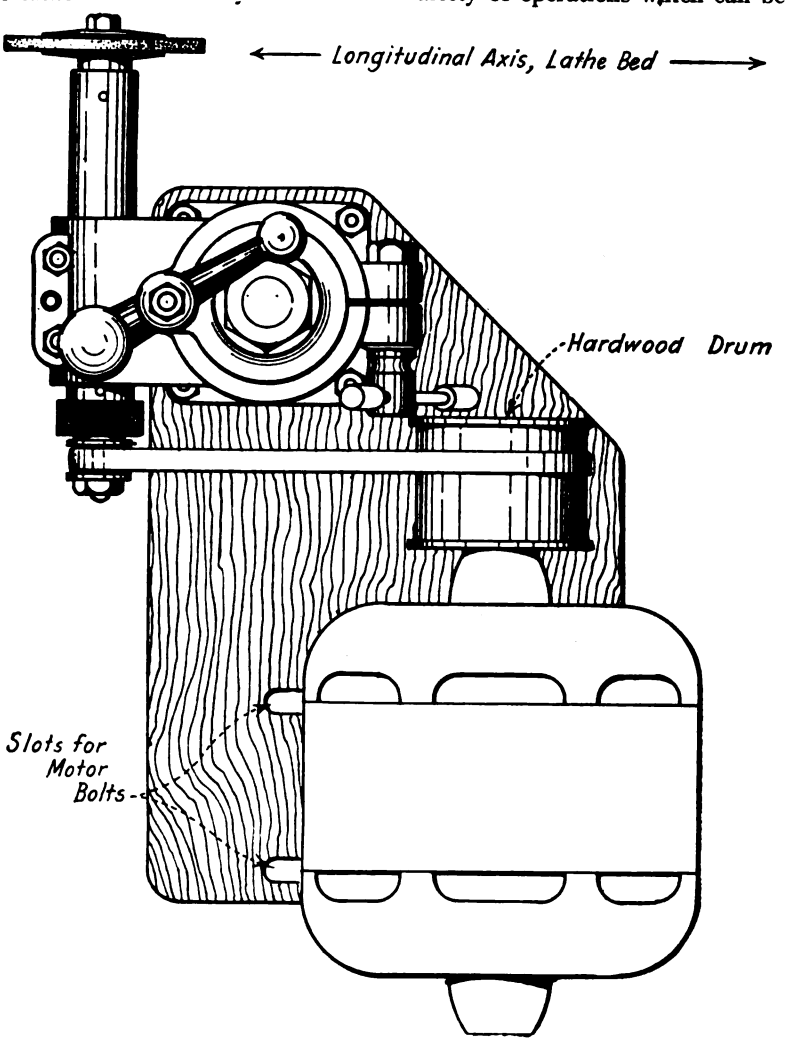


Fig. 2. Plan view showing motor drive

Indexing

One more application of this device remains to be described—its use as an index head. Fig. 22 suggests a layout of an attachment of this character,

Digitized by Google

though the actual dimensions would depend upon the size of gear used. As an example of its use, it might be required to mill a square or hexagonal head on the end of a bolt or screw. The bolt would be held in a chuck on the end of the index head arbor while the milling cutter would be rotated in the live center of the lathe and each time a flat was milled off the index gear would be turned the required amount to present the next surface to be faced.

As an accurate index plate is difficult for an amateur to construct, a gear is used for this purpose, preferably a new gear the teeth of which would be in good condition. If not badly worn, one of the change gears of the lathe could be used. One of 48 teeth would be best for general purposes; sometimes one of 36 teeth might be better. The pitch should be such that the diameter of the gear would be small enough to swing close up to the face of the vertical slide—about three inch P.D. would be right. The drawing shows the index fixture bolted to the vertical slide, a boss having been provided on the casting for the purpose. This is shown in Fig. 3, though the bolt holes are not. The fixture must be high enough to allow clearance for the 48 gear, but it would be a good idea to allow the stop spindle enough up and down motion to adapt it to the 36 gear also.

A one-inch steel spindle is turned up to make a push fit into the vertical slide; one end is threaded to take a lathe or other chuck which holds the work to be milled; the other end is turned down so that the gear will make a push fit over it, the gear being held by a locknut as well as a small key. The remaining portion of the spindle is turned down to about three-eighths in diameter and threaded. When in position the gear is prevented from turning by a vertical stop on the end of a spindle which slides in a reamed hole in the fixture casting and is clamped by a thumb screw which closes the split clamp lug. No play whatever should be permitted in the stop spindle, as this would spoil the accuracy of the device. This spindle has a small keyway cut in it, being milled or shaped by one of the methods described above, to prevent its turning. The end of the spindel, or the stop, is filed to an included angle of 29 degrees, to fit between the gear teeth.

As it is a nuisance to count the number of teeth every time the gear is turned, a pair of spacing fingers are shown. These are cut out of one-thirty-second iron or brass sheet and the fingers bent over at right angles to cover the face of the gear. The inside finger disc carries a clip and thumb screw; the clip extends over the edge of the outer finger disc and the thumb screw clamps them both together, yet allows the two to turn on the spindle, to which they are clamped when desired by a thumb nut on the threaded end.

In use, the fingers are so spaced around the gear that their outer edges cover the required number of teeth and one finger bears against the stop; then the end thumb nut is tightened. After the cut has been made, the vertical slide spindle clamp nuts are loosened enough to allow the gear and the fingers clamped to it to be turned; the second finger will then bear against the stop. The index spindle is then clamped, as well as the stop spindle. Then the end nut is loosened and the fingers, still clamped together, turned all the way around until the first one again bears against the stop. Then the end nut is tightened, another milling cut is made and the process repeated until the operation is complete.

When not in use, the entire index fixture may be removed by taking out the two bolts and withdrawing the spindle.

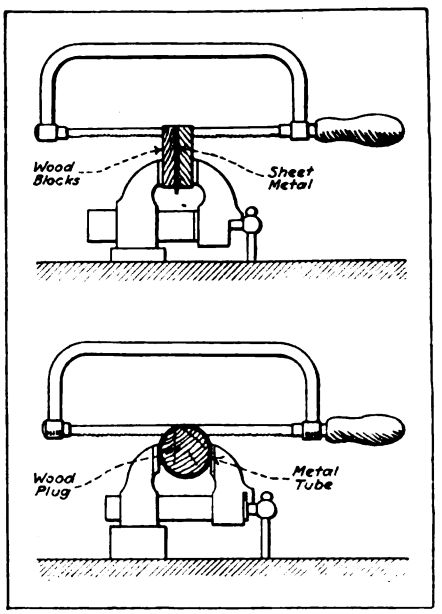
In concluding, the builder is cautioned to see that the column of the lathe attachment stands perfectly vertical when clamped to the tool side of the lathe; otherwise it may not give accurate results when in use. This depends upon the face of the tool slide being square and parallel with the lathe bed, assuming that the base of the column has been squared off accurately. If the slide is found to be out of true, a cutter could be rigged up in a sort of boring bar between centers and extending down to the tool slide. Then by running the carriage back and forth and moving the slide at the same time by the cross feed, the tool will act as a planer cutter and will face up the tool slide by taking a light cut across it. All play between the carriage, cross slide and ways must be taken up before beginning this work and also while the attachment is in use after completion.

HOMEMADE CANNED HEAT

WHILE up in the North Wisconsin woods last summer the wife of one of the resorters became ill and often during the night required some hot water. Since the small electric lighting plant was shut down every night after eleven o'clock and no other source of heat was available, the man set about to provide some means for heating the small quantities of hot water required. He managed to purchase some wax at a nearby general store, and this with some newspaper solved the problem. The newspaper was folded into strips about one inch wide with several thicknesses. The wax was melted and the paper rolled into coils, which were then dipped into the wax. The wax with the paper imbedded in it, all contained in the tops of tin baking powder cans, were stored away and used in the same manner as alcohol burners. They were very successful in operation and gave their inventor a feeling of satisfaction, particularly so since in everyday city life he was a prominent attorney and had little time to put on handicraft work — GEO. J. KIRKGASSER.

SAWING SHEET METAL

WHEN sheet metal or brass is to be cut with a hacksaw, clamping the material between two wooden blocks in a vise will greatly facilitate the process. Without this support, the thin metal may bend and buckle, the saw blades frequently breaking or stripping their teeth. Thin sheet metal tubes



can be cut in the same manner. A plug or rod of wood is forced in the tube and clamped in the jaws of a vise, the saw will cut right through the tube without the saw teeth catching, even if regular saw blades are used instead of the fine tooth saws generally used for tubing. The metal to be cut should be clamped in the vise so it will be rigidly supported and the hacksaw should just clear the vise jaws.

WHITEWASH FOR INTERIORS

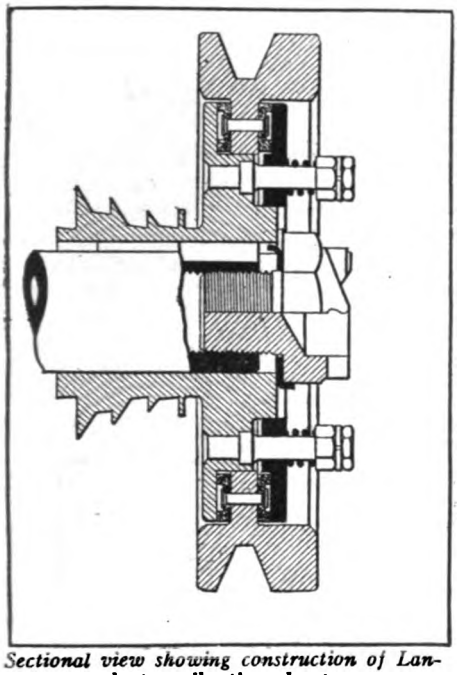
NOTHING brightens up the interior of a dingy garage like a good coat of whitewash. Poorly prepared whitewash flakes off soon after being applied. The United States government standard receipt is probably the best there is. Slake one-half bushel of unslacked lime in boiling water, keeping the lime covered during the process. Strain and add a peck of salt dissolved in warm water. Add also three pounds of ground rice boiled to a thin paste and ½ pound of Spanish whiting. Dissolve one pound of clear glue in water and add. Mix whole thoroughly and let stand for several days. When ready to apply, heat thoroughly and apply as hot as possible.

Digitized by Google

EVERYDAY MOTORIST

LANCHESTER VIBRATION DAMPER

WITH a six-throw crank-shaft, whether there be six pistons or twelve, one of the commonest forms of vibration is that produced by the twisting of the shaft at certain speeds. The shaft has a natural period of vibration if deflected torsionally, and when the sequence of explosions coincides with the natural vibration period the pendulum effect causes the violence of the vibration to be increased. The vibration which is perceptible to the passengers in the car is due to the front



Sectional view showing construction of Lanchester vibration damper

crank throw twisting with each explosion, and then the spring of the crank jerking the piston back as soon as the power stroke is over. Elasticity of the steel causes oscillations to take place, so the crank flies back too far, springs forward again and so vibrates many times before returning to its proper position, by which time the succeeding explosion again displaces it. The oscillation of the piston disturbs the center of gravity of the whole piston mass much more than the first deflection does, and the object of the Lanchester damper is to resist the return spring of the crank so that the twist caused by the explosion is made "dead beat."

The original design of F. W. Lanchester, a leading British atomobile engineer, was to mount on the front end of the crankshaft a little fly-wheel and disk clutch, as shown in accompanying illustration. The inner member of the clutch was secured to the shaft and the fly-wheel rim rode loose. Thus when the crank twisted forward the inertia of the fly-wheel rim caused it to try to maintain a steady speed and the clutch slipped a little, and when the crank tried to twist back at the end of the power stroke the fly-wheel rim again resisted the tendency to oscillate. The sum total of effect is that the energy of the twisting crank is absorbed by friction between the clutch surfaces and the rapid oscillations are prevented. Something depends upon the strength of the clutch spring in the damper, as the little fly-wheel rim must be sufficiently loose to be able to act as described, but not so loose that the friction will be too small to absorb the energy of torsion. The adjustment is not delicate and once the proper strength for the clutch spring has been found the damper can be made on a production basis and fitted complete without any further attention. When first tried out the effect of the damper was amazing, turning a six-cylinder motor with a weak shaft and two bad vibration periods into a smooth-running and practically vibrationless one.

DRIVING AWAY FROM CURBS

IT is quite often the case that a car is parked so close to a curbing that it cannot be driven away. When this occurs place the jack under the center of the front axle, raise the car a few inches and then push the car off the jack sideways, away from the curb. This will give room to turn the wheels out enough to drive away.

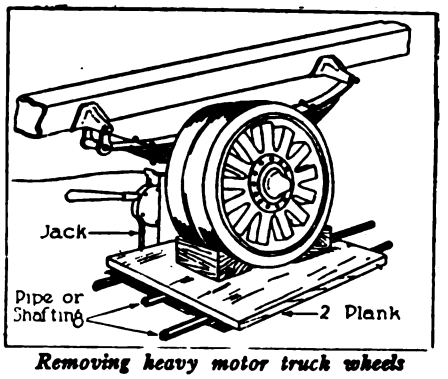
FITTING ROLLER BEARINGS

IN replacing roller bearings on a front wheel spindle on which it is a tight fit, many owners slip the bearing on to the taper end of the spindle and then put on the wheel, using it as a hammer to drive the bearing home. This is a poor method, as the bearing is likely to be injured. The hardened shoulder of the inner race, which receives the brunt of the blows, is especially liable to be broken.

For furnaces where a traveling chain brake is used in automatic stoking, a registering apparatus has been devised based on the rate of speed of the grate and the area of the hopper opening. From its registration the coal consumption has been found within a limit of accuracy of 5%.

REMOVING MOTOR TRUCK WHEELS

A SIMPLE device for removing motor truck wheels of the dual type and especially serviceable where one man has to do the work, is made from a two-inch plank, cut to the desired length and width. Jack up the wheel



Removing heavy motor truck wheels

several inches from the floor, lay four rollers, made from either iron pipe or old shafting, on the floor beneath the wheel, place the plank on top of them and chock the wheel at each side. After the wheel has been loosened on its axle it can be easily adjusted on the movable platform for further work.—*Automobile Journal.*

LOCATING UNUSUAL NOISES IN ENGINE

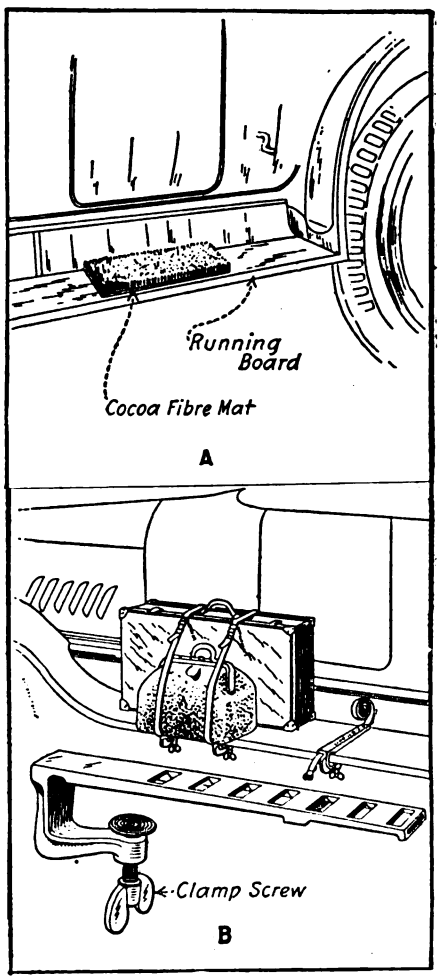
AS an aid to locating the cause of unusual noises in automobile engines, it is recommended that the engine be throttled down and the frequency of the occurrence of the noise determined. Generally speaking common engine noises occur at either camshaft or crankshaft speed. By noting when the knock occurs with reference to the rotation of one or the other of these shafts, it may be more easily classified. In every case main bearings produce knocks at crankshaft speed, as do also crankpin and wrist-pin defects. Knocks at camshaft speed, which is half that of the crankshaft, are usually due to a loose bearing or to end play of the shaft. If an attempt is made to classify these sounds before proceeding further in the diagnosis, much time and effort can be saved.

The annual expense of repairs for two pumps in use at Bridgewater, England, built by the Watt works in 1877, nearly fifty years ago, have been reported. For one year they amounted to a little over $20. Some years later the repairs run up to $75—a remarkable proof of good engineering practice.

Digitized by Google

RUNNING BOARD ACCESSORIES

WHEN the interior of a closed car is fitted up with delicate trimmings and carpets like a lady's boudoir, and many cars are of this nature, it is an advantage to keep dust and mud off the floor, yet anyone stepping into the car from the street cannot help carrying in a little dirt on the shoes, no matter how careful they are. To avoid this, an idea which originated in Paris and ought to be popular in the big cities of America is worth mentioning. This



Useful auto running board accessories

is to have a small piece of stout door mat neatly cut and edged and strapped to the running board just below the door opening. The mat can be sewn to metal end pieces and screwed to the running board, or it can be fixed with screws and washers, the heads of the screws being well buried in the mat. A device of this sort is now marketed as an accessory.

Luggage carriers, as shown at B, are securely fastened to the running board by means of thumb screws. It is not necessary to drill any holes through the running board. It is claimed that the device will not rattle or work loose if properly installed. Suit cases, traveling bags, or parcels of any size may be safely carried and can be quickly strapped in place and removed. They do not touch the side of the body to mar the finish. The carriers may be removed in an instant and stowed away so that they are not evident when not in use and will not clutter up the running board.

CORRECT TIRE INFLATION

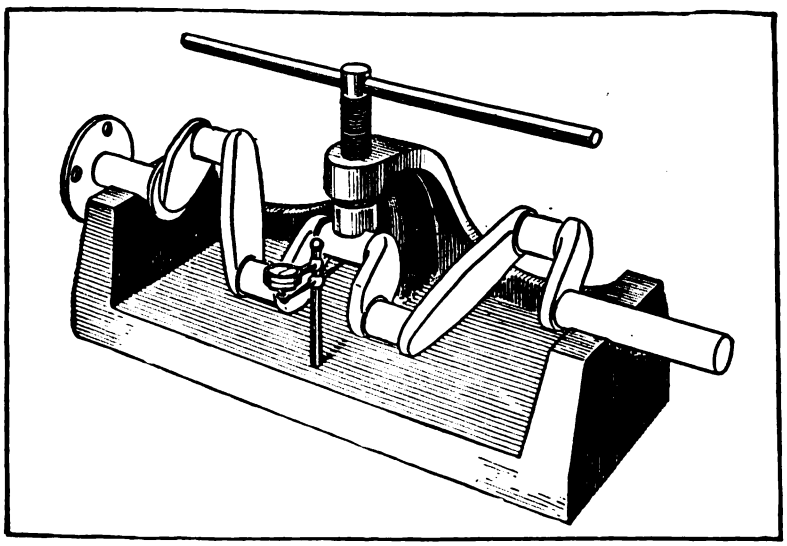
MANY motorists labor under the impression that they should run their tires under-inflated during the warmer summer months and fully inflated during colder winter months. This practice has become so general that one of the larger tire manufacturing companies has recently carried out a series of tests to determine the wisdom or fallacy of this practise. It remained for the B. F. Goodrich Rubber Co., Akron, Ohio, to test this theory. A 34 x 4 inch tire, for which makers prescribe a 70-pound pressure, was used for the test. Air at various temperatures was pumped into the tires and they were then run at excessive speeds under severe road conditions. The changes in pressure were found to be negligible. Goodrich recommends an even pressure the year round with adherence to the pressure designated for the various sizes of tires. Frequent observations conducted by experts of the company have demonstrated that the vast majority of motorists keep their tires under-inflated. Even if hot weather makes a slight difference in pressure it would be policy to risk it rather than take the chance of having the tire under-inflated. Of the two the latter is far the worse and more universal.

In this connection it is well to remember that air pressure is just as apt to increase in cold weather as in hot. This is brought about by the friction of the tire against the road where the traveling is rough. Yet the motorist never thinks of letting out the air in the winter months. A safe rule is to keep the tires inflated to the standard pressure. In order that the correct amount of air in tires may be readily ascertained, a standard table for all makes of tires is shown as follows:

Rim Sizes	Inflation Pounds	Rim Sizes	Inflation Pounds
28 x 3	...60	33 x 4½	...70
30 x 3	...60	34 x 4½	...70
29 x 3½	...60	35 x 4½	...70
30 x 3½	...60	36 x 4½	...70
31 x 3½	...60	37 x 4½	...70
32 x 3½	...60	38 x 4½	...70
33 x 3½	...60	40 x 4½	...70
34 x 3½	...60	42 x 4½	...70
36 x 3½	...60	33 x 5	...80
32 x 3	...70	34 x 5	...80
34 x 3	...70	35 x 5	...80
30 x 4	...70	36 x 5	...80
31 x 4	...70	37 x 5	...80
32 x 4	...70	39 x 5	...80
33 x 4	...70	41 x 5	...80
34 x 4	...70	43 x 5	...80
35 x 4	...70	36 x 5½	...80
36 x 4	...70	37 x 5½	...80
37 x 4	...70	38 x 5½	...80
40 x 4	...70	39 x 6	...85
42 x 4½	...70		

SHAFT STRAIGHTENING DEVICE

THE crank and cam shaft straightening press shown in accompanying illustration was designed for service stations catering to the Ford trade. It comprises two tools in one, is light in weight and very accurate in its work. The device consists of a bench rest, made of heavy cast metal, the ends vertical with V-shaped grooves for the shafts to rest in while straightening and a screw clamp in a vertical bracket,



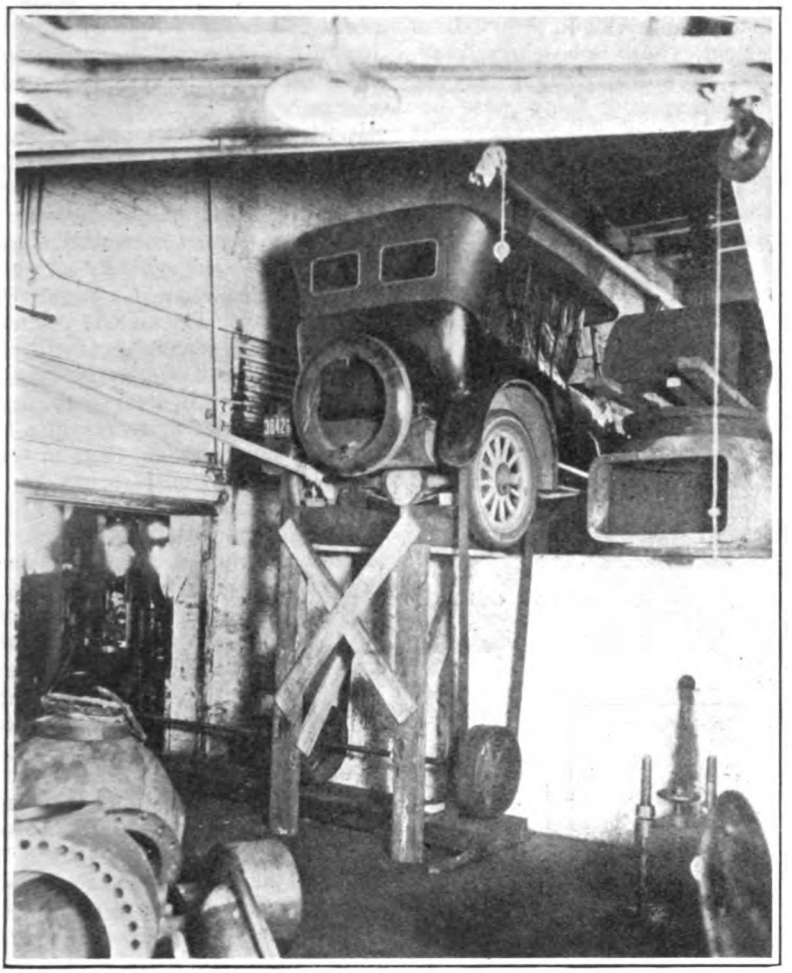
Crankshaft and camshaft straightening press

that fits the shafts at its center. The device is equipped with a dial test indicator reading accurately to a thousandth of an inch. Ford repairers are aware of the fact that Ford crank and cam shafts are bent very easily and by testing them during the course of repair, guess work on this score is eliminated.

Digitized by Google

AUTOMOBILE AS EMERGENCY POWER

OUR attention has been called to a factory in Chicago, engaged in manufacturing mechanical devices for the Government, which operated on the power of a standard touring car for twelve consecutive days.



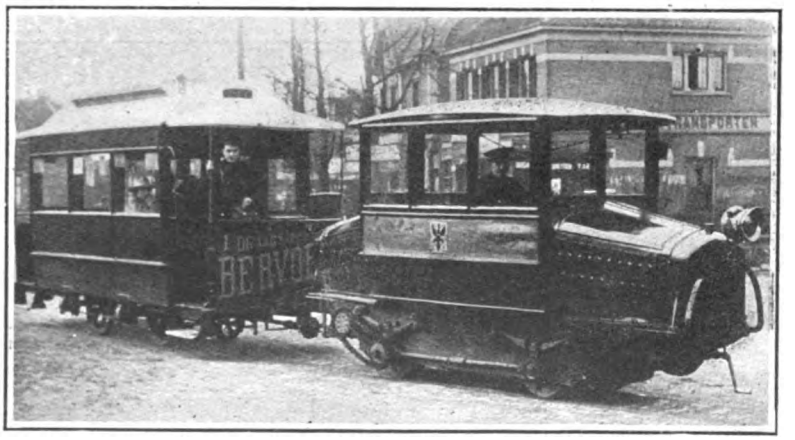
How an automobile may be belted to a line shaft as an emergency source of power

When the coal shortage threatened to tie up the plant, the president decided to press his touring car into service. It was rigged up in the factory as shown in the accompanying illustration with belts placed around the rear wheels and to a line shaft, in order to drive a 220-volt generator. This generator supplied current for lighting and also power for running the various lathes, drills and other machine tools as well as the automatic machinery throughout the factory. A belt was placed around each rear wheel and both wheels drive the shaft to prevent the wear on the differential gear which would be inevitable if only one wheel was used for driving the shaft.

In Boston, the Transit Commission tried the effect of paint on concrete reinforcement bars. This was done to see if it was practical thus to preserve them from corrosion, but it was found that their bonding strength was cut down below that of the plain bars.

AUTOMOBILE TRAMCAR TRACTOR

THE automobile engine has been put to a new use in Apeldoorn, Holland, as shown in the cut herewith. Two automobile power plants, each in its own hood, as shown, are mounted on a small four-wheeled truck and drive the wheels through a simple chain transmission, making an internal combustion engine propelled tractor. In this manner the horses used previously are replaced and the gasoline locomotive hauls one or two tramcars through the city streets with a considerable gain in economy and satisfactory operation, besides it has not been necessary to electrify the lines or build an expensive central power plant for generating current as is needed with the usual electrical railway system.



Gasoline tractor replaces horses for hauling tramcars in Holland

COTTON USED IN AUTO TIRES

IT is estimated that nearly four per cent of the cotton production of the world for 1920 will be consumed in the manufacture of pneumatic automobile tires, a total consumption of approximately 400,000 bales. The 1920 production of tires in the United States should approximate 40,000,000, to equip nearly 1,500,000 new cars and to maintain about 7,000,000 now in operation. Cotton promises to remain indefinitely as indispensable in tire making as rubber.

Many motorists wonder how much cotton goes into the manufacture of pneumatics. Tires now contains an average of four pounds—an increase of one pound, due to the increasing number of pneumatic truck tires, which require more cotton because of their size. Much of the cotton used is Egyptian or Peruvian. The larger companies use the cream of the world's crops—the 1⅛-inch staple or better. A few of the larger companies will make more than half the year's output—the remainder will be divided among more than 230 smaller concerns.

MANDRELS

IN general practice, mandrels do not require as high a percentage of carbon as cutting tools. Small-sized mandrels give good results when made from steel of from 1.00 to 1.10 per cent carbon. Larger sizes of mandrels are better when made of steel containing from .80 to 1.00 per cent. carbon. Material containing this carbon content will harden well and can be very accurately finished by grinding. This insures that the surface will be true and round and that it will be more resistant to wearing than a softer surface would be.

Digitized by Google

Experimental Physics

Ultra-Violet Rays—Part 2

By James L. Clifford

IN the first article of this series the experimental production of ultra-violet rays was discussed, and the construction of a simple arc lamp for this purpose briefly outlined. Ultra-violet rays are easily produced, and, in fact, are constantly about us, but their detection is not always simple. It is for this reason that their presence was so long unthought of.

The statement has been made that it is absolutely impossible for the human eye to detect ultra-violet rays. This is not entirely true, for pure ultra-violet light, after all of the ordinary wavelengths from .0004 to .0007 mm. have been filtered out by means of suitable screens, causes some impression on the eye. A hazy blue patch will be formed on the retina of the eye, caused no doubt by the fluorescence produced by the rays. Thus to say that they are invisible is not true, but for all practical purposes it may be accepted.

The two methods best applicable to the experimental detection of ultra-violet light are: the use of phosphorescent screens or the use of a special type of gold leaf electroscope. In the early work with this type of radiation, as also in the experiments with phosphorescent bodies, an instrument known as the Phosphoroscope was utilized. As this type of instrument is difficult to construct, and to properly adjust, it has not been used by the author.

For simple qualitative experiments with ultra-violet light phosphorescent screens may be used. Such a screen may easily be prepared in the following manner: A small quantity of the chemical, anthracene, is moistened with water and then thinly spread over a ground glass surface. When dry most of the anthracene will adhere to the glass. This fluorescent surface when exposed directly to the rays will glow brightly. If the reader is unable to procure any anthracene another screen can easily be made using Sidot's Blende (crystalline zinc sulphide) or Willimite. The powdered substance is evenly spread over a glass surface first covered with sticky gum arabic or other adhesive.

When observing ultra-violet rays by means of a phosphorescent screen it must be remembered that ordinary light also will to some extent cause phosphorescence. The effect of ordinary light may be found by interposing thick glass between the source of the rays and the screen. When this is removed the difference in intensity of the phosphorescence is caused by the ultra-violet light which reaches the screen.

This method, however, of detecting ultra-violet rays gives practically no opportunity for accurate work. The author has found that the best way is to utilize what is known as the photo-electric effect. If a metal plate is exposed to a beam of light of short wavelength the plate will assume a positive electrical charge. Thus if a gold leaf electroscope negatively charged is placed in ultra-violet light it will rapidly lose its charge. The explanation of this effect is really very simple. When the light having a very short wavelength strikes the metal surface a disturbance is immediately set up, ending in the emission of a negative electron as a ray. The electric potential of the plate was originally neutral (by a neutral potential we mean that there are equal quantities of both negative and positive electricity residing in the plate). The emission, then, of a negative electron obviously leaves the plate with a positive charge.

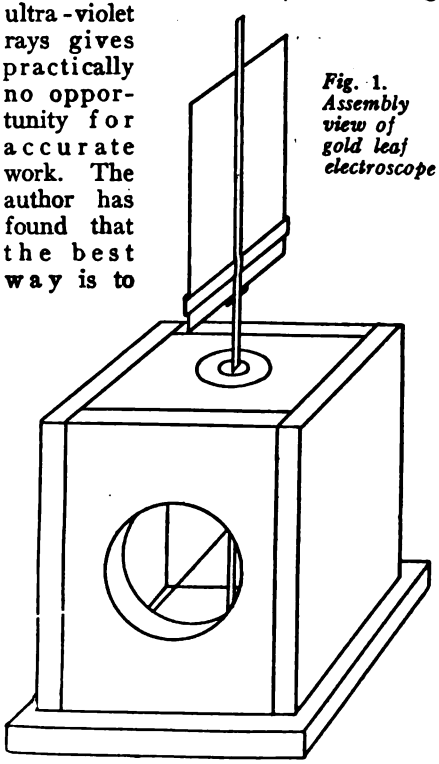


Fig. 1. Assembly view of gold leaf electroscope

A gold leaf electroscope having a definite surplus of negative electricity or a negative charge as we generally call it, is placed in the path of the rays. The negative ions are literally knocked off by the rays, thus causing the electroscope to discharge. The rate of fall of the gold leaf is the measure of the amount of ultra-violet light present. If, now, the electroscope is positively charged, the rays will have little appreciable effect. In some cases the electroscope will be a little more charged positively as a result of the emission of the negative electrons.

The construction of an electroscope as designed especially for this type of work by Mr. F. W. Russell is shown in Fig. 1. In Fig. 2 is shown the completed instrument to the right, and the arc lamp described in the first article to the left. The details of the instrument should easily be gathered from these illustrations.

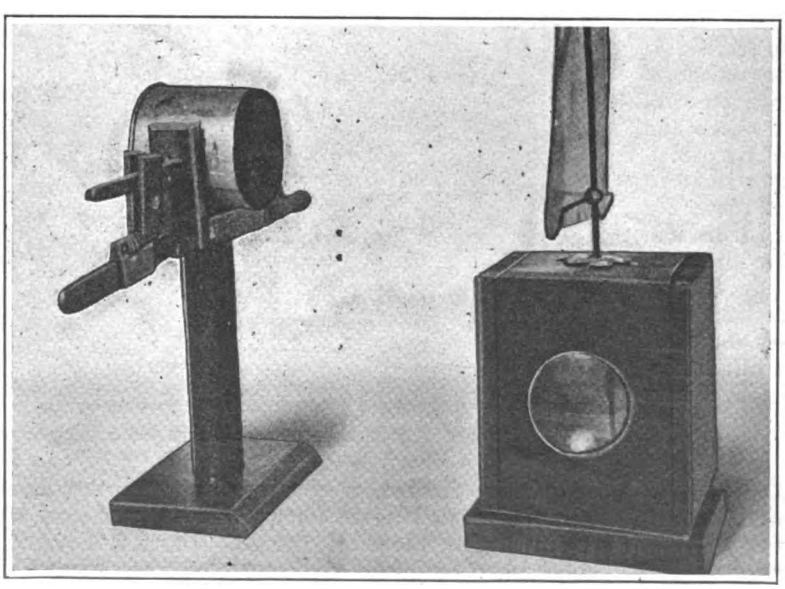


Fig. 2. Completed electroscope and arc lamp

The housing for the electroscope is of ½-inch oak or mahogany. In the front of the container a reading glass of about 4-inch focus is mounted, while directly in the rear of this is an opening over which a transparent scale of the type shown in Fig. 3 is glued. In the top of the housing a hole about ¾ of an inch in diameter is cut into which a cork snugly fits. The cork is hollowed out to allow the

Digitized by Google

electroscope proper to extend through, after which it is filled with melted sulphur and allowed to harden. The construction of the electroscope proper is depicted in Fig. 4. It is made of a well smoothed brass strip of ¼-inch width, and so shaped as to hold a metal sheet of about 4 inches by 4 inches. The metal plate was of aluminum in the author's electroscope, but some authorities use zinc for this purpose.

When the electroscope proper is assembled, well insulated from the cork by the sulphur, and well smoothed and polished to obviate leakage, a small strip of gold leaf is attached to the strip about an inch and a half from the lower extremity. A tiny drop of shellac will hold the gold leaf firmly in place. The cork is now put in place, and the electroscope is ready for use.

To charge the electroscope negatively it is only necessary to rub a glass rod with a silk or flannel pad, and then touch the plate of the electroscope with the rod. The desired charge may be produced by repeated applications of the charged rod. If hard rubber or ebonite is used instead of the glass, the electroscope will assume a positive charge, and will then be useless for detecting ultra-violet rays. For this type of work, then, glass must be used exclusively.

Now when the charged electroscope is brought in front of the arc lamp producing ultra-violet light it will be noticed that the gold leaf will immediately fall. The speed with which the electroscope is discharged by the ultra-violet rays produced by the arc lamp with soaked electrodes, is surprising. Even at the distance of ten feet or more the electroscope is easily discharged. When a glass plate is interposed the gold leaf comes to rest. The reason for this, as explained in the first number, is that glass is opaque to this type of radiation. The difference in the speeds of discharge of the electroscope can be used to determine the amount of high frequency radiation produced by the arc with various types of electrodes.

After using the electroscope for some time a very peculiar property will be noticed. The electroscope will refuse to discharge even when exposed directly to the radiation. Repeated attempts will fail and the electroscope will appear to have lost all its power to detect ultra-violet rays. If, however, the metal plate is now well sandpapered with emery paper, or better, well rubbed with a little wire wool, the power will be restored. The explanation of this peculiar property is in reality very simple. After repeated exposures of the plate to ultra-violet light the supply of free negative electrons on the surface of the metal is completely used up. The rays can find no electrons to force from the plate, and thus cannot impart to the plate any positive charge. If now, a new surface is formed the supply of electrons is again ready and the rays can again give the plate the necessary positive charge. It is necessary, then, every now and then to form a new surface on the plate.

It should not be necessary to go on with the innumerable interesting ex-

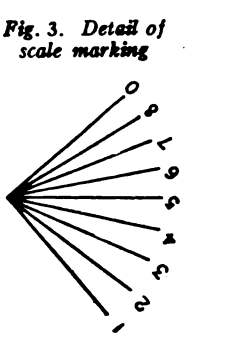


Fig. 3. Detail of scale marking

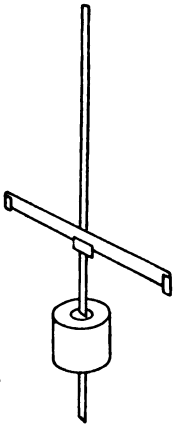


Fig. 4. Electroscope frame

periments which can be performed by the use of these two pieces of apparatus. To the experimenter interested in this type of work it should only be needed to suggest the fundamental principles involved, and his mind should supply the rest. Needless to say, any labor expended in the production of apparatus and in performing experiments with them, will not be wasted. It is a wonderful field for research and study. Ultra-violet light is little understood today, and practical use of it is almost unheard of. No one can say to what use it may be put in the future, for we are just beginning the century of radical discovery and experiment. It certainly behooves us to be working and thinking along this most wonderful field of modern physical science.

TREATING SULPHATED PLATES

IF, on test, the efficiency of a storage battery cell sinks to 50 per cent, or lower, the plates should be removed and washed thoroughly with distilled water. They are then placed in a cell containing a two to five per cent solution of caustic soda in water, and the charging current sent through the cell in the usual way. If the sulphate on the positive plate does not disappear during the time of the ordinary charge, and the solution gives an acid reaction with litmus paper, more caustic soda must be added to the solution, and the charging continued until the plate has the usual chocolate appearance. The plates should then be removed from the soda solution, well washed, replaced in the sulphuric acid solution, and the charging continued until gassing begins. Many cells have had their efficiences raised from 25 to 75 per cent, by six hours' charge, and many electricians believe that any plate which will hold together will well repay treatment by this method.

LEGALIZED FRENCH METRIC MEASURES

ON September 6, 1919, the French Chamber of Deputies legalized a set of metric measures, of which many are so familiar as not to need special notice but several are of interest in themselves and the whole set is to be noted as being based not directly on the familiar C. G. S. system, the centimeter-gram-second system, but on the M. T. S. system, the meter-tonne-second system. It was concluded that the meter-kilogram-second system, as well as the decimeter-kilogram-second system, gave units too small for commercial and everyday use. Of course the same objection applies in still greater degree to the C. G. S. system.

The first thing to be observed is that the metric tonne is a little less than the avoirdupois long ton. It is one thousand kilograms, which are 2,204.6 pounds avoirdupois.

The unit of angular measurement is the grade, symbol, gr., and is the one-hundredth part of a right angle. The degree, it is stated, can be used if desired.

The marine mile is to be one-sixteenth of a degree of latitude or 1,852 meters. The mass of the standard kilogram, preserved at Paris, is stated to be 27 milligrams less than the weight of a cubic decimeter of water at maximum density. This indicates the failure of the attempt to absolutely standardize units. The carat, used in weighing precious stones, is to be two decigrams.

The unit of density is the mass of a ton occupying a space of one cubic meter. The unit of force is the sthene, equal to one hundred million dynes.

The unit of pressure, the pieze, is the pressure of one sthene per square meter. It is equal to one thousand baryes.

The unit of power, or of energy rate, is the poncelet, one hundred kilogram-meters per second. This is 0.981 kilowatt. The unit of atmospheric pressure is 1,013 hectopiezes or 1.033 kilogram per square centimeter.

The unit of heat is the thermie, one tonne of water at 15 degrees C. raised one degree C. in temperature under a pressure of 1.013 pieze.

For low temperature work a unit, the frigorie, is defined as one millitherm.

The decimal candle, the unit of candle power of light, is one-twentieth of a violle.

The unit of luminous flux is the lumen; it is the light of one decimal candle emitted for one second at a distance of one meter, covering one square meter on the surface of a sphere of one meter radius. It is a rare unit. Its symbol is lu.

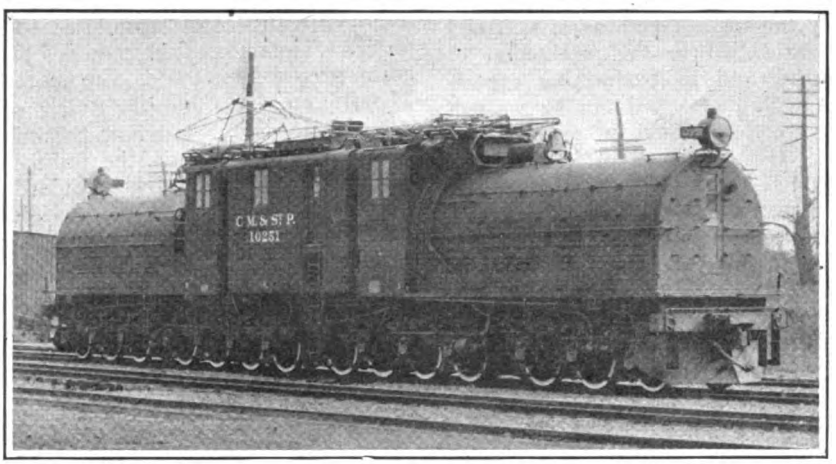
The lux, symbol lx, is the light of one lumen distributed over one square meter; 10,000 luxes are equal to one phot.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

LARGE STEAM TURBINE-GENERATOR HAS RECORD RUN

OPERATING without a shutdown for a period of 84 days, 11 hours, 36 minutes, the 45,000 Kw. Westinghouse turbine-generator at the power plant of the Narragansett Electric Lighting Company established, recently, a world's record for the continuous operation of a multiple-element steam turbine of the cross-compound type. During this run there were generated 51,104,000 Kk. hours or considerably more than the total output of the Narragansett Company for any year prior to 1915. In fact this unit generated about 85 per cent of the total station output. Furthermore, this record was made with the load varying from a minimum of 6,000 Kw. to a maximum of 41,000 Kw.



The enormous bulk of the new electric locomotives used by the Chicago, Milwaukee and St. Paul Railroad is supported by seven trucks or twenty-eight wheels

To some extent this continuous operation was made possible by means of an 800-gallon self-contained lubricating system. Oil is pumped through a cooler to the bearings at the rate of 600 gallons per hour.

One of the most important features of this run was the fact that the turbine was operating under ordinary conditions. No preparation was made for the run, for when the unit was started early last December there was no thought other than to operate for a week, which is the ordinary period of a run. Abnormal weather conditions, however, brought about such a demand for power that it was not considered economically advisable to shut down the unit until the conditions were relieved. Even at this time it was not necesary to stop the turbine but existing station conditions allowed this procedure.

ELECTROLYTIC TREATMENT OF METALS

COPPER has been purified by electrolysis for many years and recently much attention has been given to the development of the electrolysis of iron. The power required in any electric process depends on the amperes used and the voltage at which the work must be done—it is a question of watts. If either factor, intensity of current or potential drop, is low the power required is small. As the electrolysis of a metal requires a very low voltage a comparatively low power is required to carry out the process, notwithstanding the very large current needed. The principle of the process is simplicity itself. A solution is used capable of dissolving the metal, if it is made the anode; the current, which effects the solution also effects the deposition of the metal on the cathode. The potential expended on the deposition, however high it may be, is almost compensated for by the potential developed by the solution of the anode.

Various solutions are used where iron is to be electrolyzed; double oxalates or double sulphates may be employed; sulphocresylate of iron is also given as a suitable electrolyte. A rotating cathode is sometimes used. The material of the cathode is of interest as the iron has to be stripped therefrom, and copper and lead work well in this respect. The process is applied to the production of iron so pure as to take the place of charcoal iron, such as Swedish iron. It is also applied to the production of tubes.

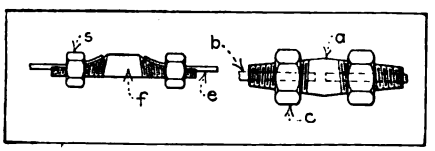
A number of cost data have been published, giving the result attained in France, and therefore not very applicable to this country. The cost is put at one hundred francs a ton above that of the original metal purified by the process. At ordinary temperatures 0.66 volt potential is required.

SIEMENS DRY CELL

The Siemens inert cell is attracting considerable attention. No chemical action whatever takes place in it until it is moistened. After that it operates exactly as a dry cell. An English contemporary suggests its availability for flashlight torches. The idea would be for the vendor to keep them dry on his shelves and when he puts one in a flashlight for a customer to charge it with water so that the customer receives a perfectly new cell. Dry cells even on open circuit gradually deteriorate.

SCREW COUPLINGS FOR CONDUCTORS

TWO variations in construction of couplings for electric wires are shown in the cut. The one for smaller wires consists of a central cylinder of metal with conical ends and on these ends right and left hand screws respectively are cut. Longitudinal grooves are cut through the threads on each end. Right and left hand threaded nuts screw on the ends over the ends of wires to be connected, jamming them solidly against the central piece making a very solid, yet easily released, coupling. In the other figure is shown a modification in which appear the conical right and left end screws. But here the central piece is cut in two longitudinally, axial grooves are made in each half, so that when they are put together an approximately circular aperture is formed. The ends of the wire to be joined are inserted in these grooves, which they just a little more than fill. The two nuts as shown are screwed up towards each other, compressing the halves of the coupling against the wire in the central groove. The coupling is instantly released by slacking the nuts.



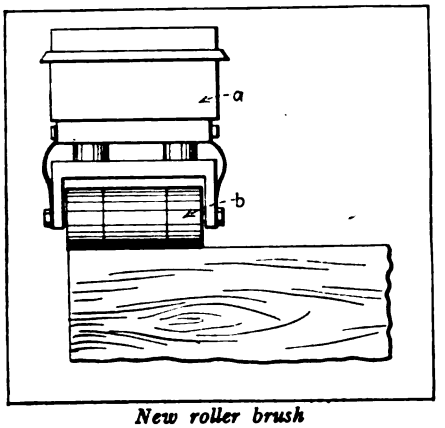
Simple screw couplings for wires

Never use machine oil on the commutator of an electric dynamo or motor. It is matter out of place, does damage and serves no useful purpose.

Digitized by Google

COMMUTATOR BRUSH.

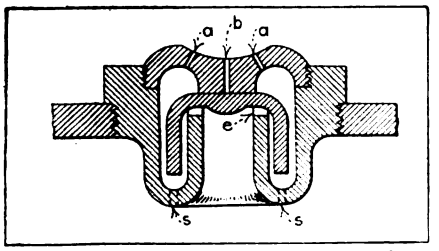
THE inventor of this brush proposes to substitute for the friction contact of the regular D. C. dynamo air motor a rolling contact as shown in the cut. The brush holder (a) carries rollers (b) which bear upon the commutator. He claims that much wear is avoided by this invention and that the grooves between the commutator bars never fill with carbon. It is also suggested that balls may be used instead of rollers.



New roller brush

STORAGE BATTERY STOPPER

THE object of this stopper is to prevent acid spray from being carried out of a storage battery during the charging operation. When a battery is gassed, a stream of bubbles of hydrogen are emitted and carry a certain amount of spray with them. In the stopper which we illustrated and whose construction is clean from the sectional view and which is supposed



Special cell vent for storage batteries

to be screwed into the battery jar top, the gas escapes through the apertures (e), then descends and the most of the spray, which it will have carried with it, runs back into the battery through the apertures (s). The gas now takes an upward cross escaping finally through the apertures (d) into the open air. The central opening (d) is provided with a perforated recess at the top of the plug, whose central aperture through which a trivial amount of liquid which may have escaped is returned to the jar.

The Puget Sound Traction, Light and Power Co. have adopted pulverized lignite as fuel. It gives 9,000 B.T.U.'s per pound and its culm gives 7,300 only. It is reduced to ½-inch size, dried, passed through magnetic separators to remove any fragments of iron, and is fed by screw stokers into the boiler furnaces.

THERMO-ELECTRIC BATTERY FOR AUTOMOBILES

IT is proposed to use the waste heat of the exhaust of the engine of an automobile to excite a thermo-electric battery. The couples are to be arranged radially about the exhaust pipe and their outer ends are to be cooled by the water of the circulating system. It is to be used to light the car or for the other uses on a car whose engine is running. It will not be of service except in such case, as if the engine is stopped it will give no current. As such a battery is almost indestructible and as the heat used by it is absolutely wasted in ordinary practice, there is much good in the idea.

PHOTOGRAPHING MAGNETIC CURVES

ALL are familiar with the production of magnetic curves by sprinkling iron filings on a sheet of paper held over a magnet. The filings arrange themselves along the lines of force, and varied results may be obtained by using different magnets, straight or horseshoe, and by using several at once, with their poles in various relationship. To photograph the curves all that is necessary is to use blueprint paper, to distribute the filings on it, and when they have been brought into their final position, by gently shaking, if necessary, to expose the paper to sunlight and then to develop by immersion in water. This will give a perfect and permanent reproduction of the lines of force of the field in question. Developing papers may be used, such as bromide paper, and the operation then must be done with observance of the regular methods of photography, using a non-actinic light in the distribution of the filings. The advantage of the blue-paper process is that it is so simple and easy, and a collection of curve-photographs obtained in this way may be quite interesting.

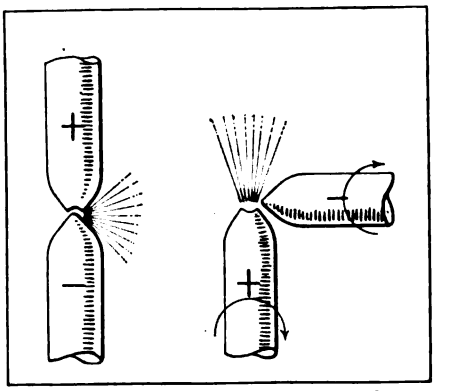
MERCURY RECTIFIERS

THE mercury vapor rectifier, acting by only letting one element of a two directional current pass through it, has attained considerable popularity, although now the Tungar rectifier is taking its place to a considerable extent. The mercury vapor rectifier needs a high vacuum. One of the terminals is mercury; this terminal must be the cathode; the anode may be a solid metal one. A current of three to five amperes is good practice. Some heat is generated; the mercury is heated and the solid anode may show low red heat.

The report appears in the English journals, that the London County Council is trying out no less than two trackless trolleys. This seems anything but a daring attempt, when it is remembered that such a system has long been in successful operation in the Orient.

ARC LAMP

IN an arc lamp 95% of the light is said to be in the crater, 4% in the negative pole and 1% in such portions of the carbon as are brought to red heat. To get the full advantage of the crater it is proposed to arrange the carbons at right angles to each other as shown in one of the diagrams instead of facing each other end to end. Of course the angle can be varied and it will probably be necessary to rotate the negative carbon and perhaps also the positive one in order to keep the crater in axial position.

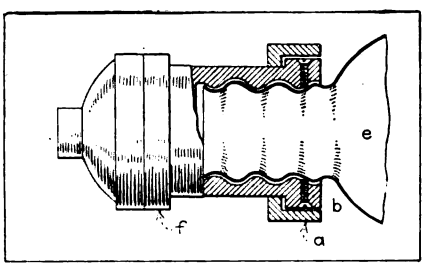


Novel arrangement for arc light carbons

The operations effected by electricity in the California citrus belt have excited some attention. The ground is irrigated by water distributed from electrically driven pumps and electrically driven machinery cleans the fruits, sorts, packs and labels it and is naturally called into use for driving the box-making machinery.

LAMP SOCKET

THIS socket is of the regular contion with the exception that it is arranged so that a special tool or key may be required to remove the lamps. The end of the lamp is screwed into the socket (f). Set screws (b) are provided which, when screwed up, preclude



Lamp socket to prevent theft of lamps

the unscrewing of the lamp from its socket. The heads of the screws are covered by a ring (a) which is constructed with any special form or lock desired, so that a special tool is needed to remove it. To take the lamp out of this socket this ring has to be removed so as to expose the heads of the screws to enable them to be turned back when the lamp is to be removed.

Digitized by Google

AVIATION BRIEFS

USEFUL LIFE OF AN AIRPLANE

ONE of the drawbacks to the commercial use of airplanes has been their short life, which coupled with their high initial cost has resulted in unusually high depreciation charges. During the war, it was found that the average life of airplanes in active service was from sixty to ninety days so strength and endurance were sacrificed to gain the desired military advantages of high speed and quick manoeuvering qualities. The efforts of designers are now directed to increasing the life of both the power plant and airplane structures.

Many of the aeronautical engine manufacturers have remodeled most of their successful types with intention of increasing reliability. This has usually resulted in a slight increase in weight. The question of overhauling cost has been gone into and modern engines are so designed that their accessories, valve gears, and similar parts are easily reached for cleaning and adjustment. The result is that most engines on the market to-day for commercial use can be relied on, with proper use and care, for from 125 to 150 hours without being overhauled. And if, simple cranes or hoists, suitable benches, and other shop equipment are not available, valves may be ground and even pistons changed in many modern types without removing the engine from the engine bed.

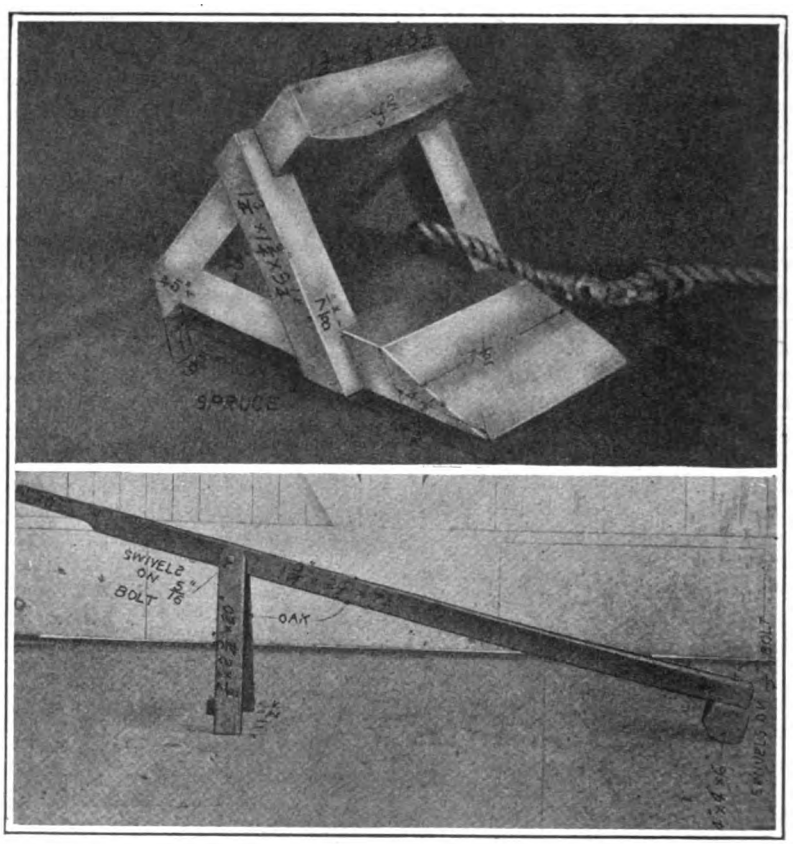
One feature was developed as a result of the war which will have a great effect on the future use and development of aviation. This is the application of metal, such as alloy steels, duralumin, etc., to the structure of the airplane. The Germans were driven to this by the lack of a reliable supply of suitable lumber. Some French and English firms also worked on this problem, notably Brequet in France. Many inventors have brought forward alloys, new structural combinations, etc., with the object of using metal in whole or in part.

This development has been foreseen for many years, but presents a difficult problem. The effort to obtain the maximum of strength with the minimum of weight resulted in vastly refined types of internal structure and thorough investigations into the strength and properties of the available materials. All of this data and knowledge is now available to the designer who is working with the idea of durability.

The shortage of suitable linen prompted an investigation of other materials as a substitute. Various fabrics of cotton and cotton with linen were developed which have some properties of value that all-linen has not, besides being cheaper. Streamline wire was brought out of the experimental stage and can be obtained of equal strength and reliability with stranded cable. Very light sheet metal has been used for surfacing wing frames, which have already been constructed entirely of metal. All of these experiments cannot fail to bring out designs of planes and engines which will be much more enduring and lower in cost than present types. There is no reason why a good, substantial airplane cannot be built on a quantity basis cheaper than a good automobile and if it is reasonably enduring, its up-keep cost will be no greater than that of an automobile of similar capacity for a given mileage. Of course, before the airplane can compete with the automobile, to any extent, the demand must be large enough to warrant production on a large scale.

COMMERCIAL AVIATION IN ENGLAND

REPORTS from abroad indicate that the Handley-Page Co. is now making use of converted bombers, for continental air service. These machines are known as Type W-S, and carry 15 passengers or 2 tons of freight at a speed of 112 miles an hour. The first of these machines was exhibited at the Paris Aero Show, having been flown there from London. On the close of the exhibition this machine was flown back from Paris to London, making the flight in 2 hours 10 minutes. The average time between Paris and London is under 3 hours by air; by train and steamer the journey often occupies 14 hours. Since the London to Paris and Brussels air services were established on Sept. 2, 1919, until Jan. 29, 1920, Handley-Page machines had carried 924 passengers, 43,412 lbs. of freight and had covered a distance of 65,293 miles. On May 1, 1919, civilian aviation was established in Great Britain, and from that date Until Jan. 29, 1920, Handley-Page



Two useful appliances for the airplane hangar. Dimensions of practical wheel chock are given at top and of a quick action lifting jack to go under the axle at the bottom

Digitized by Google

machines carried 461 passengers, 44,805 lbs. of freight, and covered 74,743 miles.

A new service has recently been established between London, Paris and Brussels for carrying freight at reduced rates. The following is the scale of charges:

	Per Lb.
Shipments up to 10 lbs.....	*2/6
" from 10 to 20 lbs....	2/3
" from 20 to 50 lbs....	2/–
" from 50 to 100 lbs...	1/9
" 100 lbs. & over.....	1/6
Passengers baggage (unaccompanied by passengers).....	1/6
Minimum	5/–

* At English rates. Shillings equivalent to 25 cents and pence, 2 cents.

Numerous consignments of delicate articles, such as ladies silk dresses, scientific instruments, antiques, valuable flowers, are now constantly carried by air between Paris and London. Air service is proving itself particularly valuable for this class of transportation, for all danger of damage by rough handling is removed, and the risk of loss by theft becomes negligible.

FRENCH AERO ENGINE OUTPUT

ACCORDING to a paper read by M. Martinot-Lagarde, before the Society of Civil Engineers of France, the production of aircraft engines in that country increased from 40 per month in August, 1914, to 4,200 in October, 1918, or from 900 per year in 1914 to 34,000 for the first ten months in 1918. During the war a total of nearly 90,000 aircraft engines were built, representing an aggregate work of 100,000,000 man-hours, an output of nearly 2,000,000 hp. and a cost of 2,000,000,000 francs.

A NEW RECORD IN AVIATION

THE great transatlantic aeroplane A. R. F. which was completed on February 26, 1920, at the airship shops of the Fiat, began its flights at the Aviation Field of Mirafiori in Turin with a wonderful speed record, in which the world's record was beaten by the well-known aviator Lieutenant Francesco Brak Papa, who, with four passengers on board, attained the amazing speed of 261 kilometers an hour. The flight was carried out according to the rules of the International Aeronautic Federation and was officially supervised by the commissaries of the Aero Club of Italy, and by officers of the Italian Military Aviation, to whom was entrusted the duty of verfying the electric measuring apparatus.

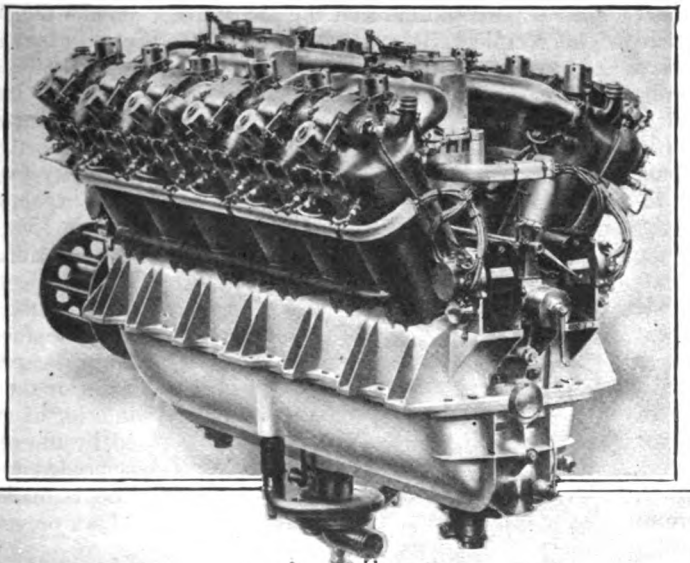
This record marks a decisive turning point in the development of aviation and shows the seriousness of intent and the broad means with which the great Italian Company, long known for its multiform activity in the various branches of industry, has persevered in the study of this new branch of engineering, before which there is certainly a bright future. The machine was the one invented by Engineer Celestino Rosatelli and shown at the International Exposition in Paris. It attracted the general admiration of engineers by its ponderous bulk combined with a pleasing elegance of form and harmony of lines. This craft is a biplane of conventional design propelled by the powerful 700 hp. motor illustrated, this is also the product of the Fiat Company. The machine has a capacity, in addition to the crew and instruments for fully 660 gallons of fuel, or sufficient to supply the motor for twenty consecutive hours, which renders it possible for the airplane to cover the great distance of five thousand kilometers without stopping, while the voyage across the Atlantic is only three thousand.

AN ELECTRICAL TURN INDICATOR

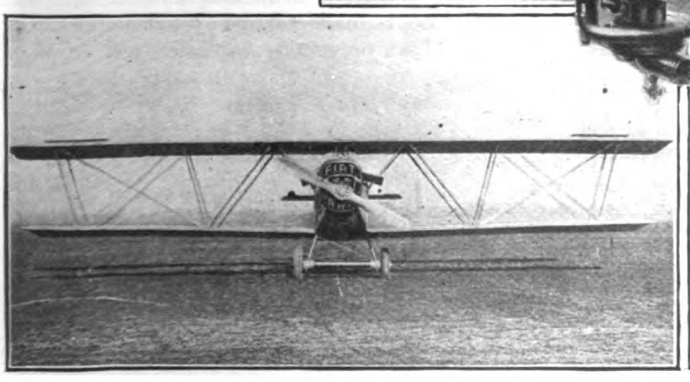
There has recently been introduced in German flying circles an instrument that indicates the difference in air speed between the two wing tips, which is but another way of expressing the rapidity of turns. Two venturi tubes are used, one over each wing tip. Each venturi contains three resistance thermometers, one in the throat, one in the entrance section, and one in the exit section. The temperature difference between the throat and the entrance and exit can thus be obtained for each venturi. By combining two instruments differentially, the difference in temperature between the two throats can be measured. This temperature difference will depend on the rate of turning. It is claimed that the electrical recorder has very little lag.

It is advised that lenses should be boiled in distilled water before being put in place and where it is possible the instruments should be airtight and filled with dry air.

The 700-H.P. F.I.A.T. aviation engine shown at the right is a good example of modern high power and light weight motor design. It is a twelve-cylinder type



F.I.A.T. four-passenger biplane shown below is a very efficient large capacity airplane design with amazing speed possibilities. It has a flying radius of twenty hours





Digitized by Google

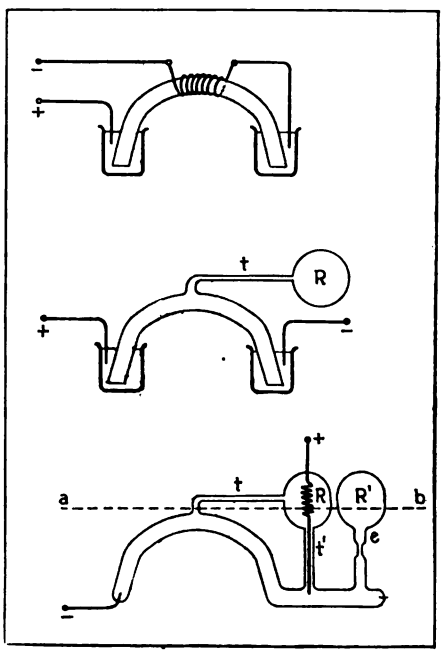
The Henri George Mercury Vapor Lamp

By Prof. T. O'Conor Sloane

THE quartz tube mercury vapor lamp of the ordinary type has various disadvantages. The fact that mechanism is required to rock or oscillate the lamp back and forward in order to light it, is one objectionable feature. It takes some fifteen minutes to get started into full illuminating power. Containing a quantity of mercury in a high vacuum there is danger of fracture from a mercury hammer, analogous to the well-known water hammer. No matter how well constructed as regards the joints, and no matter how pure the mercury and the quartz may be, there is always danger, that air will find its way into the interior, impair the vacuum and interfere with the proper operation of the lamp. Other troubles incident to their operation are cited. The lamp described here lights on turning on the current without rocking, has no vacuum in its interior, and starts into full operation at once. Referring to the three diagrams its operation and general features of construction may be followed out.

Suppose the tube in Fig. 1 was filled with mercury, and that its ends were open and were immersed in open cups of mercury; the pressure of the atmosphere would keep the tube full. If a current of electricity were passed through the circuit as shown, the mercury would complete the circuit. But if the current was of sufficient strength it would heat the mercury in the upper bent of the tube, would vaporize it and form a bubble, breaking the circuit and giving at least one of the conditions for starting an arc. This arrangement is very insensitive, as so much heat would be needed to break the mercury column. Now suppose a bulb or flask-like recipient, R, of Fig 2 communicated by the tube, t, with the upper part of the bent tube. A comparatively slight heating of the bulb, R, would form a bubble of gas in the upper part of the bent tube, across which an arc under proper conditions would spring. It is clear, that we have got rid of the need of rocking or oscillating the lamp to start it.

So much for the basic principles. Now referring to Fig. 3 we see there in diagram a bent tube hermetically sealed. The recipient, 4, communicates by a tube t, as before with the top of the bend, and by another tube, t', with the lower part of the working tube. A second recipient, R', with a stricture at e, gives additional capacity for mercury. Here too the circuit is differently arranged. One of the wires of the circuit enters the recipient, R, at its top, where it is sealed in, and wound into a heating coil passes down through the tube, t', into the mercury lying in the quartz tube. The other wire enters the quartz tube at its other end. The level of the mercury when the tube is inactive is indicated by the dotted line, a, b. When the current is caused to pass it heats the gas in R, expands it breaks



Figs. 1, 2 and 3—Diagrams showing principles of Henri George mercury vapor lamp

the mercury column and the arc starts. The recipient, R', receives any excess of mercury, the stricture preventing sudden changes and ensuring a steady action.

The breaking of the mercury column is thus provided for, and the next question is what gas should be used to fill the recipient, R. The gas is to be at

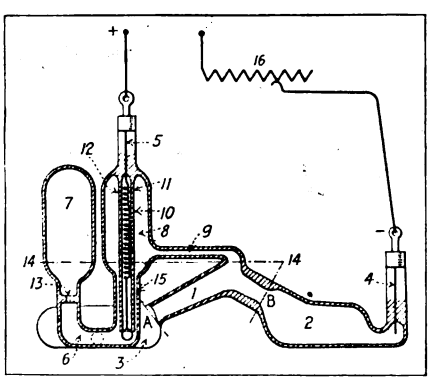


Fig. 4—The Henri George mercury vapor lamp

atmospheric pressure; hydrogen will not do for at such pressure it will prevent the formation of the arc; air contains oxygen which would attack the mercury in action; nitrogen does not work well as it forms a deposit on the walls of the tube, probably an unstable nitride, and interferes to a considerable extent with the action. It is the use of the rare gases of the atmosphere, which has made this lamp successful. If the mercury column is broken in an atmosphere of neon, argon or helium the arc always forms and starts at once into full action, provided the gas is absolutely dry. If there is any moisture present hydrogen is formed by dissociation and the action is interfered with.

The actual lamp is shown in Fig. 4. The quartz tube, within which the arc is formed is indicated by 1, W is the cathode reservoir of mercury, 3 is the anode reservoir, 4 and T are the positive and negative terminals. The recipients, 7 and 8, corresponding to R and R' of Fig. 3, are connected by the tube 6. The tube, 9, corresponding to T' of Fig. 3, must be three-sixteenths or more of an inch in diameter. The tube, 10, containing a heating coil of tungsten, 12, has a hole in its wall at 11; the lower end of the wire is always immersed in mercury at the base of the lamp. At 13 is the steadying stricture, the line 14, 15 shows the level of the mercury when the lamp is inactive. At 15 there is an annular space between the concentric tubes. The lamp is hermetically sealed. The lamp operates on direct current, regulated by a rheostat, 16; this is set so as to give a current of eleven amperes when the lamp is in operation.

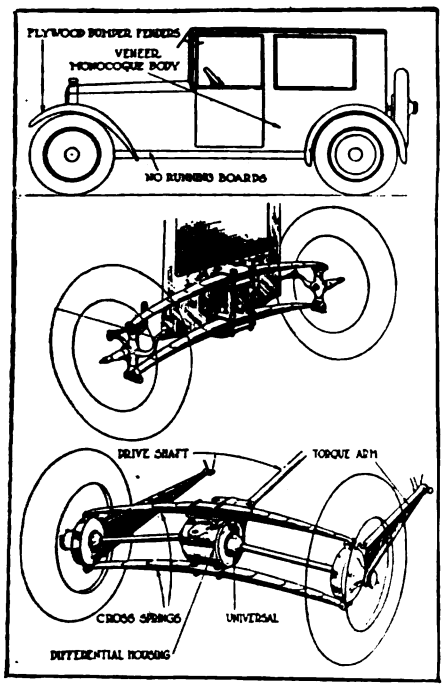
To start the lamp, the current is turned on by a switch. The coil, 12, becomes hot, the gas expands and breaks the column of mercury in 1, the arc forms and eventually plays from A to B; the excess of mercury rises into 7. In a lamp for a 115 volt circuit, the current drops to four amperes at a voltage between the terminals of eighty to eighty-five volts. The mercury vapor soon expels all gas from the arc-tube, 1, and in five or ten seconds the lamp is in operation. The long period of waiting, incident to the use of the ordinary quartz tube lamp is done away with, and the fact that the pressure in the lamp is practically atmospheric disposes of the trouble of leakage into the interior of any air. The lamp is started by the turn of a switch, no rocking is needed to draw out the arc. Its action is made steady by the stricture at 13 as previously explained.

To make twist drills available for drilling marble, a French contemporary gives the following instructions: One side of the point is to be kept at the regular angle of 59°. The other side is to be ground off to 48°. Both angular measurements are referred to the axis of the drill. Another thing recommended is to file or grind a slot across the point at 90° with the cutting edge about one-quarter of an inch deep.

Digitized by Google

EXTREMELY LIGHT AUTO BODY

MENTION has been previously made in these columns of the influence of automobile engine design principles on the development of the aerial power plant and now we find that aerial designers are contributing to the refinement of automobile construction, especially as relates to body construction. Our contemporary, *Automotive Industries,* describes a special five passenger Sedan body which is claimed to weigh only 120 pounds for a car of 112 inches wheelbase. These bodies are constructed on airplane



Light car has novel spring suspension

fuselage principles and are of a three-ply veneer combination. The great strength and light weight of plywood permits it to act as a sheathing and at the same time contribute considerably to the strength of the structure. The veneers usually employed consist of two plies of birch with a play of mahogany between. The thickness used in auto body work is 1/8 inch.

At the last summer meeting of the Society of Automotive Engineers there was an interesting discussion on a five passenger Sedan that would weigh 900 pounds complete. In this car, the sills and frame are combined and the axles are replaced by cross-springs, which perform the functions of both springs and axle. The drive to the rear is through propeller shafts with universal joints. Plywood is used practically exclusively in the construction of the car, even the fenders being of this material. The cross-spring suspension is of particular interest, and is illustrated herewith.

There is nothing experimental about the construction as it was tried out on a light cyclecar six years ago. The rear construction is modified from De Dion practice of nearly twenty years ago and should prove practical in the new application. As will be evident, there will be very little unsprung weight and exceptionally easy riding should be obtained from this method of springing. As an example of the light weight of the plywood body, there has just been shipped to one of the well known eastern manufacturers a five-passenger Sedan body weighing 196 pounds. This car, which is known for its lightness, has hitherto used an aluminum body weighing 600 pounds.

NEW USE FOR POISON GAS

A NEW use has been found for surplus war stocks of asphyxiating gas. Some cases of typhus occurred in Paris, among refugees, and it was suspected that they originated from clothes from which vermin had not been entirely removed.

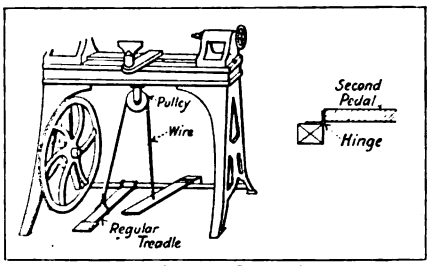
One of the measures used by the Pasteur Institute was to take the clothes, hair brushes and combs of those who had been in contact with persons affected and hang them for twenty minutes in a cylinder containing a mixture of chloropicrine, which was one of the asphyxiating gases used in the war. Twenty cubic centimeters of gas were used for every cubic meter of air and the mixture was heated to 45 degrees Centigrade. In addition to clothes the mattresses and blankets were treated in this way and it was found that as well as killing all vermin the gas disinfected them completely.

PROPOSES SHAFT TWELVE MILES DEEP

SIR CHARLES PARSONS, lecturing recently at the Royal Institution, referred to his proposal for sinking a bore hole twelve miles deep into the earth. He said that the cost of boring the hole would not be very great. In countries where the atmosphere is dry, the sides of mine shafts are cooled by sprinkling them with water, the evaporation of which cools the rock. This effect might be augmented by artificially drying and cooling the air before passing it down the mine. With still greater depths of shaft further methods of cooling would probably be necessary. The heat might be carried upwards by means of brine circulated in a closed ring of steel pipes with a rising and descending column, or a simpler method would be to arrange for a rain of liquid air down the shaft. When seeking the deeper portions of the shaft probably shields would be required to protect the miners from the splintering of the rock, since the intense compressive stress splits off scales from the surface, sometimes with considerable violence. When he first brought forward his suggestion in 1904, the estimate of the time required to sink a shaft twelve miles deep was eighty years; but with improved machinery and methods the records have been so much lowered that he now thinks an estimate of thirty years reasonable.—(*Compressed Air Magazine.*)

AUXILIARY LATHE PEDAL

IN the usual arrangement of foot lathes, the foot, which does the driving gives one impulse downwards for each turn of the flywheel, and then has to be raised simultaneously with the rising of the pedal. In the simple arrangement illustrated an extra pedal is provided, hinged to a block of wood, which block is screwed down to the floor. The two pedals are connected by



Auxiliary lathe pedal

a rope passing over a grooved pulley attached by a bracket underneath the lathe bed. In operating the left hand working pedal is pressed down as the flywheel turns. At the end of the down stroke, instead of raising the foot by muscular effort, the other pedal is driven down by the other foot, lifting the driving pedal and with it the other foot of the operator. This makes the work much easier as the feet press alternately down, and the tiresome lifting of the foot is done away with. The attachment of the second pedal to the floor-block is shown in the smaller figure.

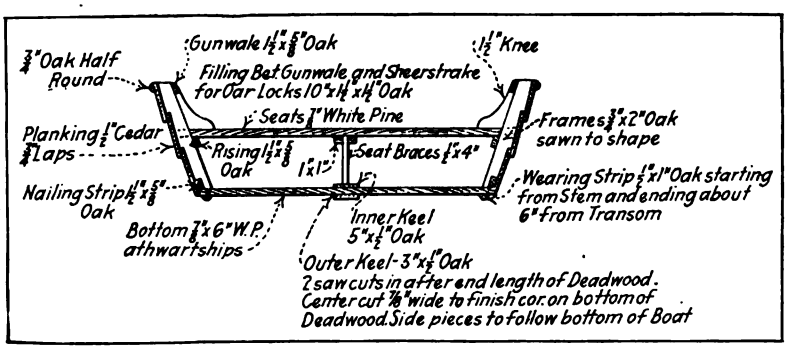
The asphalt lake on the Island of Trinidad is one of the classic curiosities of the world. Owing to the closing of the Continental markets, the output was greatly reduced during the war, little more than one-quarter of the normal output being exported in 1918. In Trinidad and Tobago there are a number of wells, producing upward of 43,000,000 gallons in a year.

Continual reports are coming in from all over the world about iron ore and coal deposits. It is reported from Queensland that in one place there are 500,000 tons of magnetic ore. This ore has a way of being very pure or very impure and the Queensland ore is said to be of wonderful purity. Boring operations have shown the existence of many millions of tons of coal. In the existing condition of things it is a comfort to hear of coal and iron ore deposits.

Digitized by Google

Small Boat for Outboard Motor

THE economical and simple installation of the various types of outboard motors intended to convert ordinary rowboats into motor boats is remarkable and many varieties of this type of light power plant have been made and have been found satisfactory in many respects. The average rowboat, however, is not well enough built to be adapted for an outboard motor or to warrant making it a semi-permanent installation. It is possible to build a small, inexpensive craft that will be as easy to propel with oars as a rowboat is and at the same time have proportions that make it much better suited to carry the added weight of the outboard power plant at the stern.



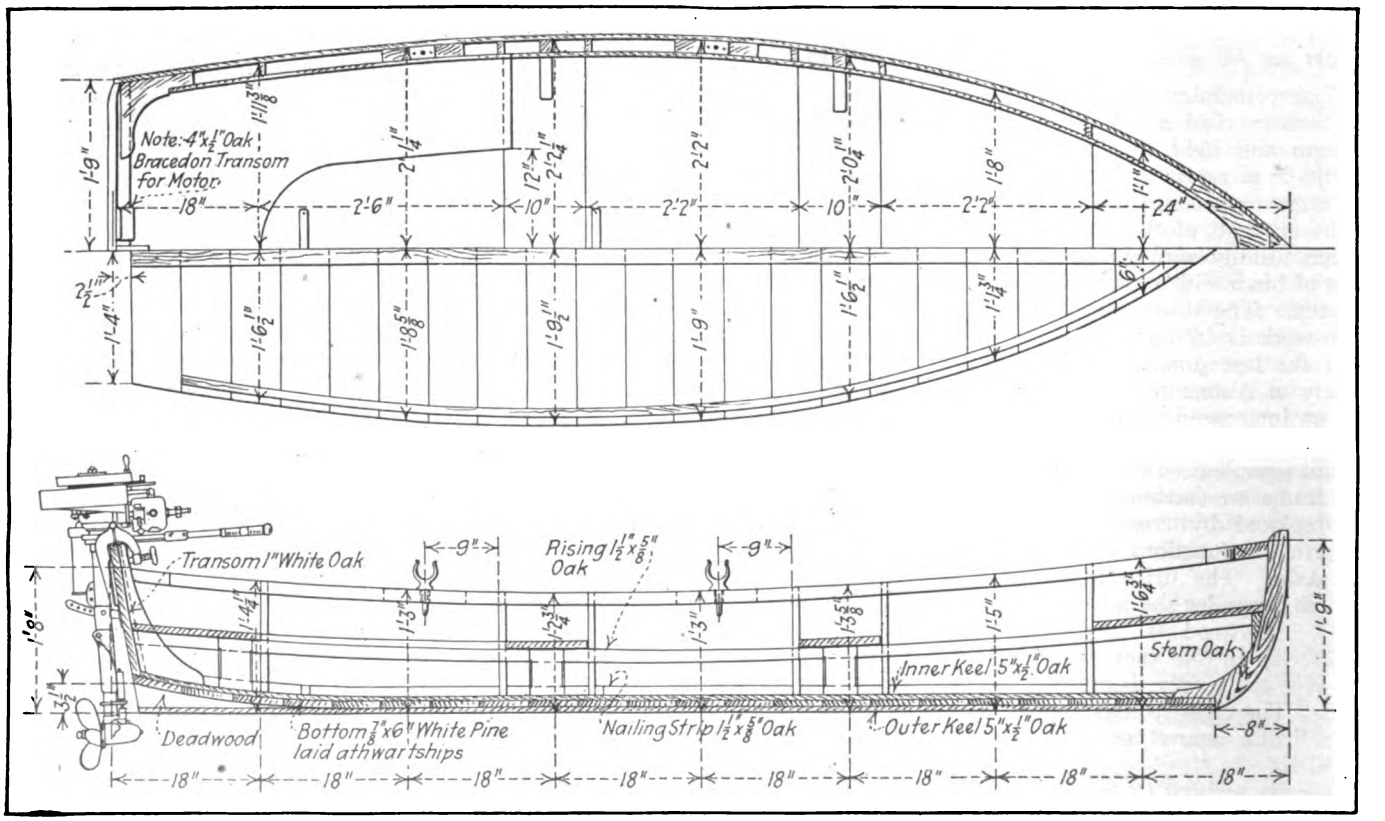
Cross section of boat showing lap strake construction

One of the requirements is that the after sections be fuller and the boat have more beam than would be the case if intended to be used only as a simple rowboat. The boat illustrated has been designed by an experienced naval architect, who has had considerable experience with small boats of this type. It is clearly outlined in the accompanying design drawings and its construction will be clear to anyone familiar with boat making. It should be of special interest to our readers interested in small boat construction. The boat has lap strake sides and the gunwale is left open so that any water collected in the boat will run out when the boat is turned on its side to clear the interior of water.

The main feature is the extra strength of the transom, which is materially strengthened to be better able to resist the vibration of the engine and carry the weight. Another feature is the design of the rear or stern seat, which is so shaped that the operator can sit comfortably in any of the positions he may desire to occupy while working at the power plant or controlling the boat. The sides flare out more than in the usual rowboat. This flare extends the entire length of the craft. This is to keep the boat dry in choppy seas by throwing the water to the sides as the boat progresses forward.

The broader beam at the rear will keep the boat from riding with its stem in the air as the ordinary rowboat does when it is fitted with a special outboard motor and enables the boat to sit better when the operator riding in the rear seat alone which brings most of the weight at the back end. The outer keel is made removable because a small boat of this kind is constantly hauled out on the beach and it may be necessary to replace the keel with a new one after the friction against sand and stones has worn out the old one. Rubbing strips are also provided along the sides and the removable keel piece and these strips may be used when necessary thereby protecting the bottom and side planks against undue depreciation.

A boat of this size is not only an excellent type of tender for larger water craft, but is also a very good and handy general utility boat for fishing and other work of that nature. It may be built of any of the woods recommended for boat construction in previous issues of this publication and the details of construction should be readily understood.

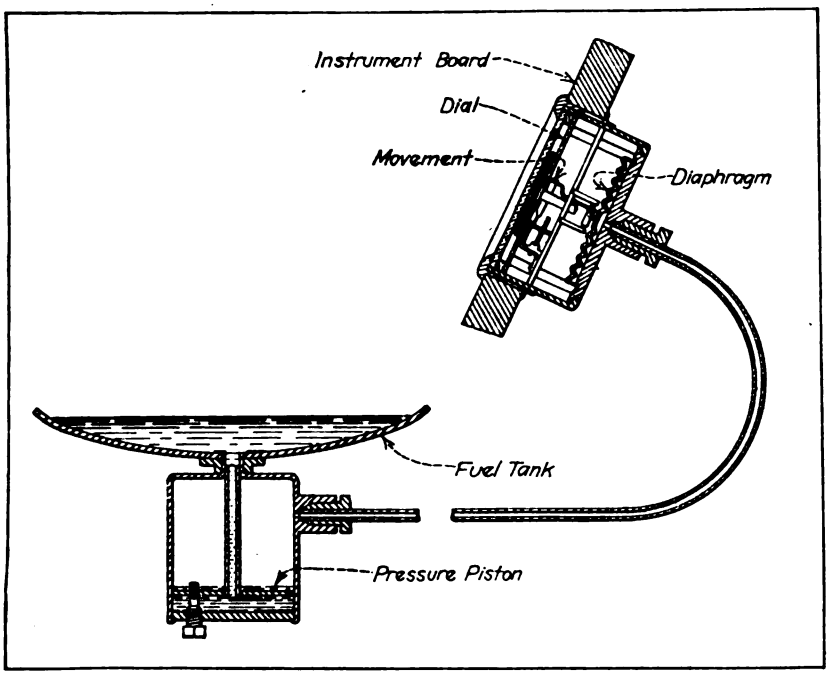


Design drawings of small boat especially well adapted for use with outboard motor

Digitized by Google

THE GASOGRAPH FUEL GAUGE

A TANK gage designed to be mounted on the instrument board and adapted to indicate the amount of fuel either in a seat tank or a rear tank has been placed on the market recently. The device contains no float, springs or wires, and it is not necessary to mutilate the tank in order to install it, as it screws into the drain opening. The principle of the device is as follows: The pressure due to the weight of the gasoline in the tank is transmitted through a small copper tube to the gauge on the instrument board, and this indicates the quantity of gasoline in the tank by an indicating hand moving over the dial. The principle on which the indicator works is the same as that of a pressure gauge or manometer, except that a diaphragm is used instead of a Bourdon tube. The instrument can be installed with tanks located anywhere on the car and using either vacuum or gravity feed. It is guaranteed for one year.



The Gasograph fuel gauge shows amount of liquid in rear tank on car dash

---

Aeroplane propellers have been made of Bakelite-Micarta. Bakelite is familiar to our readers as an insulating material in the construction of fine electrical apparatus and many other places, where celluloid or hard rubber formerly figured. These propellers were found to be much stronger than wood, sometimes twice as strong, and therefore can be made thinner and lighter. To secure them to the engine light keys may be used, bearing directly on the material itself, instead of the heavy flanges, hubs and bolts used on wooden propellers. They were exposed during their trials for two summer months to changes of weather and varied in pitch only 0.2°. The plane speed and rate of climbing were about the same as with wooden propellers, but the engine speed was 100 r.p.m. less. They lend themselves readily to reinforcement by metal strips imbedded in them. It is claimed that one will outwear several wooden propellers.

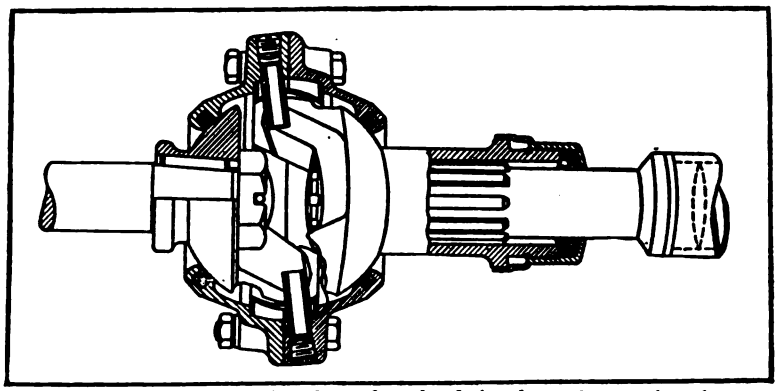
STRENGTH OF UNIVERSAL JOINTS

THE strength of the various parts entering into the construction of the average automobile is seldom appreciated by the layman. The great strength of universal joints was brought out by a series of torsion tests made in the Laboratory for Testing Materials of the Massachusetts Institute of Technology and shows how manufacturers of such components provide a large factor of safety so that breakage due to weakness of design is almost impossible.

The specimens were centered in a torsion machine. In the first test the universal was connected up at one end to a 1½-in. S. A. E. standard taper with S. A. E. standard key, and at the other end to a 1¾-in. S. A. E. standard ten-spline fitting. The joint failed under a twisting moment of 40,680-inch pounds, owing to the S. A. E. key shearing off. No damage was done to the ring, bushings or forks.

In the second test, made on the same joint fitted to new shafts, these being connected at one end by two 7/16-in. keys and at the other end by a 1¾-in. S. A. E. standard ten-spline fitting, the joint showed yielding under a twisting moment of 72,000-inch pounds, and failed under a twisting moment of 75,600-inch pounds. The shaft failed at the spline end by shearing at the neck. The keys started to shear slightly at the other end. No damage was done to the ring, bushing or forks. This would correspond to the transmission of more than 1,000 horsepower at a speed of 1,000 R.P.M., which is the normal speed of many auto and truck engines and which corresponds to the propeller shaft speed with the gearing in direct drive at car speeds ranging from 30 to 40 miles per hour, depending on the size of the rear wheels and final drive gear ratio. The most powerful average auto engine would not deliver over 50 or 60 horsepower at this speed so it will be apparent that the factor of safety is twenty.

In the third test the same ring was used as in test No. 2, but fitted with two new forks and shafts. The shafts were solid at both ends and fitted with two 7/16-inch keys in each. The joint showed yielding under a twisting moment of 93,000-inch pounds, and failed under a twisting moment of 100,000-inch pounds. The shaft was badly twisted at one end and the keys sheared. At the other end the shaft was slightly twisted and keys sheared. No damage was done to ring or bushings. The keyways in the forks were slightly twisted. A scale drawing of the joint tested, which was reproduced from "Automotive Industries," is shown herewith.



Tests of this universal joint show that the design has a large safety factor

Musicians find the drum an unsatisfactory instrument for lack of harmonic overtones. From India comes the description of a drum whose parchment head is loaded with an adherent composition containing finely divided iron. Such composition lies in a central circle. Around the edge a second ring shaped membrane is secured and the effect of the loading is to produce good harmonic overtones.

The forests of the world are being depleted as we all know and from Brazil comes the statement that reforestation of the eucalyptus tree is proposed. Five years suffices for the growth of the tree to a commercial size, and the expense is figured at 3 shillings sterling per cubic meter of wood.

Digitized by Google

MANUAL ARTS AND CRAFTS

PROJECTS FOR THE SCHOOL, HOME OR SHOP

SLIPPER BOX AND FOOT REST FOR THE BEGINNER

THIS foot rest is also used as a receptacle for father's or mother's slippers. It surely will be a very acceptable birthday or holiday gift. It may be made from any convenient material. Ordinary soap boxes or canned-goods boxes at the corner grocery store will suffice for the stock required. The dimensions may be varied to suit the builder. The principle factors governing the size is the material at hand, the comfort of the user and the length of the slippers. The principal aim in this design is simplicity of construction, all butt joints securing the components by lock-nailing with one and one-half-inch number sixteen finish nails or brads.

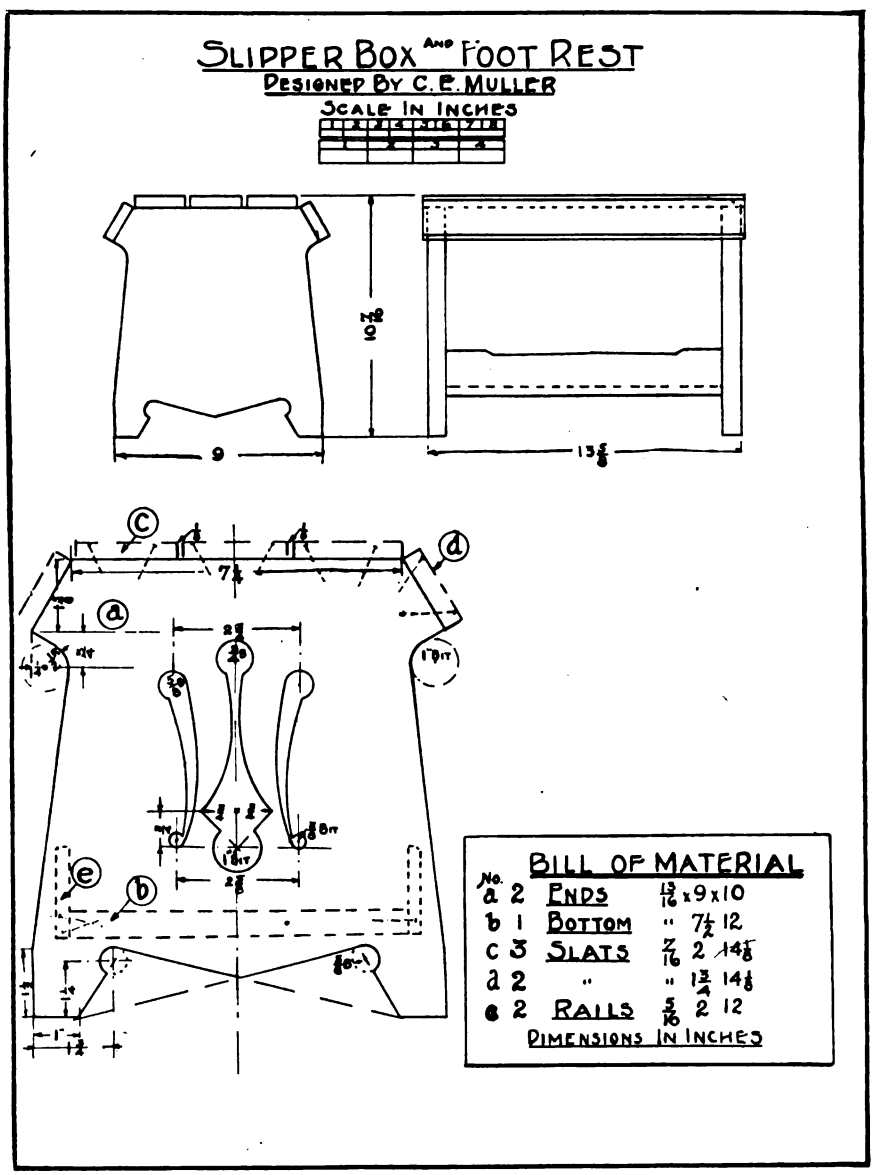
Chestnut, whitewood, cypress, redwood and pine are recommended for the beginner. The hardwoods, plain or quartered oak, ash, mahogany or black-walnut from old furniture will be found excellent material for the advanced workers and will take a much nicer finish.

The ends may be braded together when fashioning the contour. The design is such that only a few bits, a cross-cut saw, a plane and spoke-shave are necessary to shape it. The cross-cut saw will saw with the grain well enough if a rip saw is not available.

The first step is to establish the working edge, second, square off the length, saw to within a sixteenth of the line, if great care is taken to do this accurately, no further tool operation will be necessary either on the top or bottom of the end pieces "A." Third, lay out the centers of the 5/8-inch holes for the foot and the 1-inch holes for the sides, then the sloping angles for the slats to dimensions or at 60 degrees to the horizontal. You will observe that the lower recess section is made so that the contour can be sawed with any saw in the line indicated by the dashes. This, if carefully done, will only require touching up with a rasp or coarse sand paper. The particular part of this operation is to resolve to maintain the lines tangent to the circles. That particular feature instantly indicates the workmanship and skill of the worker, or as it is more commonly called, the carefulness of the student.

A very easily produced design to add to the pleasing appearance of this project, especially when the end pieces lack character of grain is shown in the large end detail. The design is merely a suggestion of a method that may be used. A series of different sized holes would also serve the same purpose. It is urgently recommended, however, that any change in this design be drawn out on paper full size or to correct scale, then submitted to others for criticism before adoption. This may be easily done by shaping the piece, then tracing around it on drawing, wrapping or even news paper. This will be found interesting and decidedly instructive to the amateur. I find it very convenient when designing or helping the students to develop the initiative to fold a sheet of paper on the symmetrical center line shown in the end detail layout, full size, one-half of the design, then cut out the pattern. It can then be altered to suit one's fancy. The law of design will be taken up in a future article.

In all projects where only butt joints are used it is essential that the nailing be given due consideration. In this case the bottom will require four 1½ No. 16 brads driven in No. 1 and 3 approximately 15 degrees, diagonally in a horizontal plane, left to right 2 and 4 right to left. This will lock the nails similarly to those shown at C. Here again it may be necessary to caution the amateur to be on his guard not to nail too closely to the edges or ends of the slats. The nails or brads act as wedges and may split those parts, especially in hard woods. To eliminate any



Digitized by Google

possibility of this occurring, close-fitting holes may be drilled for the brads with either a twist drill or brad awl if very cautiously done. The brads must be set very little, care must be taken not to let the nail set slip as it would scar the wood and perhaps split it. Finish the project by any of the methods described in previous articles.

MISSION CHAIR

THIS style chair is of the simplest possible construction and when carefully made is substantial, comfortable and appropriate for a dining room. It is designed particularly for the amateur that appreciates the mission style. It is usual to start work of this character by getting out all the stock to size and dressing all surfaces that show in the finished product.

It is advisable for the amateur to set up the front and back posts in the position they are to occupy relative to one another in the finished product and mark off with penciled symbols the approximate location of the mortises. (This will prevent a possible error by laying out mismated legs.) Then place them on the bench, side by side, accurately squaring, with a try-square across the bottom of the legs. Now gauge all the mortises precisely from the same relative corners so that any difference or error in dressing the posts will not be noticeable. Next the rails are laid out and cut to length allowing for two 1-inch mortises. It is recommended that one of each of the various members be accurately cut to length, then used as a template to mark off, by using a sharp knife, the similar parts.

Now lay out the shoulder lines and the cheeks of the tenons. The shoulder lines must be exactly squared on the four surfaces by a knife mark; this if carefully done, will not only insure a perfect joint but will assist in forming a clean cut shoulder. A back saw or mitre box will be found to work very satisfactory when cutting the tenons. It is customary to make the mortises first and fit the tenons in their respective positions, as they are made when produced by hand methods.

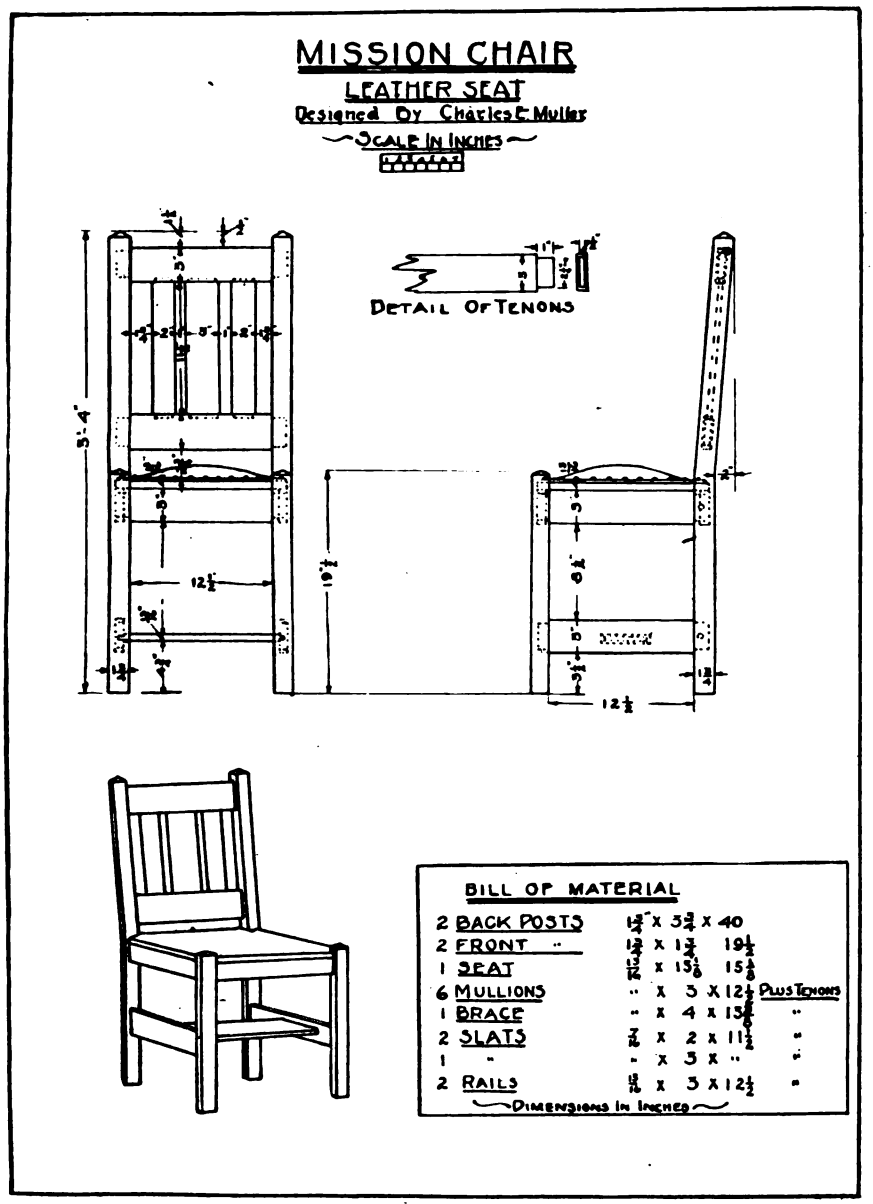
When gauging the mortises care should be taken not to scratch beyond the shoulders, so that no gauge marks will show after assembling the parts. Bore a series of holes with an augur bit that just fits the width of the mortise. A Stanley bit jig is surely worth the price, and will positively insure excellent results. It may be also used to employ the dowel method of construction, which is a good substitute for tenons. Many cabinet makers and practical carpenters use the dowel method, using two or three ⅜-in. dowels 2 in. long instead of the tenons. The centers of the dowels may be located by driving in small brads, cutting off the heads with nippers, then pressing the adjoining surfaces accurately against these brad joints. Using the intersection of the lines produced by the gauges and a squared penciled line is the common method. The slats are usually housed into the back rails their full thickness and width about ½ in deep.

The rule for size of tenons is to make them one-third of the thickness of the material, but when used with a thicker post they are increased in width, always allowing sufficient shoulder stock to avoid crushing the softer side grain. While the drawing shows the back and front of equal width, the back may be an inch or more narrower if desired, but this entails a much more difficult problem of angles in the side rails and mortises or tenons.

When "gluing up," the two front legs are clamped together until the hot glue sets. The back posts are glued together in a similar manner. Then the front is assembled to the back of the chair with all four legs setting squarely on a level floor or bench.

The chair is now finished by an application of the desired filler or stain as per the manufacturer's directions or a home-made stain may be made of any pigment dissolved in turpentine, kerosene or even gasoline. Water and alcohol stains are sometimes used. Cut nails soaked in vinegar for a day or two will produce a pleasing brown stain. It is suggested that the amateur try this on a specimen of his waste wood, as all stains vary in shade and affect different varieties of wood in various ways.

Wipe off all surplus filler or stain. Let it dry thoroughly before applying a thin coat of orange shellac. After shellac has hardened, sandpaper with No. 00 grade sheets. Over this apply several coats of good rubbing wax a little at a time, well rubbed in. Each coat is to be well polished with felt or flannel and dried. A lustre will appear after a second or third coat. This may be purchased especially prepared or



Digitized by Google

may be made of beeswax with only sufficient turpentine to produce a paste. Care must be taken not to add too much wax, as it fills the small pores and produces a chalk-like appearance.

The leather seat is then tacked on with No. 43 gilt-headed upholstery nails. These seats may be purchased in great variety in imitation or genuine leather. Coil springs may be added to these seats. There is a patented metal frame work with attached coiled springs that makes a very durable and extremely comfortable seat. Burlap, webbing or canvas strips may be used to fasten the springs to, and a cover cushion with horsehair or cotton padding produces a very comfortable seat. In the latter cases a seat frame is used instead of the one-piece seat. The front piece should extend the full width of the chair, thus avoiding the joints in front. Cane seats are neat and comfortable, and this method of construction will be explained in a coming issue.

PASTE FOR CLEANING HANDS

A GOOD mixture for cleaning grimy hands is made by pounding a cake of "Sapolio" or "Bon Ami" up quite fine and stirring it into a cupful of pure leaf lard, heated very hot. Stir until well mixed and when it is partly cool pour into a tin or tins of convenient size to get the fingers into.

PLUGGING HOLES IN CAST IRON

A GOOD mixture for plugging blowholes in cast iron is made of sulphur, cast-iron borings, sifted very fine, and graphite. Melt the sulphur in an iron ladle and stir in as much of the sifted borings as the sulphur will allow, not making it too thick to pour readily. Add a small quantity of graphite, say a tablespoonful to a quart of the mixture. Pour into the holes while hot and after it is cool smooth off with a file. When holes are filled with this mixture on surfaces to be machined, a finishing cut can be taken over it which will obliterate the holes.—*American Blacksmith.*

Glue for Model-Making

THERE are several grades of glue, the best of which is made from scraps of hides. This is translucent and of an amber color. As glue is indispensable to the amateur who makes models with paper, or of wood, it may be interesting to learn how to prepare it. Glue may be melted in a pot, set within a larger pot, water separating the two to prevent overheating. Melting glue in this way about the house this way is objectionable, owing to its disagreeable odor. A liquid glue, however, may be made by adding acetic acid (strong vinegar will do), or a very small quantity of nitric acid, to its solution. Its property of adhesion is in no way destroyed by this action. If vinegar is used, the glue may be dissolved in it for a fluid, instead of water.

A strong glue that is liquid, or gelatinous at will, may be made in small quantities, liquified and kept in an ordinary bottle. Take of a good quality commercial glue, broken in small pieces, sufficient to fill a wide-mouthed bottle. Pour over the glue dilute carbolic acid of the strength recommended and sold for household purposes. The bottle may be heated by setting it on the back of a stove; or it may be laid slanting in the top of a lamp chimney, the wick first being lit and turned down. The glue will soon commence to bubble, or boil, and it is advisable to turn the bottle occasionally.

The thickness and fluidity of the glue is maintained at any degree sought by adding glue or carbolated water, as indicated. The quickest drying glue is that which is rather stiff at normal temperatures; this may have to be heated a minute on a lamp before it will flow freely. If made thin, it far "out-sticks" most glue. The glue does not smell offensive, as it would if it was melted in the well-known glue-pot. It is spread with a mucilage brush, and, as used, a supply of glue and diluted acid are added from time to time to replenish the stock.

A special glue may be made by dissolving purified glue in nitric ether, when there will be obtained a free-flowing ether glue. A few pellets of india rubber added to the solution will give the mixture the power to resist moisture.

A NEW HIGH-SPEED ALLOY

A NEW high-speed steel containing no tungsten has appeared and advantages of both a practical and economical nature are claimed. It is cobalt-molybdenum steel, the cobalt apparently acting as a stabilizer and as correcting certain disadvantages said to exist in molybdenum-tungsten steels. The alloy is claimed to be very efficient. The hardening is said to be more definite as well as simpler, since the hardening temperature required is only in the neighborhood of 2,000 degrees Fahrenheit. The steel is also reported to machine well, as it is exceptionally soft and cuts easily for a nature hard stock. The specific gravity of como steel, as the new alloy is called, is reported to be equal to that of the old carbon tool steels, and so 10 per cent less than that of the tungsten high-speed steels. As a result it is estimated that a given weight of steel will produce 10 per cent more tools than the same weight of regular high-speed steel. The new alloy is a British invention.

CEMENT TO STOP LEAKS IN FUEL TANK

DURING the war numerous experiments were made with the object of securing a means for easily and quickly closing rents in gasoline tanks. Toward the end of 1916 the testing laboratory of a French technical school was requested to analyze and test a special putty, called Ob. The analysis gave the following results:

		Per cent
Soaps	fatty acids	17.05
	alkalies	3.60
Glycerine		4.00
Water		21.45
Various mineral materials		53.90
		100.00

	Per cent
Clay	95.20
Lime	3.00
Magnesia	0.40
Sulphuric acid	1.40
	100.00

In order to determine how this putty behaved under the influence of vibration, a 40-gal. tank was mounted on a light motor truck. Nine holes were punched in it, varying in diameter from 0.4 to 0.8 in. and located at different heights. These holes were closed up by means of plugs made from the paste or putty under test.

The truck was driven a distance of 34 miles over bad roads at an average speed of 13 m.p.h. A single crack formed in one of the plugs and this was stopped by applying more of the putty. After 23 hours of testing there was no oozing out of liquid at any of the plugs and the conclusion was reached that this putty or cement may render great services in stopping leaks in fuel tanks. —*La Technique Moderne.*

Leaky boiler tubes are sometimes plugged up by conical plugs driven into their ends. This keeps the boiler in action until a chance arises to put in a new tube. In England recently such a tube in a locomotive boiler blew out its plug which was 4½ inches long. It killed a man by the force of its expulsion, indicating the danger of this practice.

Advocates of the obturator for gas engines claim that the piston-ring friction may constitute seventy-five per cent of the total mechanical losses in the internal combustion engine.

Digitized by Google

Foreign Biplane Flying Model

THE model flyer illustrated in accompanying drawing is of German origin and the description is reprinted from one of the German aeronautical publications and according to the report in the description, it has given very good results. As all dimensions are given and the drawing is exceptionally clear, there should be no difficulty experienced by any model maker building this machine. The main stick may be made of spruce and can be braced as indicated by a flying wire. The landing gear may be made up of wire or very light strips of spruce.

The frame work of the wings and tail structures can be constructed in the way that has been described in a number of issues of this magazine by using reed or making the ribs of balsa wood. the spar of spruce and the trailing edge of fine wire. It will be noted that the main planes are of unusual design, the entering edge being straight, while the trailing edge is scalloped on account of the ribs being different lengths. It is important that the bottom wing be given a slightly greater angle of incidence than the top wing as this will give the machine greater stability and make it easier to fly on an even keel.

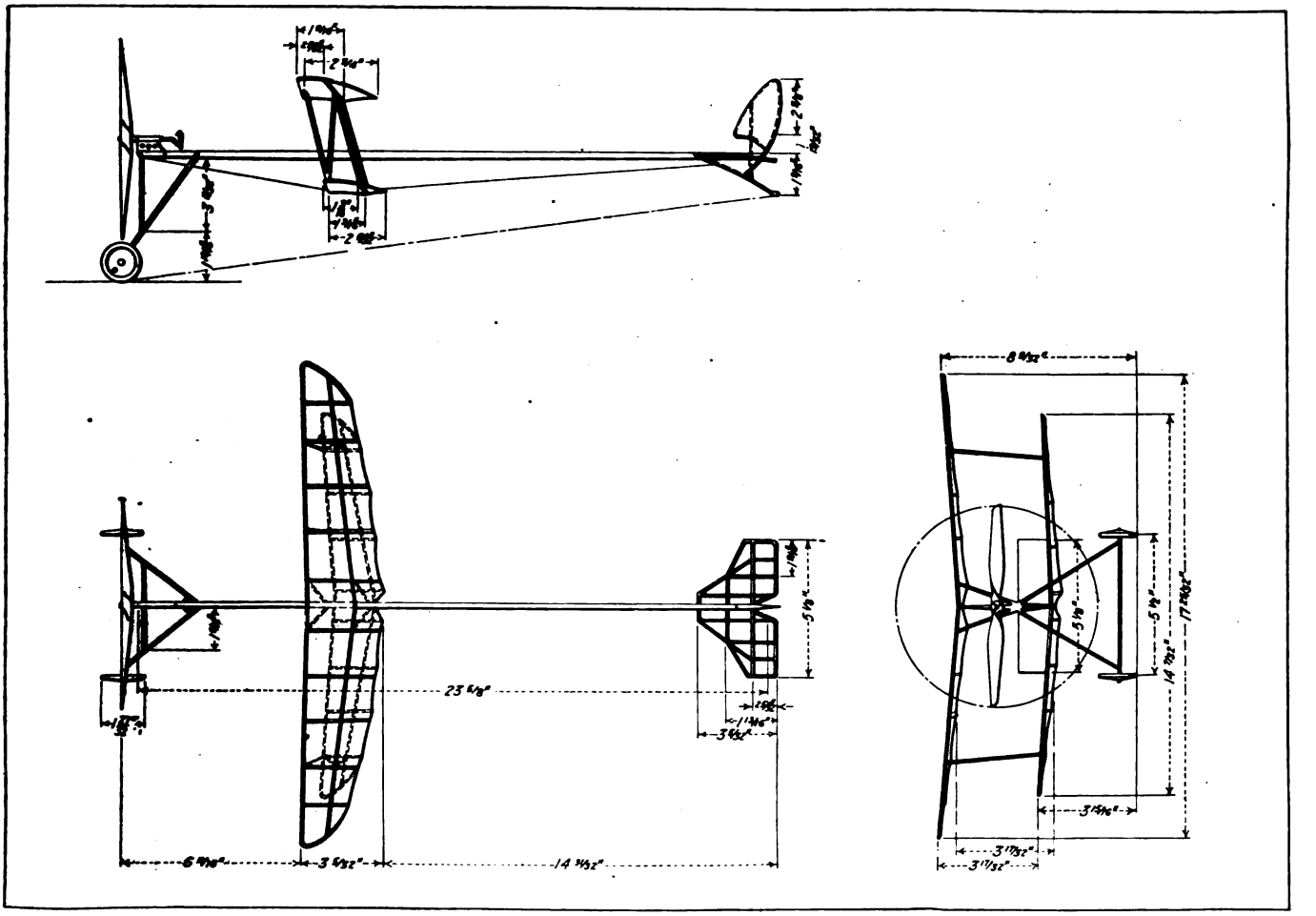
Care should be taken to balance this machine accurately, which can be easily done by moving the biplane wing structure back and forth on the motor stick until the machine flies on an even keel. If the machine is tail heavy, the biplane wing structure may be moved a little further back on the stick. If it is nose heavy, the wings may be moved forward. After the proper position has been determined, the center section struts attached to the wing structure should be fastened securely to the motor stick. In this model, the rubber motor is placed above the motor stick and the center section struts are arranged in V form, having the apex below the stick in order to provide sufficient space for the rubber motor to pass between them above the stick. The view shows that the wings are not only given a pronounced dihedral angle of five to seven degrees, but that they are also staggered in relation to each other. The rubber band motor is not shown in sketch, but is made of ⅛ in. by 1/32 in. flat rubber, the rear end being attached to the rudder post, the front end to the propeller hook in the usual way. From ten to fourteen strands can be experimented with to determine the best number to use.

Those of our readers who are interested in models suitable for long flights and of simple construction will find that illustrated a novel departure from the usual simple "flying stick" types that have been described in detail in past issues of EVERYDAY ENGINEERING MAGAZINE.

ALUMINUM SOLDERING

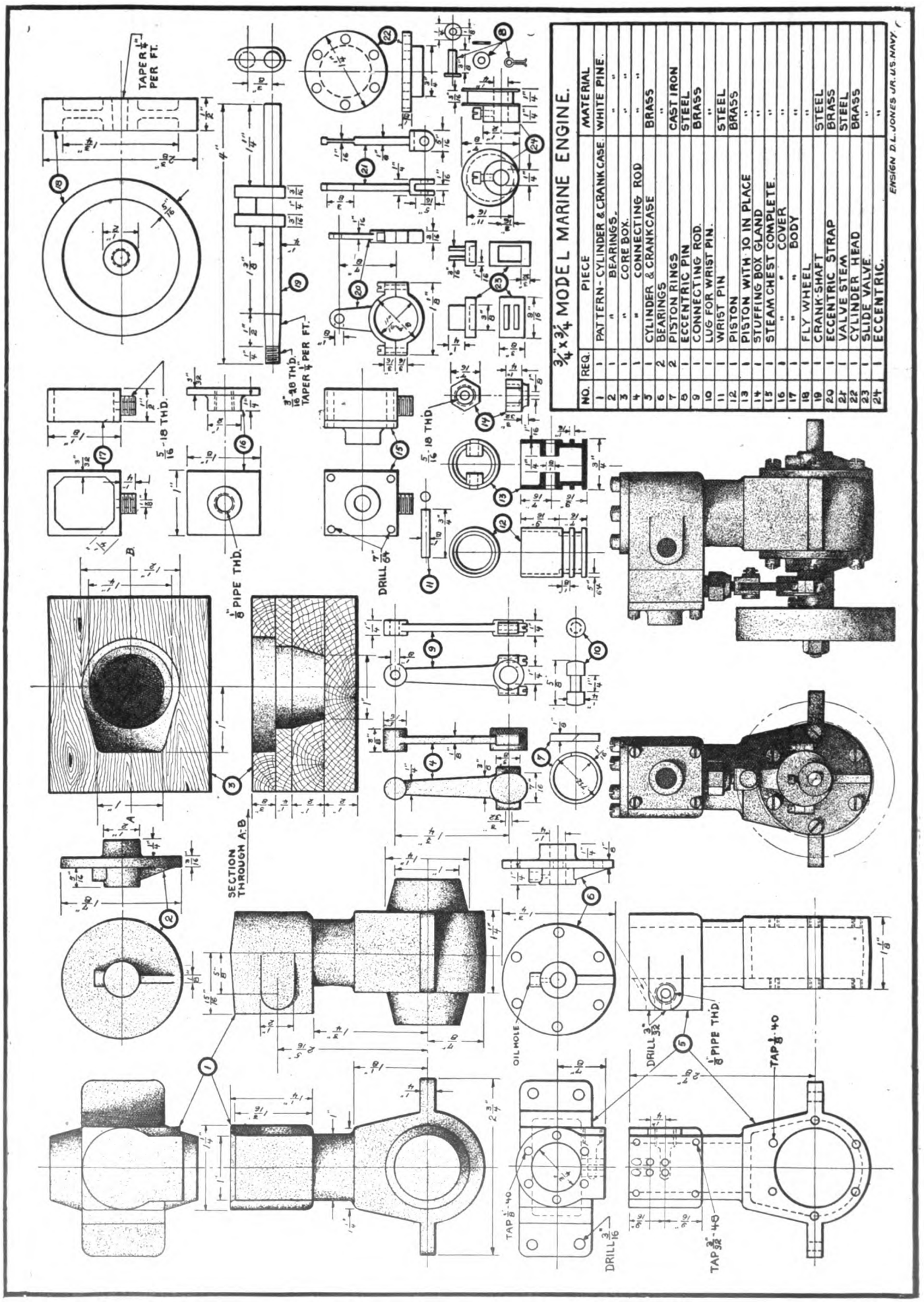
For those who wish to embody aluminum in their designs, but are unable to solder it, the following information will be useful. For an aluminum solder to be successful, it must contain a percentage of phosphor tin. A solder I can personally recommend is composed of tin, 75.5 parts; zinc, 25 parts; phosphor-tin, 1 part; and aluminum, 1.5 parts. Melt the aluminum first, add the zinc in small pieces, then the tin in small pieces, and, finally, the phosphor tin. Stearin is by far the best flux to use.

The temperature required to make a sweated joint with the above solder is about 700 deg. Fahr., and a blow-pipe is preferable to a soldering bit, as heat may be maintained. If, however, a bit is preferred, it should be aluminum or nickel instead of copper.—F. J. CAMM.



Details of foreign biplane flying model of novel construction

Digitized by Google



Digitized by Google

A Model Marine Steam Engine

By Ensign D. L. Jones, Jr., U. S. N.

Engineering Officer, U. S. Submarine S-16

THIS engine, while not strictly following marine-engine design, makes an excellent working model engine for driving a small model steamer or for direct connection to a small dynamo. It is of the single-action type with trunk piston and is made throughout of brass and steel. An exceedingly high speed can be obtained with an engine of this type, and the construction is much simpler than that of the double-acting type.

The first thing to make will be the pattern for the cylinder and crankcase. Figure 1 shows the general dimensions and construction of this pattern which should be made of white pine. The cylinder is not cored, as a much smoother casting can be obtained without core work and the extra time of making the pattern with cylinder core is offset by the slight extra work of boring the cylinder. Sharp corners should be avoided and should be filletted with beeswax and a slight draft is given the pattern from each side of the center line to facilitate drawing the pattern from the sand. The pattern is painted with black shellac and the core prints with orange shellac.

The core-box, Figure 3, is built up of four thicknesses of white pine cut to dimensions as shown on the drawing.

The pattern for the bearings is shown in Figure 2 and that for the connecting rod in Figure 4. The crank end of the connecting rod pattern is made slightly oval in shape so that when the casting is cut in two and squared off it will be round.

When the patterns are finished they are taken to a foundry and a casting obtained. Cast iron would make the best working engine, but brass is easier worked and makes a nicer looking model and will give nearly as good satisfaction.

The first thing to be done to the cylinder and crankcase casting is to bore and face the cylinder. The cylinder is chucked in the lathe and the cylinder top faced off to dimesions. The cylinder is accurately centered and a small drill is run through and then drilled or bored out to about 47/64 inch and afterwards reamed out to ¾ inch.

The casting is now set up in a shaper or miller and the crankcase sides and steam-chest shaped to dimensions. If no shaper or miller is at hand this work can be done as well in the lathe, though great care must be taken to have the two sides of the crankcase parallel with each other.

The castings for the bearings are now drilled and reamed to ¼". They are then placed on a mandrell and turned to dimensions. The six holes for the securing screws are layed off and drilled with a number 41 drill. The two bearings are now clamped to the crankcase side—first passing a piece of ¼" rod through them to secure alignment—and the crankcase drilled with a number 41 drill. The bearings are now removed and redrilled with a ⅛" drill and the holes in the crankcase are tapped with a ⅛"-40 tap.

The crankshaft is turned from a piece of ⅜"x¾" cold-rolled steel. Figure 19 shows the dimensions of the crankshaft. The tapered end for the flywheel is tapered ¼" per foot and the threaded part threaded 3/16"-28 thread.

The piston, Figure 12, is turned from round brass stock. Two grooves are cut for the piston rings. The lugs for the piston pin, Figure 10, are turned from ¼" round brass stock and are soldered to the inside of the piston. The centerpiece, which insures alignment of the two lugs, is drilled away when drilling for the wrist pin.

The piston should be a tight fit in the cylinder and should be lapped in. The piston rings are turned from cast iron.

The bearings, crankshaft and connecting rod are now assembled and the piston placed on top center. The clearance between top of cylinder and top of piston is measured and the cylinder head is turned up to just touch the top of the piston. The placing of a piece of 1/64" sheet fiber packing under the cylinder head will give the necessary piston clearance.

The steam inlet and exhaust ports are layed off and drilled. If the maker has some very small jeweler's files the steam ports can be squared off.

The steam-chest, Figure 17, is cut from ½" flat brass stock and the cover, Figure 16, is soldered and sweated to the chest.

The slide valve is filed and cut from a piece of ½" square brass stock. The exhaust side should be chipped out first with a small cape chisel and the rest of the valve finished by filing. The valve face and steam-chest face are finished by grinding and scraping, to make them steam tight.

The eccentric, Figure 20, is turned from brass stock and has ⅜" throw. The eccentric strap is cut from 3/16" sheet brass.

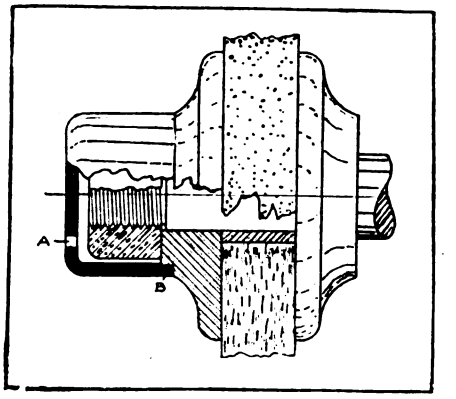
The valve stem is turned from cold-rolled steel. The location of the slotted part is found by placing the eccentric in the middle position, that is 90 degrees from top center, and the slide valve is placed in middle position. The valve stem is marked and the flat filed to fit the slot in the valve. To set the valve, the piston is placed on top center and the eccentric 90 degrees ahead or behind the crank, depending on which direction the maker desires the engine to run.

The flywheel is turned from solid stock or a pattern can be made and a casting obtained. The flywheel hub is drilled with a 7/32" drill and tapered with a number 4 taper-pin reamer to fit the crankshaft. The flywheel is drawn up tight on the crankshaft with a 3/16" nut.

The engine is now assembled and is ready to run. All parts should be polished and buffed and left unpainted.

SAFETY CAP FOR GRINDER SPINDLE NUT

THE cap illustrated is a valuable safeguard on grinding wheels where considerable work has to be done on the side of the wheel and where it is



impossible to provide a hood with a side piece covering the nut. "A" indicates one of a pair of holes for spanner wrench. The thread "B," cut in the washer, must be right hand or left hand, the same as on end of spindle.

On the European Continent efforts are being made to use cast iron wheels on trolleys instead of steel-tired wheels. The latter are not only expensive but under existing conditions are hard to get. Considerable success has followed their use. On the driving wheels over 10,000 miles without excessive wear have been attained and five times as much have been obtained on trailers, where there is no question of traction.

Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

THE SKIALYTIC OR SHADOWLESS LIGHT

THE name of this lamp, invented by Prof. K. Verain, means shadow-dissolving. It is specially designed for surgeons' use, though there are many other fields in which it might be used. An incandescent lamp is carried in the axis of a Fresnel lens, such as is used in lighthouses. The lamp and lens are surrounded by a reflector, composing the frustrum of a cone. From the Fresnel lens light rays go out horizontally in all directions. No light is permitted to go directly downwards; the rays are refracted into the horizontal plane by the lens, as shown, and are reflected downwards and obliquely from the frustrum shaped reflector as indicated by the dotted lines in the diagram, Fig. 1. An object on the table, which we may suppose to be directly under the reflector, will receive light from all sides of the reflector. If the person operating under it leans over the table, he will cast hardly any shadow, for he will only cut off a part of the light. The skialytic is designed especially for surgeons, and the other cut, Fig. 2, shows it mounted over an operating table, and shows the system of suspension and different positions it may be placed in to meet requirements of different cases.

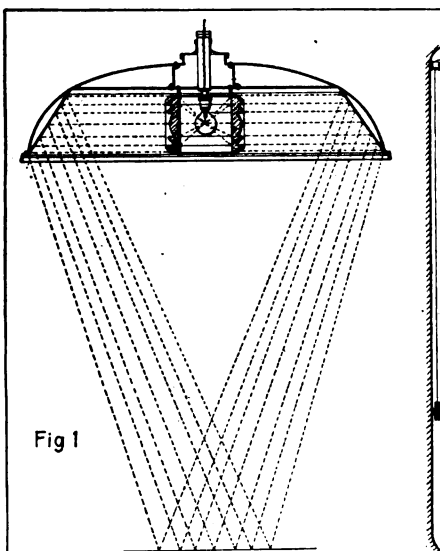


Fig 1

Diagram Showing Interior Construction of Lamp and Arrangement of Reflecting Surfaces

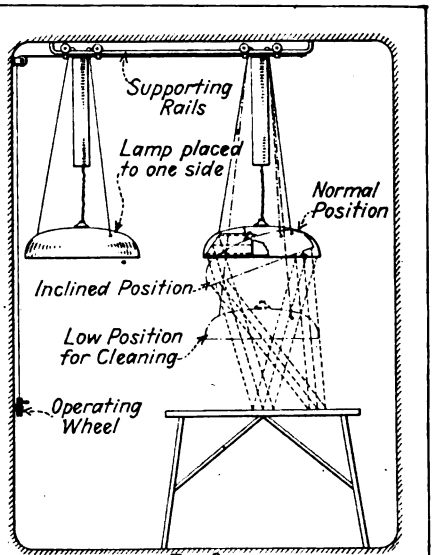


Fig 2

Showing Various Positions of Light

Preliminary work has been started on a pipe line from the British Channel at Havre to Paris. It is to be a double line, a five-inch pipe for gasoline and a ten-inch pipe for fuel oil. There will be five pumping stations on the line, and its capacity will be 4,500 tons of fuel oil and 1,000 tons of gasoline per day. There will be a 60,000-ton reserve tank at Paris.

A tunnel for vehicles and foot passengers across the Scheldt is contemplated, to be completed in 1924. There are to be three parallel tunnels, with two lifts or elevators for foot passengers, two for autos and light vehicles and two for heavy trucks. It is to be 2,100 meters, upward of 6,700 feet, long. A race should be started between this tunnel and the much-debated Hudson River tunnel, as they are both of fairly close length.

Seventy per cent. of the world's nitrogen should be used in agriculture. One of the effects of the war was to employ vast quantities of nitrogen in explosives, so as to diminish directly the fertility of the land. Efforts are being made to get the nitrogen out of explosives for commerical use.

To secure clear vision through a glass windshield in rain or snow, it has been suggested to have a disc of glass arranged to be rotated at a rate sufficient to throw off water or snow by centrifugal force. A circle of eleven inches diameter of clear vision was obtained on trial of an apparatus of this nature.

A metallic driving belt packed with paper yarn to give a soft adherent running surface has been tried out in Germany. It consists of short flat-wound wire spirals which are fastened together by pins passing through eyes at the ends so that it is virtually a chain. The sections are wound alternately right and left handed. Wood or pasteboard is packed in the interior so as to keep the paper packing in place. They were found to be suited best for slow drives on large pulleys and for long spans having two or three times the power of leather belts of the same width.

The spark discharge of a Leyden jar of less than .001 millifarad capacity has been used for motion photography. The spark gap consists of two aluminum hemispheres separated by one millimeter. The discharge gives 50,000 sparks per second, so that an enormous number of exposures per second can be obtained. A strong blast across the spark gap prevents arcing and the Leyden jar is only charged up to 5,000 volts potential. After discharge, it is at once recharged from a circuit of 12,000 to 18,000 volts.

A mixture of carborundum, 75 parts, and water glass, 25 parts, has been recommended for an application to the interior surface of gas retorts. Another mixture consists of carborundum, 85 parts, and fire clay, 15 parts. It should be put on cold and be given 24 hours to dry before firing up.

In utilizing gases from blast furnaces for heating the hot blast stove and any other purposes, the large amount of dust has been a great trouble. The dust fuses on the bricks and is deposited on metal flues or tubes, making them non-conductors and hence interfering with the efficiency of the plant. The dust sometimes makes large clinkers. Considerable success has been experienced in electrical separation of the dust. In one process, the Cottrell apparatus, the gas is passed through 6 in. vertical pipes. In the center of each pipe an electrode chain or wire with a 15-pound weight at the bottom is suspended. The pipes are grounded, but the wires are fully insulated and are negatively charged with 35,000 to 50,000 volts. The gases pass upward through the pipes, the dust collects on the chains and pipes and both are rapped periodically by an electric hammer. Fifteen to 20 kilowatts will clean 45,000 to 50,000 cubic feet of gas per minute. If the furnace is running on pig iron the potash contents may run as high as 9% and with ferro-manganese there may be 20% potash contents in the dust collected. A cubic foot of purified gas will contain less than 1/10th grain of dust.

Some examples of trees used as conduits for the water supply of London prior to the advent of cast iron pipes were discovered during some excavations in a street in London. Several fir tree trunks, about twenty feet in length, were unearthed, with the center bored through at a diameter of eight to ten inches. They are in a fine state of preservation, although it is estimated that they have lain underground for at least 200 years.

For years Peru has had great silver mines. It is an ancient industry of the country, but the value of the metal made the work only slightly profitable. Recent advances in its price have witnessed the reopening of these mines, with the employment of many men at good wages, and the development of a profitable and extensive business.

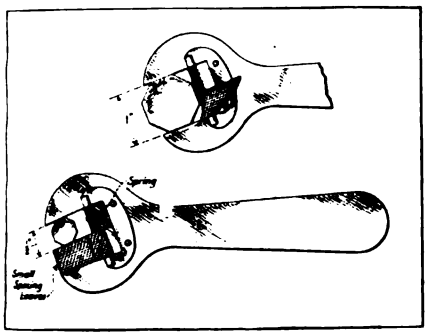
According to *Coal Age*, the principal gases found in coal mines are the following: Methane or marsh gas, sometimes called light carbureted hydrogen (CH_4); carbon monoxide (CO); which is the "whitedamp" of miners, carbon dioxide (CO_2), which, mixed with nitrogen, forms the chief ingredients of the blackdamp of miners. In addition to these principal gases, occur, in limited quantities, hydrogen sulphide or sulphurated hydrogen (H_2S), the stinkdamp of miners and the heavy hydrocarbon gases that are associated to a limited extent with methane; namely, ethene or ethylene (C_2H_4) belonging to the olefine group; and ethane (C_2H_6), belonging to the paraffin group. Of the gases named, methane, olefiant gas, carbon monoxide and hydrogen sulphide form explosive mixtures with air in certain proportions. Carbon dioxide and the nitrogen of the air are the only ones that are not explosive.

In Canada pneumatic tamping tools have been used on the railroads for tamping down the road bed. In has been found that they reduce the cost of this work 38 per cent, and that four men can cover from 400 to 700 feet of track in a day.

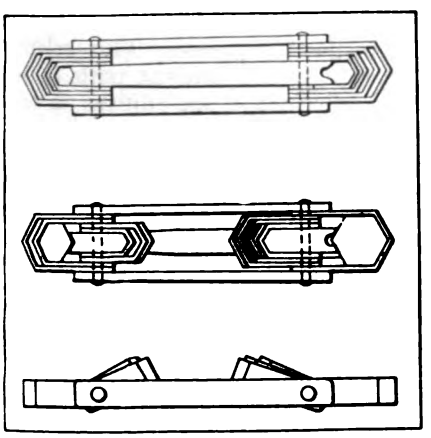
Digitized by Google

ADJUSTABLE WRENCHES

THE illustrations show two adjustable spanners or wrenches, whose construction is particularly adapted for portable or even pocket tools. In the open ended spanner the size of the opening is adjusted by turning in or out of the opening one or more of the little strips of steel as shown in



the cut. In it some of the strips are shown turned out of the opening, adapting it for a medium sized nut. The range of sizes covered by this construction may be quite large and the writer's experience with it has been very satisfactory.



The other cut shows a closed spanner of similar type. Here the adjusting strips take the form of loops. Swung outwards they give an almost complete hexagonal opening, and this opening is larger or smaller according to the number of loops swung out. The cuts show several openings, and illustrate the extent of variation of which it is capable.

In firing guns the copper rings of the shells foul the bore and to prevent this an alloy of 60% tin and 40% lead, identical with solder, has been tried in the chamber. Under the influence of the discharge the tin is supposed to unite with the copper, forming a fusible alloy and the lead is distributed along the bore, and is taken as acting as a lubricant for succeeding rounds. In France during the war, tin-foil wrapping from the fuses used to be put into the powder chamber to prevent fouling on the same lines.

It is claimed, that by utilizing the waste heat in steel works for the operation of the boilers driving the power plant, a saving of 43.75% was effected, which figured out at 987½ pounds of steam per ton of ingots produced. It is also claimed that by more perfect methods 1200 pounds of steam could be produced.

The land and sea are both slightly radioactive, the land being the more active. Owing to the greater area of the water over that of the earth, the total radiations from the water and land surfaces are about equal in amount.

The investigation of vertical air currents is exciting interest in aviation circles abroad. The use of pilot balloons for this purpose, whose ascents are to be observed and timed by trigonometrical observations and watch is an old story, but now it is proposed to use vertical axis anemometers of the registering type. It is probable that one will be installed on the Eiffel Tower in Paris.

In the British Navy there are now some 600 sets of reduction gears to bring the speed of turbine-driven propellers down to the proper limit. Nearly eight million horsepower are thus taken care of. A single ship is cited, on which there are four sets, transmitting 36,000 horse-power each. A standard ratio is one to eight or nine. In some instances the gears lasted over six years, and only two or three had to be refitted, no real break-downs were recorded and the gears after dressing were put into service again. Only two fractured teeth were reported. The use of gears, giving proper turbine speed and propeller rotation, increased the efficiency of the plant 15 to 20 per cent.

From the district of Minas Geraes in Brazil deposits of iron ore calculated at two thousand million tons are reported.

The water power of England has been estimated as only one and a half million horse-power, or about one per cent of the water power of the earth. She is assigned two and a half per cent of the coal of our planet. Blast furnace practice there has been unfavorably criticised. It is claimed, that by efficient methods 10,000 horse-power could be produced from three blast furnaces where now but little is utilized, and that half as much could be saved on the fuel side by better methods. It is only recently that the saving of potassium products from the flue dust has been taken up seriously. The gases evolved from the stacks are practically producer gas and could be used to drive internal combustion engines. Electric ore reduction furnaces, if actuated by water power, indicate an enormous saving of fuel, as only enough coal has to be used to reduce the oxide, the heating being done by the electric current. To effect this economy in coal the electricity must be produced by water power.

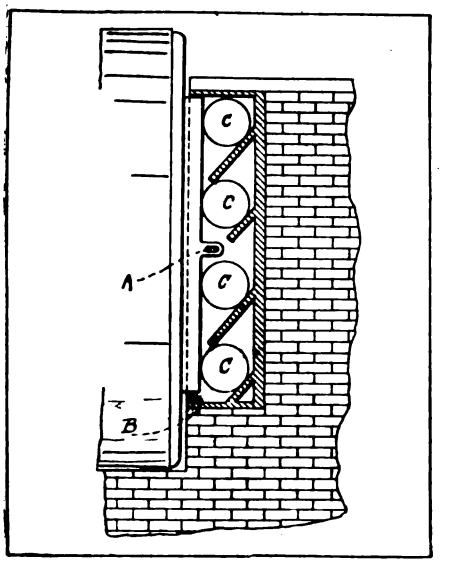
In Neuilly, near Paris, a physician was recently killed by a shock from an X-ray apparatus. If the apparatus is operated by an alternating current, a fuse on the supply line will not protect the secondary as regards its shock capacity. Practitioners using modern high power apparatus, such as Coolidge tube sets, should see to the insulation.

A small amount of water in a tungsten filament lamp soon destroys the filament. The tungsten is oxidized at the expense of the water and the tungsten oxide volatilizes and is deposited on the inner wall of the bulb. The free hydrogen reduces it to metal, forming water again, which reacts again in the same way, and the cyclic action goes on until the filament succumbs.

The statistics of the atmosphere as regards barometric pressure and temperature changes have been investigated with results of considerable certainty. At an altitude of four and a half miles the annual variation of temperature is at a maximum; at altitudes from five and a half to seven miles and a quarter the annual variation falls off rapidly. The diurnal range of temperature existing at the surface of the earth practically ceases at less than a mile altitude. Local variations in barometric pressure nearly disappear at twelve miles altitude.

EXPANSION JOINT IN BOILER SETTINGS

THE cut shows a system of constructing a gas tight joint in furnace work, which joint is undisturbed by expansion and contraction due to the heat of the furnace. It is supposed to be adapted for use in a boiler



setting, but it is quite suggestive of other uses. The problem is to maintain a tight joint between the boiler on the side of the cut and the plate A. The latter is supported by a small roller, B, and on the other side of the plate, the side remote from the boiler, a number of rollers, C, C, resting on inclined projecting plates constantly press against the plate. The rollers are perfectly free in their mounting, so that whether the boiler shell recedes or advances, they adjust themselves to its changes and exert a constant pressure against the boiler. This goes to ensure a tight joint under all the changes to which boilers and similar structures exposed to heat are liable.

It is calculated that the inefficiency of the steam boilers of Great Britain accounts for 15 to 20 million tons of coal per annum. It is held by expert engineers, that the operations of boilers should be conducted in a scientific way, the water and coal used should be accurately known and the flue gases should be analyzed. There are various simple ways of getting at the composition of flue gases without much special skill as well as quickly. The subject of mechanical stokers has recently been debated there, and no very definite conclusion was reached as to whether they economized coal or not. Both views were upheld by different authorities.

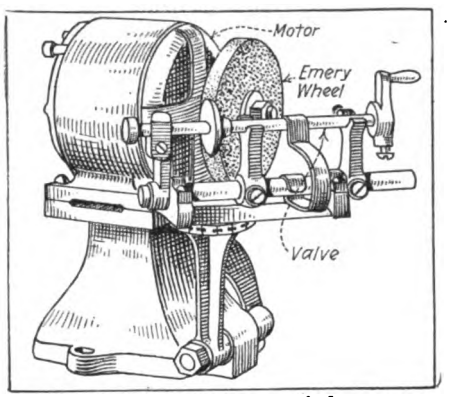
Copper is poor metal to cast, as it fails to run well and does not fill the moulds. It has been found that by melting it in an atmosphere of hydrogen gas and allowing it to cool therein, it retains much of the gas and becomes quite tractable and gives good castings. Hydrogenized copper has higher electric resistance than the pure metal. It is thought that this may be due to the segregation of sulphides and arsenides of copper, which then form films enveloping granules of the metal.

Some years ago the metal molybdenum was of little use except as the characteristic element in a reagent used to determine phosphoric acid. Fertilizer laboratories were the principal consumers. Now it has come into its own as an alloy for steel and as a material in the construction of incandescent lamps and Coolidge tubes. It is produced in Canada, and the output there is rapidly increasing.

Digitized by Google

ELECTRIC VALVE GRINDER

THE valve heads are very easily pitted or scored. It is not possible to refit them by the simple grinding hand process without the expenditure of considerable time. The electric grinder illustrated herewith makes it possible to face a set of eight average sized automobile motor valves in from ten to fifteen minutes that would ordinarily require three hours to complete "rough grinding" in. The work is very accurately done and the machine is adpatable to a number of different valve sizes.



Electric valve face grinder

The grinding wheel is equipped with a high-speed half-horsepower motor of standard design which is attached to a rigid base. The motor may be operated from any lamp socket by a simple snap of the switch. Special arrangements are provided so it is possible to grind valves accurately that have no centers. The arrangement is such that the valve is moved back and forth across the wheel, being rotated by a small hand crank in order to insure a smooth finish on all parts of the valve head. While the machine is designed initially for facing valves, it can be provided with an extra hub and wheel and used to advantage in grinding small tools such as drills and chisels. The machine is adaptable for various sized valves and is indexed so that the table may be set to grind different angles of valve seatings.

ESTIMATING HOW MUCH PAINT TO USE

IF one intends to paint a building it may be difficult to know just the number of gallons required. While the quantity of paint varies with the surface to be covered, the following method of measurement is an accurate guide: A good grade of prepared paint will cover at least 350 square feet to the gallon, two coats. First, measure the distance around the house and multiply by the average height; then divide by 350 and the result will be approximately the number of gallons to buy. Of this quantity one-fifth will represent the paint required for trimmings, cornices, etc.

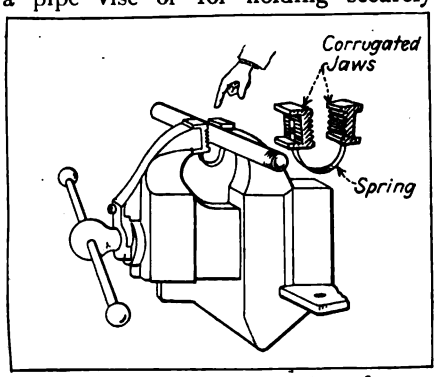
RECORD BREAKING RACING CAR

(*Continued from page* 217)

drum mounted at its rear end, a constricting band-brake working on each drum. No change speed gearing appears to be used in this unusual racing vehicle nor is it needed, because the car is much too powerful for street use and it is not difficult to "get away" by slipping the clutches when racing. Four carburetors are used, each one apparently serving a unit of four cylinders, two carburetors being employed on each engine. The engines are overhead valve types, very similar in construction to airplane motors, the cam shaft being carried above the valves and thoroughly enclosed. The method of final drive appears to be by two sets of bevel gears to a through axle to which the driving wheels are attached, this construction making it possible for either engine to drive the car if the maximum power is not required, and for this reason independent clutch control seems to be provided so one or both engines may be used at will. Of course, when breaking world's records, all the power that can be produced by both engines is needed, but for running around one engine would suffice. As is usual in racing-car practice, no differential is used.

SPRING VISE JAWS

A FITTING that finds ready use in repair shops and service stations is the vise jaws shown in accompanying illustration with which it is possible to use the ordinary bench vise as a pipe vise or for holding securely



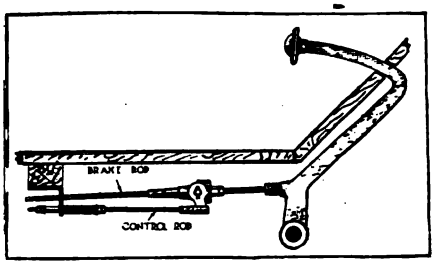
Vise jaws to hold round work

round bars of iron or steel. The device consists of two jaws shaped to fit the main jaws of a vise and held together by a flat spring. These vise jaws occupy but little space and it is stated they will fit any vise, large or small, as the jaws may be spread apart or closed to take the different sizes of pipe or iron rods.

It is noted that in X-ray work a "hard" tube, which means a tube of very high vacuum, has high penetrating power but low actinism, so that it does not give satisfactory photographs. A tube with lower vacuum, a "soft" tube, gives well-defined and clear photographs but is deficient in penetration.

AUTOMATIC BRAKE ADJUSTER

AN automatic brake adjuster described in *Automotive Industries* and illustrated herewith, is undoubtedly an entirely new device in the automotive parts and accessories field. To apply the adjuster the brake rod is cut, or made in two parts, each part being threaded to fit the device. The control rod is set in about the position indicated. Upon application of the brakes, the adjuster mechanism moves forward, with the exception of the lower portion, which is held by the guide clip through



Automobile brake adjuster

which the rods pass. This relative movement of the different parts causes the small crank of the adjuster to turn through a certain angle, which becomes greater as the brakes wear, acting upon a ratchet wheel. When the pedal is released, the adjusting sleeve is turned automatically by the ratchet and takes up the slack. It is claimed for this device that it gives an equal brake grip on both sides of the car without a brake equalizer, that greater braking surface is brought into play, and that the resulting uniformity of action enables the driver to much better estimate the distance required for stopping.

STELLITE ALLOYS

AN alloy consisting of practically pure nickel and chromium was produced, as long ago as 1899, by Mr. Elwood Haynes, of Kokomo, Ind., by heating their mixed oxides with aluminium. This alloy proved to be practically insoluble in nitric acid, even when boiling. It is malleable when cold, and under proper annealing can be worked into sheets and wire. An alloy of cobalt and chromium was produced, which showed the same untarnishable properties, possessed much greater hardness, and was malleable at a bright orange heat. In 1909 a cutting blade was made of the alloy, which took an edge comparable to that of tempered steel. Later, tungsten or molybdenum was added, and the alloy thus produced was sufficiently hard to turn iron and steel on the lathe. Later experiments demonstrated that such alloys, when properly formed, would scratch any steel, and would stand up under much higher speeds on the lathe than the best high-speed steel tools.

Digitized by Google



RADIO TELEPHONE AND TELEGRAPH APPARATUS



A Heterodyne Wavemeter for 170 to 21,000 Meters

Design Data For a Laboratory Oscillator Which Can Be Used As a Wavemeter, For Heterodyne Receptions, And Many Other Purposes.

By M. B. Sleeper

THE problem of building any type of wavemeter for a long range of wavelength, and particularly a heterodyne wavemeter, is not an easy one if accuracy and permanence of adjustment are required. The instrument illustrated here and built in meter panel, vacuum tube control panel, inductance panel, and variable condenser panel. Although the instruments might have been mounted on a 10- by 10-in. panel, the constructional operations are greatly facilitated by dividing the apparatus into four sections.

Milliammeter Panel

This section was described in the May, 1920, issue of Everyday. It consists simply of a Weston model 301 meter reading from 0 to 1 milliampere, which can be read accurately to 0.01 milliampere. The meter is of the flush mounting type fitting into a hole 2⅝ ins. in diameter in the panel. Fig. 3 illustrates the rear of the panel and meter.

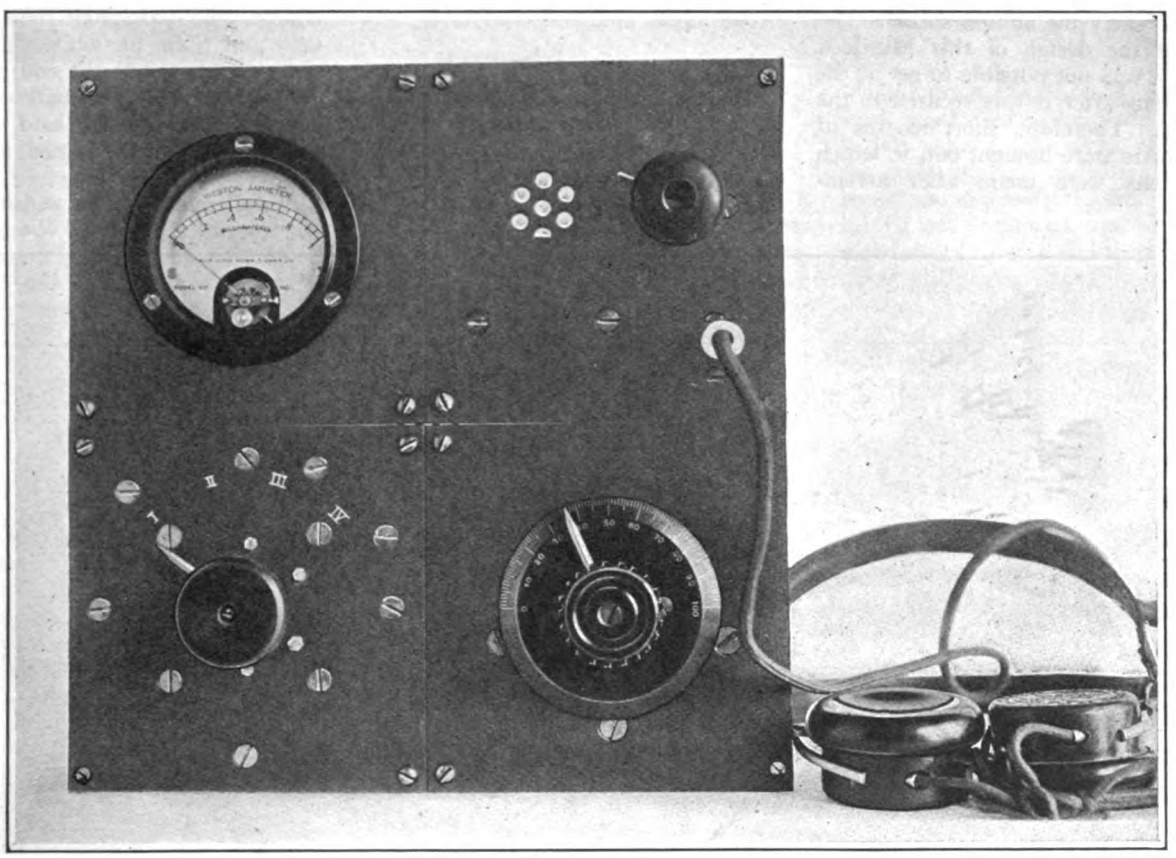


Fig. 1. Illustrating the completed heterodyne wavemeter, ready for use

Everyday's laboratory, has, however, proved to be admirably adapted for the work of calibrating wavemeters, condensers, and inductances, and for other purposes which require a calibrated generator of continuous oscillations.

General Description

This apparatus was made up on four bakelite panels 5 ins. square and ¼ in. thick. Thinner material would not have stood the strain of the heavy parts. The four units comprise the milliammeter panel, vacuum tube control panel, inductance panel, and variable condenser panel. Although the instruments might have been mounted on a 10- by 10-in. panel, the constructional operations are greatly facilitated by dividing the apparatus into four sections.

Variations of the wavelength is accomplished by a switch on the inductance panel, and the close adjustment by the condenser. The strength of the oscillations is controlled by the filament brilliancy, which can be regulated by the rheostat.

Figs. 1 and 2 show the general arrangement of the assembled apparatus. These photographs were taken before the individual instruments were connected, so that the vacuum tube and inductance panels could be shown separately.

The purpose of the meter is to show the plate current in the oscillator. Its use was explained in the May, 1920, issue.

Vacuum Tube Control Panel

A detailed view of the control panel is given in Fig. 3. It will be seen that,

Digitized by Google

at the rear, are a Paragon filament rheostat, Murdock socket, and a jack for the telephones. The B battery is carried on a support made up of brass strips, 3/8 by 1/16 in.

The same brackets that hold the battery also carry the audion socket. Because of the design of this Murdock socket, it was not possible to get at the connections after it was secured to the brackets. Therefore, short lengths of copper wire were brought out, to which connections were made after assembling.

To permit the operation of the set without the telephones, a closed circuit jack was used. That is, when the plug is removed, the spring contact closes the plate circuit. Otherwise, removing the telephones would leave the plate circuit open and inoperative.

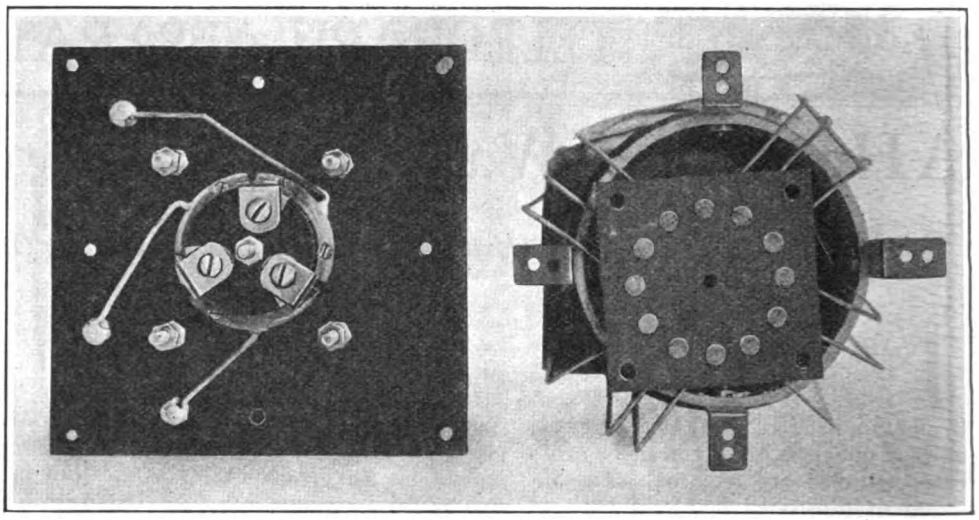


Fig. 5. The rear of the inductance panel is shown at the left, and the sub-panel, to which all connections from the coils are made, at the right. Double contact arms, carried on the bakelite disc, make connections to the front with the three brass sectors, and to the rear with the switch points. The screws which hold the sub-panel can be seen protruding from the main panel. In the view at the right, the sub-panel is held in place only by the heavy copper wires which run to the taps on the coils

The Inductance Panel

This is the most difficult part, from the point of view of the constructor, about the apparatus, and one which calls for patience as well as skill. To understand just what is required, the wiring diagram, Fig. 6, should be studied carefully.

Essentially, this is the familiar center tap type of oscillator. In positions I, II, and III of the switch, the small coil is used. Turning the switch changes the taps from the coil to the grid and filament, while the plate remains connected to the end of the coil. At position IV, the small coil is disconnected altogether, and the grid, plate, and filament joined to the long coil.

Wavelength ranges, with the G. A.

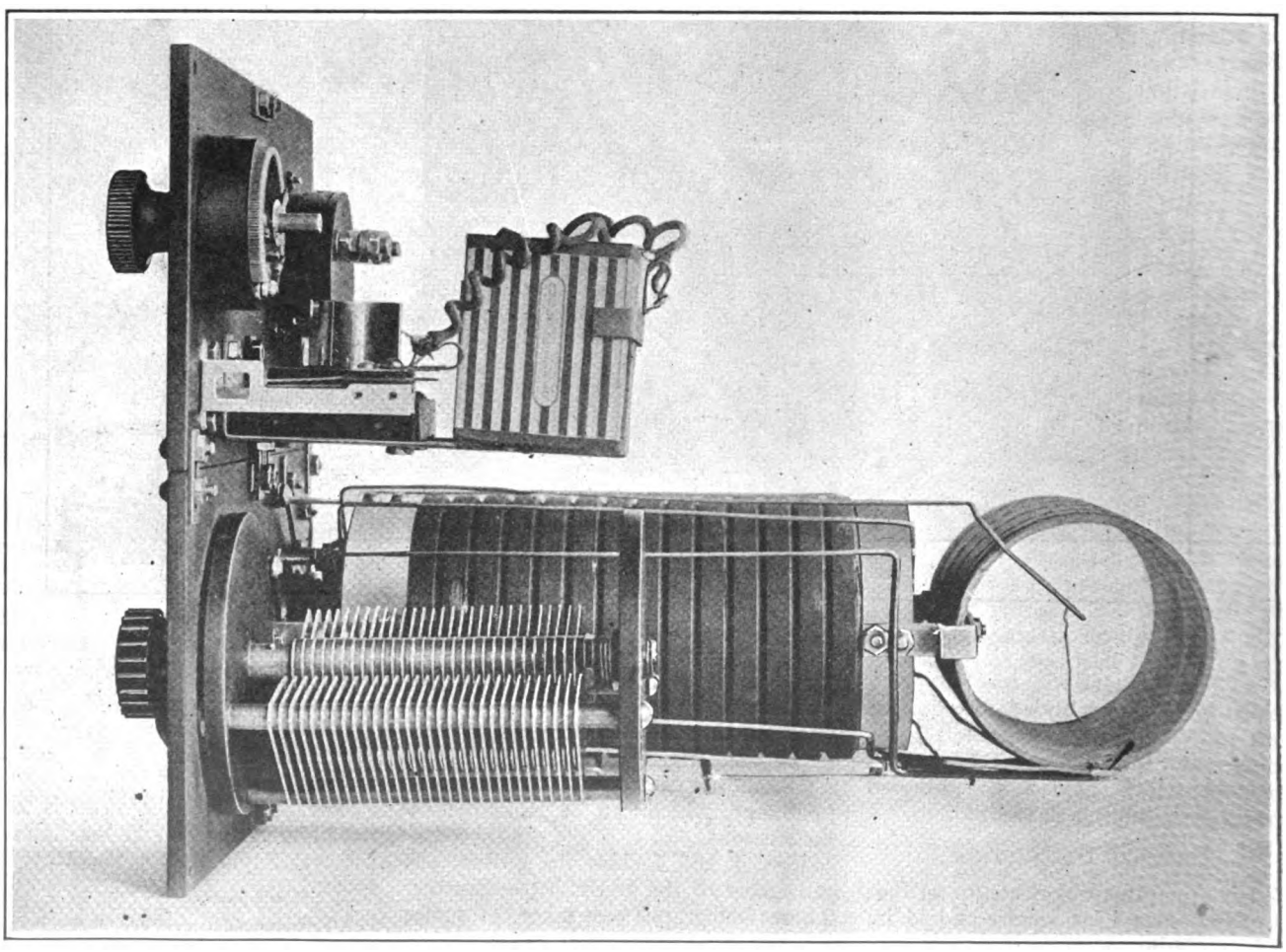


Fig. 2. A side view of the apparatus before the connecting wires between the panels were put on

Digitized by Google

standardized condenser shown, were as follows:

Section	Wavelength Range
I	170 to 790 meters
II	460 to 2,160 meters
III	1,115 to 5,230 meters
IV	4,610 to 21,650 meters

About 5 deg. at each end of the condenser scale were not used when these measurements were taken.

The small coil is 3½ ins. in diameter, wound with 2 banks of No. 24 S. S. C. solid wire, giving 45 bottom turns per inch. The taps were taken off as shown in the table below:

Section	Filament	Grid
I	15 turns	30 turns
II	51 turns	101 turns
III	179 turns	360 turns

The lengths of the grid sections, measured from the start of the winding, are:

Section	Length
I	0.34 in.
II	1.13 ins.
III	4.00 ins.

These sections give inductance values of:

Section	L
I	160,000 cms.
II	1,200,000 cms.
III	7,000,000 cms.

A tube 3½ ins. in diameter and 8 ins. long was required for the larger coil. This was wound with 13 sections in the manner described in the May issue. There were 20 bottom turns to each section, built up seven layers deep. Thus there were 119 turns per section, or a total of 1,547 turns in the entire coil. This winding gave an inductance of 114,000,000 cms.

Fig. 4 shows the complete coils. Although the smaller coil was fastened by screws to a bracket secured, in turn, to the larger coil, no screws can be seen on the former coil. As a matter of fact, flat head screws were put into the tube, with nuts and washers on the inside, before the coil was wound. The screw heads were sunk just enough so that the wire could be put over them.

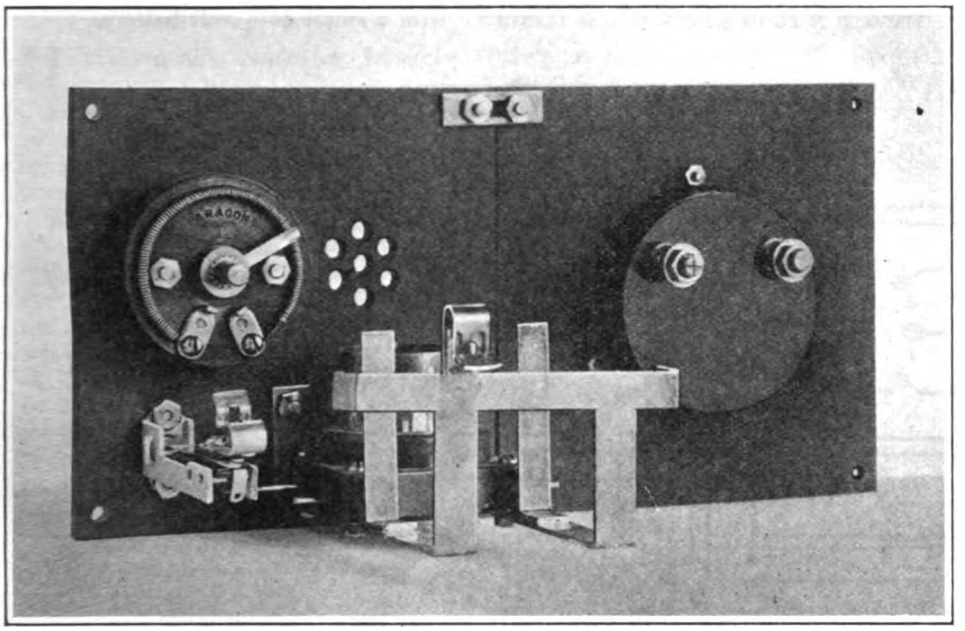


Fig. 3. A detailed view of the audion control and milliammeter panels. The wires from the socket, to which connections were made, can be seen, as well as the method of mounting the socket and B battery. Fahnestock binding posts are secured to the supporting frame and the telephone jack, to which the B battery leads are run. The Paragon rheostat is admirably adapted to apparatus of this sort because of its small size and the ease with which it can be mounted. This illustration also shows the system employed to fasten the panels together

Four brass angles of ⅜- by 1/16-in. stock were used to hold the larger coil to the panel. The work of mounting the coils required considerable care to secure the necessary rigidity. G-A-Lite tubing was employed, and proved quite satisfactory, the bakelite would have given still more strength.

Fig. 5 illustrates the inductance switch. Essentially, there are 3 circular brass segments on the main panel, and 12 switch points on the sub-panel. A bakelite plate, carrying three sets of double contact arms is located between the two panels and operated by the handle at the front. The purpose of the switch has been explained, and can be understood from the diagram. The

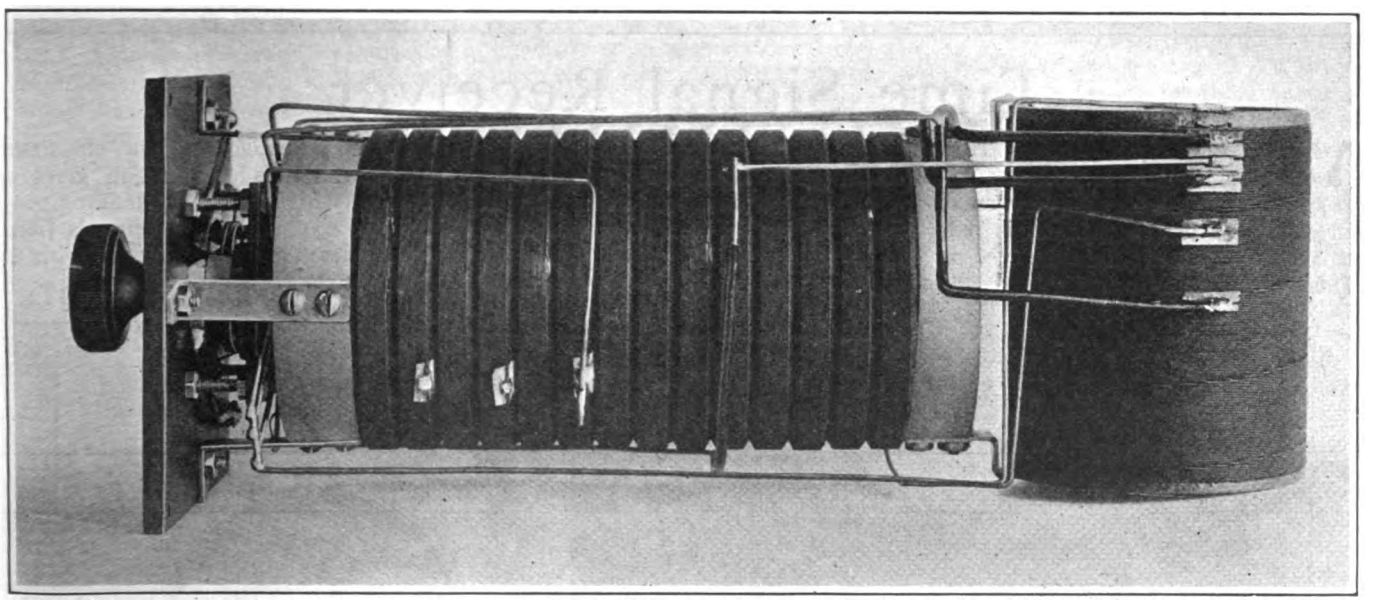


Fig. 4. Here is the inductance panel all finished. The sub-panel mounting can be seen at the left

Digitized by Google

various taps from the coils are soldered to their respective switch points, while the leads to the grid, plate and filament are taken from the brass segments.

These segments were made by bending a piece of 3/16-in. square brass rod into a circle. Then the three parts were cut out and fastened to the panel by 2-56 flat head screws with nuts at the front.

The sub-panel is supported by four long screws put in from the front of the panel. Nuts in front and behind the sub-panel hold it in place. Adjusting the tension on the contact arms was a delicate matter. Therefore, the sub-panel was put in place, and long leads of No. 16 bare copper wire were soldered to the switch points before the large coil was fastened on.

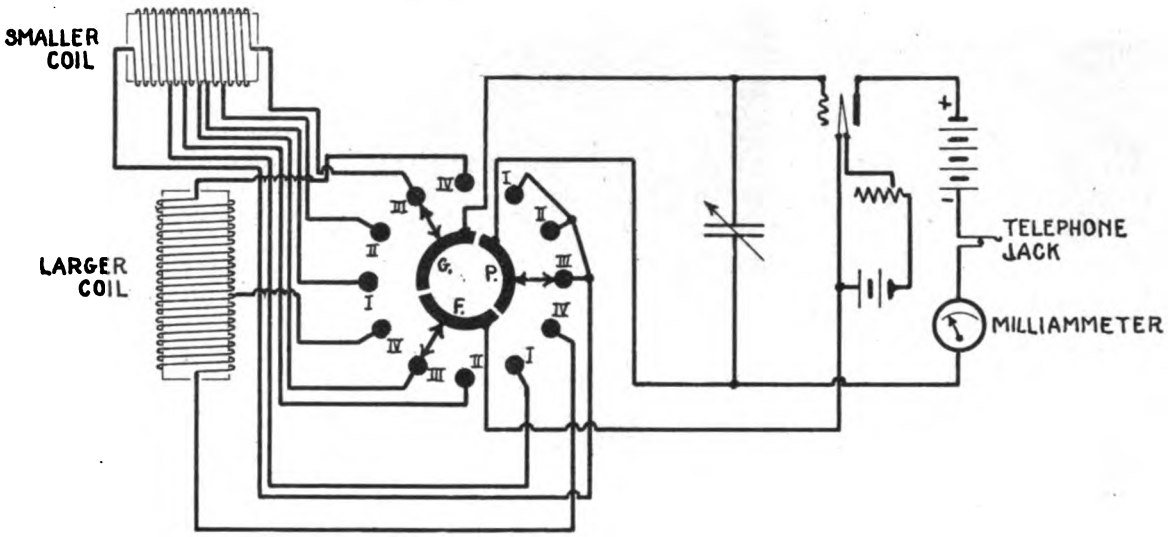
Condenser Panel

This panel carries only a large size G. A. Standardized condenser, with an A. H. Corwin indicating dial. As may be seen from Fig. 1, the dial is fastened to the panel and a pointer put in the handle where the set screw was supposed to go. A hole was drilled into the handle to take a 6-32 screw, for which the end of the shaft was already threaded.

This condenser was chosen because its design assures a permanence of calibration.

Connecting the Instruments

Fig. 6 shows clearly the circuit employed and the method of connecting the switch points and sectors. Since the B battery is contained in the set, no external connections are required except for the filament battery, unless a larger amount of power is required from the oscillator than can be obtained with a small 22½-volt battery.



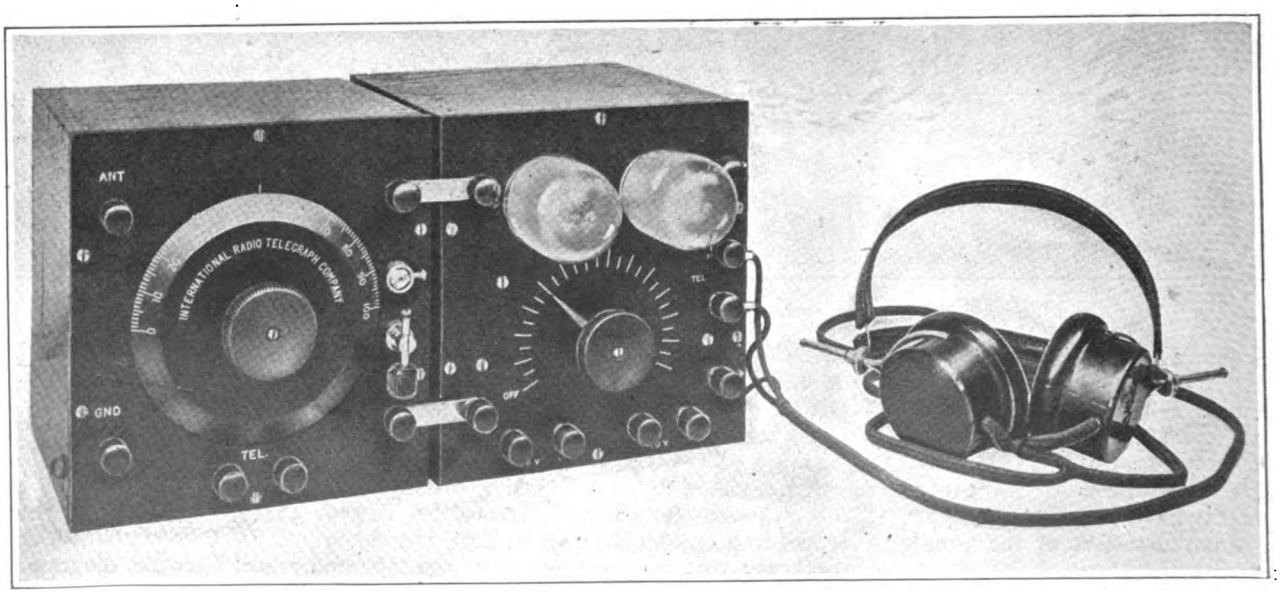
Calibration

No calibration for this wavemeter will be given, as there are bound to be discrepancies between any two instruments, though built identically. However, a heterodyne wavemeter can be readily calibrated from any other type of wavemeter, and more accurately than is possible with the usual crystal detector and buzzer exciter.

Time Signal Receiver

A NEW time signal receiver from the International Radio Company is illustrated here. Very small and simple in design, this set is particularly well suited for the use in watchmakers' stores, on shipboard, and under similar circumstances where no skilled radio operator is available.

At the left is a variometer, on the panel of which is a crystal detector, to be used when the vacuum tubes are not in operation. The second cabinet contains a detector and a one-stage amplifier. This combination gives a set of very high sensitivity, making possible the reception of time signals from a considerable distance, even with a small antenna.



Digitized by Google

Condenser Capacity Ratio

Pointing Out the Significance of Capacity Ratio, and Means for Obtaining Maximum Wavelength Range with Concentrated Coils

THE variable condenser, formerly used to a limited extent to regulate the wavelength of the secondary of a receiver, has come into much popularity since the introduction of concentrated inductances.

Since the inductance steps, with the news coils, are necessarily large, a variable condenser is required to tune over a range of wavelengths. To keep the number of coils required to tune from 200 to 2,000 meters, for example, as low as possible, the condenser must be of a type to give a maximum wavelength range on each coil.

Antenna series condensers will not be considered here, as they are not widely used by the experimenters, but only condensers shunted around the primary and secondary inductances.

Eeefcts of High and Low Capacity Ratios

A variable condenser generally has a range of 0.0001 to 0.001 mfd. Connected around an inductance of 1,000,000 cms., the wavelength in meters, at the maximum and minimum capacities, can be determined by

$$\lambda = 59.6\sqrt{L_{cms.} \cdot C_{mfd.}}$$

giving

minimum wavelength = 596 meters,
maximum wavelength = 1,885 meters.

If, however, the capacity variation had been from 0.00002 to 0.001, this would have given a range of

minimum wavelength = 267 meters,
maximum wavelength = 1,885 meters.

In other words, the greater the ratio

$$\frac{\text{C max.}}{\text{C min.}},$$

the greater the wavelength range that can be obtained from a given inductance coil.

The wavelength range is in proportion to the square root of the ratio

$$\frac{\text{C max.}}{\text{C min.}}$$

Take the example above:

$$\frac{\text{C max.}}{\text{C min.}} = \frac{0.001}{0.0001} = 10.$$

The square root of 10 is 3.16. Therefore, if the wavelength at 0.0001 mfd. is 596 meters at 0.001 it should be $596 \times 3.16 = 1{,}883$ meters, or practically the value shown. The second condenser has a ratio of

$$\frac{0.001}{0.00002} \text{ or } 50,$$

the square root of which is 7.07. Therefore, this gives more than twice the wavelength variation of the other condenser and, as a result, requires only one-half as many coils to cover a given wavelength range.

To make this more clear, the tables below have been made, comparing the two condensers:

0.0001 to 0.001 Mfd. Condenser
Capacity Ratio = 10
120,000 cms. coil
min. λ, 206 m.—max. λ, 653 m.
1,200,000 cms. coil
min. λ, 653 m.—max. λ, 2,065 m.
12,000,000 cms. coil
min. λ, 2,065 m.—max. λ, 6,529 m.

0.00002 to 0.001 Mfd. Condenser
Capacity Ratio = 50
600,000 cms. coil
min. λ, 206 m.—max. λ, 1,460 m.
30,000,000 cms. coil
min. λ, 1,460 m.—max. λ, 10,320 m.

This shows that the condenser with a capacity ratio of 50 covers, with two coils, almost twice the range covered with three coils and a condenser whose ratio is 10.

The foregoing does not, however, apply to antenna circuits, for there the capacity of the antenna must be considered. It must be remembered that the antenna capacity is added to the capacity of the shunt condenser. Hence, if a tuning condenser of 0.0001 to 0.001 mfd. is used with an antenna of 0.0005, the effective capacity variation is from 0.0006 to 0.0015 mfd.

Because of the antenna capacity, the ratio $\frac{\text{C max.}}{\text{C min.}}$ is $\frac{0.0015}{0.0006} = 2.50$. The square root of 2.50 is 1.58, as compared to 3.16 in the case described before. Thus it can be seen that the wavelength range covered by one coil in the antenna circuit is greatly reduced.

Now, if an antenna of 0.0002 mfd. is used, the ratio, with the same condenser, is $\frac{\text{C max.}}{\text{C min.}} = \frac{0.0012}{0.0003} = 4$, the square root of which is 2, instead of 1.53, as found before. This shows that a low capacity antenna gives a longer wavelength range than the high capacity antenna.

A condenser of high capacity ratio helps somewhat in the primary circuit, although not as much as in the secondary. Connected with the 0.0002 mfd. antenna, the ratio is $\frac{0.0012}{0.00022} = 5.5$, the square root of which is 2.35, or slightly higher than the other.

A reduction of antenna capacity suggests a decrease in the size and a corresponding loss of efficiency. This is not true, however, for a high capacity multiwire antenna is no better for receiving than the low capacity single-wire type.

The conclusions to be drawn from the foregoing are that, to get the greatest wavelength range with the fewest number of coils, the antenna should be of the low capacity single-wire type, and that the tuning condensers should have a high ratio of maximum to minimum capacity.

SPECIAL SIGNALS FOR CHECKING WAVEMETERS

INFORMATION has been received from France that the stations at the Eiffel Tower and Lyons are sending out test signals to permit the checking of wavemeters. Experimenters should have no trouble in hearing these signals.

On the first and fifteenth of each month Eiffel Tower sends out special C. W. signals for the checking of wavemeters, as follows:

On 5,000 meters—At 6.00 P. M. and for one minute, a series of A's followed by a dash lasting for three minutes.

On 7,000 meters—At 6.10 P. M. and for one minute, a series of B's followed by a dash lasting for three minutes.

The programme is then continued by Lyons, as follows:

On 10,000 meters—At 6.20 P. M. and for one minute, a series of C's followed by a dash lasting for three minutes.

On 15,000 meters—At 6.30 P. M. and for one minute, a series of D's followed by a dash lasting for three minutes.

At 6.45 or 7.00 P. M., according to the time required for the measurements, the actual measurements of the emitted waves are sent out by Y N, on 15,000 meters, and repeated thrice.

Example:

A— 5,170 meters.
B— 7,090 meters.
C—10,025 meters.
D—14,990 meters.

The time indicated is Paris time, which is earlier than ours. Therefore, the proper allowances must be made for the part of the country in which the experimenters are located.

Digitized by Google

The Measurement of High Frequency Resistance

Part II. Circuits used for resistance measurements, and an explanation of their use

By L. M. Clement

The ability to measure the high frequency resistance of coils opens to the experimenter many new, interesting, and possibly profitable lines of investigation. Signal strength and the sharpness of tuning must be considered in relation to the resistance of the circuits. All kinds of tests and comparisons can be carried out by the man who has the apparatus for measuring high frequency resistance.

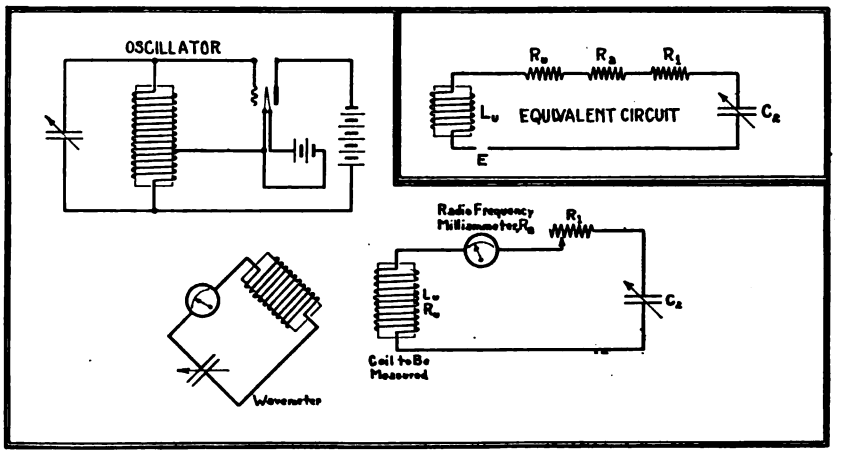


Fig. 5. This circuit is used in the resistance variation method

1. Bridge Method

An adaption of the well-known low frequency impedance bridge at once suggests itself for the measurement of resistances at high frequencies. Such a bridge is illustrated in Fig. 4. The low frequency bridge is supplied by an audio frequency current which is made audible by means of a pair of telephone receivers. The bridge is balanced when there is no sound in the telephones.

The current of a frequency at which the measurements are to be made is supplied by the vacuum tube oscillator through the transformers L and T, across the bridge at CD. The detecting apparatus is connected across AB. In this bridge r_1 and r_2 are non-inductive resistances which are made equal so that the resistance R will represent directly the unknown resistance. The unknown, usually a coil, is placed in series with a condenser which is adjusted until resonance is obtained, that is, until the inductive reactance of the coil equals the capacity reactance of the condenser. The resultant reactance is zero and the coil acts as if it were a resistance. This is assuming that the coil has no distributed capacity. The effect of distributed capacity has been discussed elsewhere.

In high frequency measurement work, the frequency is beyond the range of audibility and for this reason it would not be possible to determine the balance point accurately by ordinary methods.

Two general methods are available, namely, the use of a modulated high frequency input to the bridge and a radio frequency detector connected across its output or a radio frequency input, and a heterodyne detecting system across the output. Such an arrangement is shown in Fig. 4.

The frequency of the oscillator is determined by the inductance and capacity in circuit. The wave length of the oscillations is expressed approximately by

$$\lambda \text{ meters} = 59.6\sqrt{L \text{ cms. } C \text{ mfd.}} \quad (1)$$

The bridge oscillator, the heterodyne oscillator B, and the detector tuned circuit A should be calibrated and carry scales which make them direct reading. This is of inestimable value in the actual manipulation of apparatus.

The resistances r_1, r_2, and R must be non-inductive and should have a resistance characteristic independent of frequency. This can be accomplished by the use of extremely fine wire of some non-magnetic metal such as "Advance" or "Manganin".

In order to obtain satisfactory results with a bridge of this sort, it must be very carefully constructed and very well shielded. If the shielding is imperfect there may be enough leakage to obscure the null point.

Operation of the Bridge

The unknown inductance should be connected in series with a condenser of such a value that series resonance can be obtained. Set the bridge, the heterodyne oscillator and the detector circuit A at the desired frequency. Adjust the oscillator B until a convenient beat note is heard in the telephones, adjust C_2 until minimum sound is heard in the telephones. Adjust alternately R and C_2 until a balance is obtained, then the resistance of C_2 and L_u is equal to R.

Unless the bridge is very carefully constructed and thoroughly shielded it is very difficult to obtain reliable results with this method. The method is best

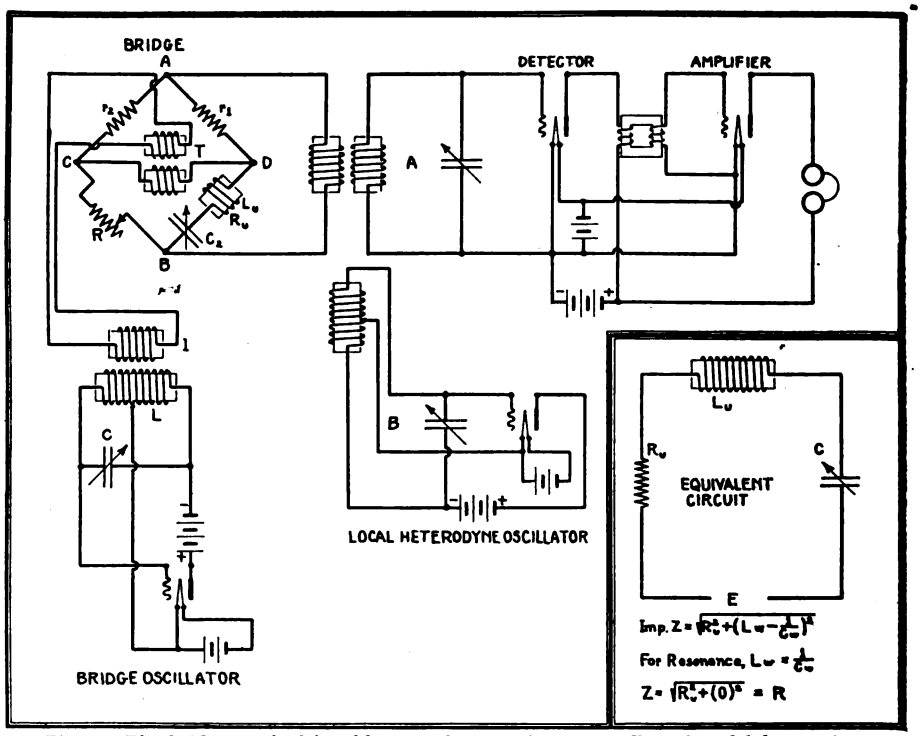


Fig. 4. The bridge method is seldom used except in very well equipped laboratories

Digitized by Google

suited to the laboratory which has facilities for building this type of high grade apparatus.

2. The Resistance Variation Method

The so-called resistance variation method of determining the resistance of a coil at radio frequencies has been used very successfully to a considerable extent.

If the calibration of the meters is accurate and the resistances are reliable over the frequency and current range used, very accurate results can be obtained with this method.

A diagram of the apparatus and connections involved are shown in Fig. 5. The coil to be measured is connected in series with an accurate radio frequency milliammeter of known resistance R_a, a condenser C_2 and a variable radio frequency resistance R_1. The oscillator should be coupled very loosely to the measuring circuit and be able to deliver enough power to it, under this condition, to give nearly full scale deflection of the indicating instrument.

The oscillator is set to generate the frequency at which the measurement is to be made, the resistance R_1 is cut out and the condenser C_2 is adjusted until the measuring circuit is in resonance with the oscillator. This is true when the current is maximum and equal to I_m.

For resonance the reactance of the coil, $2\pi fL$, is equal to the reactance of the condenser, $\frac{1}{2\pi fC}$, and the impedance of the circuit is then equal to its resistance. The power delivered to the circuit is expressed in terms of the current and resistances as follows:

$$\text{Power} = I^2_m (R_u + R_a) \qquad (2)$$

Now insert a resistance R_1 of some known value in the circuit and note the current. Let this value of current be I. The power dissipated in the resistances will now be expressed as:

$$\text{Power} = I^2 (R_u + R_a + R_1) \qquad (3)$$

Assuming the total power in the circuit is the same in both cases we can equate equations 2 and 3 and solve for $R_u + R_a$,

$$I^2_m (R_u + R_a) = I^2 (R_u + R_a) + I^2 R_1$$

from which

$$R_u + R_a = \frac{I^2 R_1}{I^2_m - I^2} \qquad (4)$$

When the current is reduced to 0.707 of the maximum value the resistance R_1 is equal to the sum of the resistances of the coil and the meter. This is seen by substituting for I the current value $0.707\ I_m$.

Then

$$R_u + R_a = \frac{(0.707\ I_m)^2 R_1}{I^2_m - (0.707\ I_m)^2}$$

or

$$= \frac{0.5}{I - 0.5} R_1$$

which gives

$$R_u + R_a = R_1$$

This method, although it involves much less apparatus than the bridge method, is hardly a method which many amateurs can use.

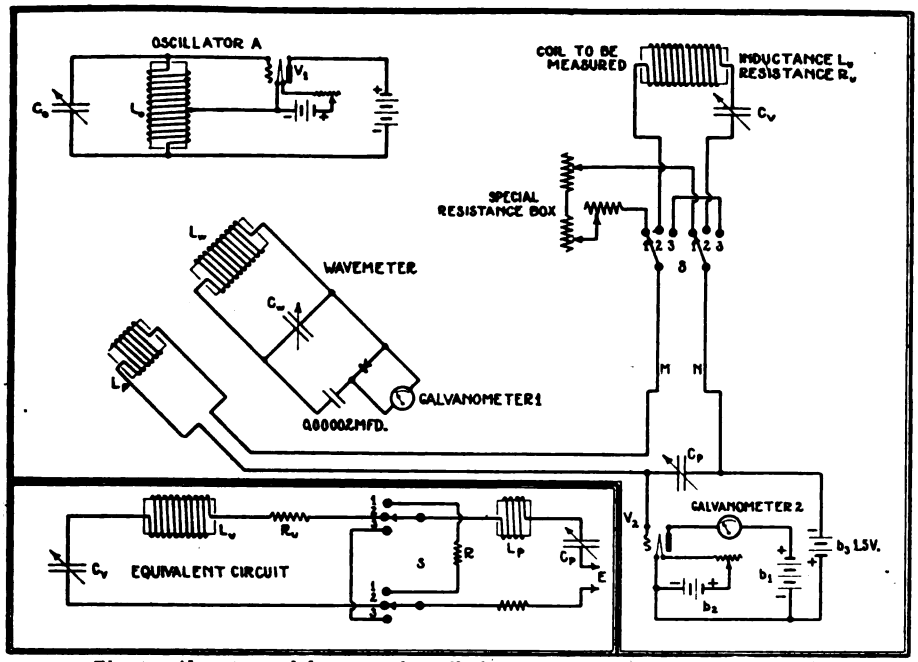


Fig. 6. Almost any laboratory has all the apparatus needed for this circuit

3. Substitution Method

The connections of the apparatus necessary for the measurement of resistance at radio frequencies by the so-called substitution method is illustrated in Fig. 6. The apparatus consists of a vacuum tube oscillator A capable of generating alternating currents of the desired frequency. The oscillator is very loosely coupled to a wavemeter of the ordinary type. Resonance is indicated by a maximum reading of a sensitive galvanometer which is connected across a crystal detector of any ordinary type. The detector is connected in series with a very small condenser and the combination is connected across the wavemeter condenser. This arrangement affords better tuning as less resistance is introduced in the wavemeter circuit, due to the detector, than in the ordinary connection.

The coil to be measured should not be coupled with the oscillator to any measurable extent and for this reason the coil L_u, its condenser C_v and the pick-up circuit condenser C_p should be placed at some distance from the oscillator. Usually 15 feet is sufficient separation. An alternate plan would involve shielding the oscillator and the pick-up coil.

The pick-up coil L_p is coupled to the oscillator or wavemeter loosely and connected to the measuring circuit by a pair of twisted leads. This is done to prevent the leads from picking up any stray field.

The voltage across the condenser C_p is indicated by means of the vacuum tube circuit, consisting of the tube V_2, the galvanometer G_2, and the plate, filament, and grid batteries b_1, b_2, and b_3 respectively. The tube acts as a detector and the change in the galvanometer reading is an indication of detected current or voltage applied to the grid. The voltage will be the same for two successive readings if the galvanometer G_2 deflection is the same in both cases. This galvanometer can be of either the Rawson Unipivot or the moving coil wall type and it is not necessary that it be calibrated.

The condenser C_v and the wavemeter should be carefully calibrated so that the value of inductance and distributed capacity as well as the resistance of the coil can be determined.

This method because of its simplicity, ease of operation and accuracy has found quite a wide application in experimental laboratories.

Operation

The oscillator should be adjusted to the wave length at which the resistance of the coil is to be measured and the wavemeter adjusted to resonance with the oscillator. Place the switch S, Fig. 6, on position 3, which short circuits the leads M and N. Adjust the condenser C_p so that the circuit $C_p L_p$ is in resonance with the oscillator. This is indicated by a maximum reading of the galvanometer G_2. It is obvious that L_p should be so chosen that it will resonate with the oscillator for some value of the condenser C_p.

The equivalent circuit is shown in Fig. 6 with the switch S thrown to position 3. Then E is the alternating E.M.F. induced in the circuit from the oscillator. When the circuits are in

(*Concluded on page* 260)

Digitized by Google

Duo-Lateral Type Inductances

A New Machine-wound Coil of Very Low Distributed Capacity and Resistance

FROM the point of view of the radio man, other lines of work must seem very dull, for there is no other industry in which so many new and clever ideas are brought out in such rapid succession. It almost appears that there is nothing more to be added to the line of radio achievements save a substitute for electricity itself.

The duo-lateral coils, invented by Mr. Giblin of the Electrical Products Manufacturing Company, and distributed by the Pacent Electric Company, are different from the familiar "Coto-coil" in that the wires of every other layer are between the wires above them, instead of being directly below them. This effect can be observed in the unmounted coils shown at Fig. 1. As a result of this change from former practice, the distance between the wires of alternate layers is increased. Tests on these coils show that this new method of winding decreases the distributed capacity, and, because a smaller number of turns is required for a given inductance, the length of wire and, consequently, the resistance is lowered.

A table is given here showing the number of turns, the high frequency resistance at various wavelengths, and the distributed capacity, as well as the natural periods of duo-lateral coils of various inductances. All sizes are 2 ins. inside diameter and 1 in. wide.

DATA FOR DUO-LATERAL INDUCTANCES

L Mhs.	H. F. R. Ohms at	λ Meters	C Mfds.	Natural λ Meters	Turns	Wire S. C. C.	Diam. Ins.
0.045	1.9	150	17	70	25	24	2 3/16
0.075	2.6	200	17	86	35	24	2¼
0.156	4.2	300	18	102	50	24	2 5/16
0.36	6.3	400	19	150	75	24	2⅜
0.66	27.2	500	19	220	100	24	2½
1.40	38.0	700	20	290	150	24	2⅝
2.50	48.0	1,000	20	350	200	25	2½
4.20	63.0	1,400	20	420	250	25	2 15/16
6.25	68.0	1,500	21	540	300	25	3
10.62	73.0	2,000	22	700	400	25	3¼
17.6	75.0	3,000	23	860	500	25	3½
25.0	90.0	4,000	23	1,120	600	28	3⅞
38.0	97.0	5,000	23	1,260	750	28	3 5/16
72.8	104.0	8,000	24	1,750	1,000	28	3¾
116.6	125.0	10,000	24	2,200	1,250	28	4 1/16
171.5	140.0	15,000	25	2,600	1,500	28	4 7/16

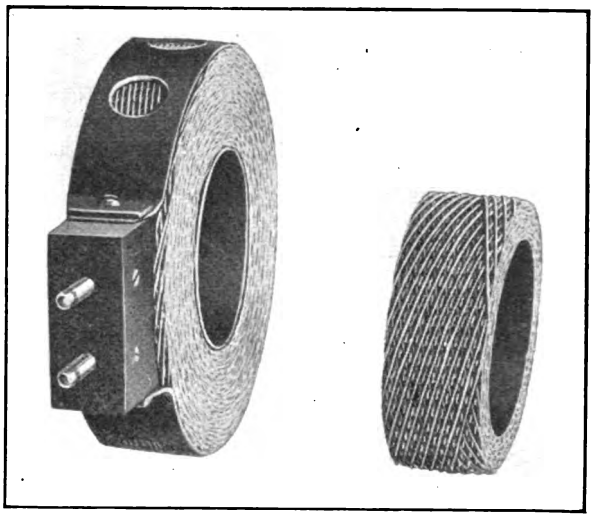


Fig. 1. Mounted and unmounted duo-lateral inductances

In Figs. 2 and 3, a new type of inductance mounting is illustrated. Here the panel effect is achieved by connecting the shafts of the handles to the shafts of the movable plugs by bevelled gears. Another improvement is the indicating dials. Connections from the movable plugs to the binding posts are made by flexible conductors.

The plugs are of the Pacent type, made up of a grooved plug which snaps into a spring socket, similar, in principle, to the Pacent binding posts.

A three-coil mounting permits considerable flexibility of circuits. The most usual method is to use the center coil as the secondary, one outside coil as the primary, and the third as a tickler. Another way, for undamped wave reception, is to replace the tickler by a very small coil in series with a separate oscillator. This serves to heterodyne the incoming oscillations.

Again, the three coils can be connected in series, and used as a variometer.

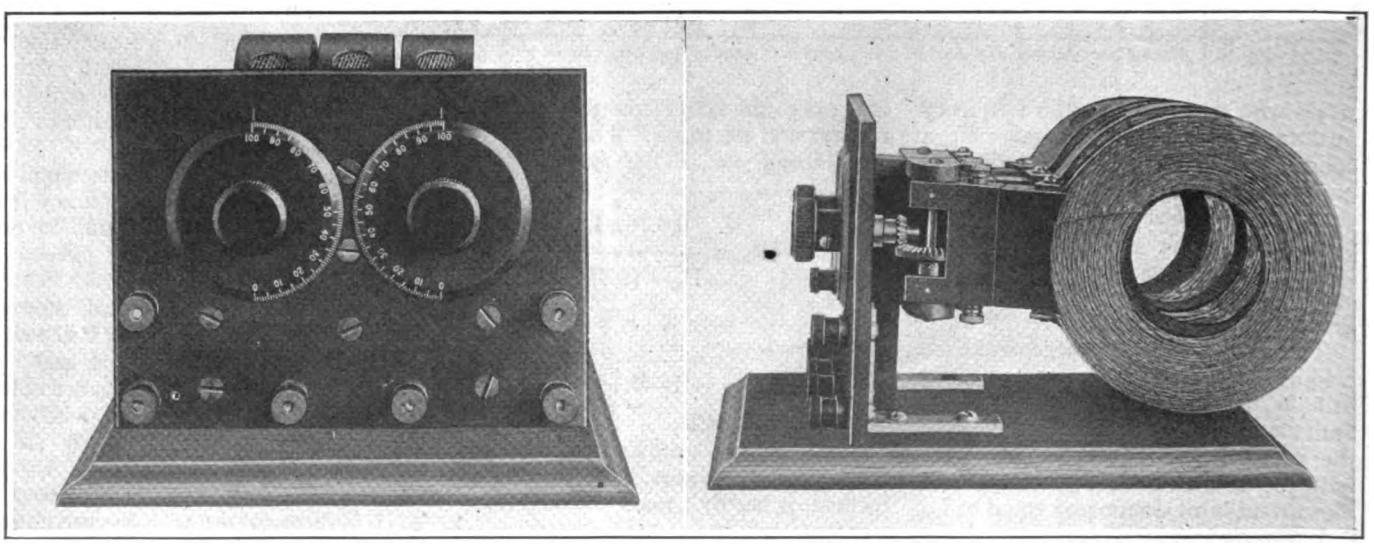


Fig. 2. Primary and tickler coupling are controlled from the front of the panel

Fig. 3. Showing the bevelled gears by means of which the the coils are turned

Digitized by Google

The Radio Department

EVEN when the automobile had passed the "gasoline wagon" stage, and people had come to realize that this new means of conveyance was destined to become a permanent factor and one of tremendous influence upon civilization, the automobile was not popular, so that one could say, for example, that one man in every one hundred, throughout the nation, owned a car.

The nationalization of any product depends upon three things—its value as a convenience or necessity, its value as a pleasure, and its cost.

The automobile, for the first few years, possessed the first two points of popularity, but not the third. Having these two properties, the mastering of the mechanical difficulties did not trouble the public. All they required was an automobile at a moderate price. Since that result was accomplished by the manufacturers, we all know the remainder of the story.

Has the foregoing any bearing on radio telegraphy or telephony? Most certainly. Radio, a necessity in many cases, has the imaginative appeal which makes it a tremendously fascinating hobby. Its technical problems make it interesting, and its rapid and continuous changes and developments maintain the fascination which it has for every man or boy *once he has put up a station.*

There is the point which has been so sadly neglected by the manufacturers.

Sit down with your catalogs and find out first what you need for a beginner's station, and then what it will cost. Being quite ignorant of the requirements of a radio receiving set, you probably will not be able to find out what you need, if you depend upon the catalogs to tell you.

If you are determined to have a radio station, you may hazard an inquiry to one of the manufacturers. The result may put an end to your interest in radio. Or you may know an experimenter who has a station. He will, of course, suggest the purchase of the best instruments, wishing to assure the success of your outfit.

Then comes the reckoning of the cost. It will vary from fifty to two hundred dollars.

How many men want to put that amount into something they know nothing about, and have no assurance of the results to be obtained, or their continued interest in the purchase after it is made? Between these two experiences through which the average beginner must go, it is a wonder that anyone ever takes up radio work.

The introduction of a complete receiving set, with materials for an antenna and a set of simple instructions, to sell at twenty dollars, would give a greater impetus to radio experimental work than any of the new ideas which have been brought out in the last ten years. This set should not be cheap because it is cheaply made, but because the design is very simple. It must be a set which will not get out of order, and can be operated successfully by anyone who knows nothing about radio.

If those who are mildly interested in wireless could get a set at a low price, and make it work, they would quickly respond to the call of radio, and join the ranks of those who spend all the time and money they can spare for better apparatus. The problem is to make it easy for a man or boy to start. The number of such prospects far exceed that actually doing radio work now.

Incidentally, this is the time to prepare for the manufacture of such a set, as there is just time enough before the fall season starts. The men who operate such a set this winter will be buying expensive apparatus next year.

NOW a word to those who are making their own instruments. In a recent discussion concerning a new device to be sold for experimental work, one of the men at the head of a large supply company said, "There's no use in putting so much finish on the instrument. It's too good. Experimenters don't care how a thing looks as long as it works—at least that is my opinion from what I can judge by the stations I have seen."

Let us hope that this man's idea was not correct. No matter how well an instrument may work, if it is merely thrown together, an experimenter cannot feel the pride in it that he would if it looked like a real job. We cannot all be instrument-makers, to be sure. At the same time, a careful choice of materials and a little extra care make a very great difference in the completed apparatus.

The main trouble with the experimenter is that, when he decides to build an instrument, he wants to make it immediately. Rather than wait to get the proper materials, he falls back on makeshifts. That is why his set gives the impression that he doesn't care how it looks as long as it works fairly well.

WHILE the experimenters have, no doubt, all they can do to keep up with developments in this country, they should have an eye on the other side of the ocean. As they were surprised to know to what extent radio research had been carried on during the War, they may be again surprised at the work subsequently accomplished.

In the May, 1920, issue of EVERYDAY, there were the names and addresses of several British radio societies. Since England and France have worked together, practically all the European developments are known in England. Correspondence with those societies will certainly be helpful and interesting at both ends.

Such success has been attained by some of the A.R.R.L. stations, that transmitting across the ocean to a well-equipped English receiver is not at all out of the question, and arrangements could be made without difficulty for the attempt. The accomplishment of such a feat would be no inconsiderable feather in the cap of the operator, and the League would share in the credit. Someone will do it. The question is who will be first.

HOW many radio catalogs have you? Probably fifteen or twenty. When you try to arrange them in your bookcase, what is the result? You can't keep them in an sort of order because no two are the same size. They can't be put in a loose-leaf binder, in fact, they are rather a nuisance to have around except that you can't get along without them.

Think what it would mean to have all your radio catalogs and bulletins printed on the same size paper. Then they could be readily filed and kept in proper shape without losing the little ones, or having the big ones all bent up.

If each experimenter, when he writes for a catalog should say at the end of his letter:

"P S. I hope you print your catalogs on 8½- by 11-inch sheets, so I can keep them neatly filed."

the companies might realize after a while, that, to have their catalogs preserved and not lost in the shuffle, they should use regular size paper which, incidentally, is more economical than the small sheets.

FOR next month, there will be even more radio articles than in this issue, an increase of three pages over May. The constructional article will be a two step radio frequency amplifier, not radical in design, but an example of the best practice. A new type of concentrated inductance, entirely different from any other will be described with tables and data on the use of all types of coils for receiving work. Another feature will be a description of radio equipment suitable for small boats. Illustrations of transmitters, receivers, and directional receivers will be shown.

Mr. Clement, although he is taking a well-earned vacation on the Pacific coast, has written an article on the measurement of inductance, describing a method which, as might be expected, is quite different from the usual practice. In fact, the inductance is measured on a resistance box.

Digitized by Google

A Duplex Radio Telephone Set

This Equipment, Built By the Western Electric Company, Transmits and Receives Simultaneously

THE question of two-way radio telephony in which two speakers may carry on conversation without the necessity of changing the circuit connections from the receiving to the sending condition or the reverse, and which for brevity will be spoken of as "duplex radio telephony", is one which has been of considerable interest to radio engineers for sometime and while a number of attempts have been made to obtain such communication it has not come into general use. This is, no doubt, due largely to the enormous ratio between the power developed for transmitting purposes and the power of the received energy at a given station which makes it exceedingly difficult to prevent an overwhelming amount of side tone during the transmitting period, that is, the presence in the operator's receiver of the message which he is endeavoring to transmit. This condition has made necessary thus far the use of a circuit in which a switch or key of some kind is employed for throwing from the receiving to the sending condition, the set normally being in the condition for reception and being thrown into the other condition only during the actual transmitting period, during which time the local receiving circuit is entirely disconnected for its own protection.

The Western Electric Company has recently designed and built duplex radio telephone sets for the United States Navy which, in accordance with the definition of the term, permit two people at remote stations to converse with one another by radio without the necessity of throwing switches and with no more thought to the question of whether one is transmitting or receiving or both than is done in the case of an ordinary wire telephone conversation.

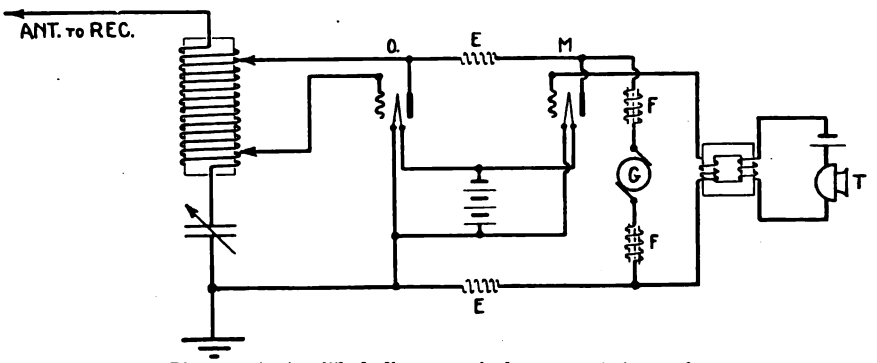


Fig. 4. A simplified diagram of the transmitting unit

There are a number of different arrangements which might be used for successful duplex radio signalling. One method would obviously be to have two separate antennae, one for transmitting and one for receiving, the two antennae being tuned for different frequencies or being so related by form or position that the receiving antenna is not affected materially by the transmitting antenna. This is particularly convenient if the receiving and transmitting stations can be separated by a distance of a few miles, the speaker being located at one or the other station or at some intermediate point and being connected to the two stations by means of wire connections. Another method would be to use a single antenna for transmitting and receiving in which some balancing scheme reduces the amount of transmitted power which enters the receiving circuits. In places of restricted space, such as sea going vessels, it is apparent that the first method cannot well be used, and that the second method offers a satisfactory solution of the problem, if a sufficiently accurate

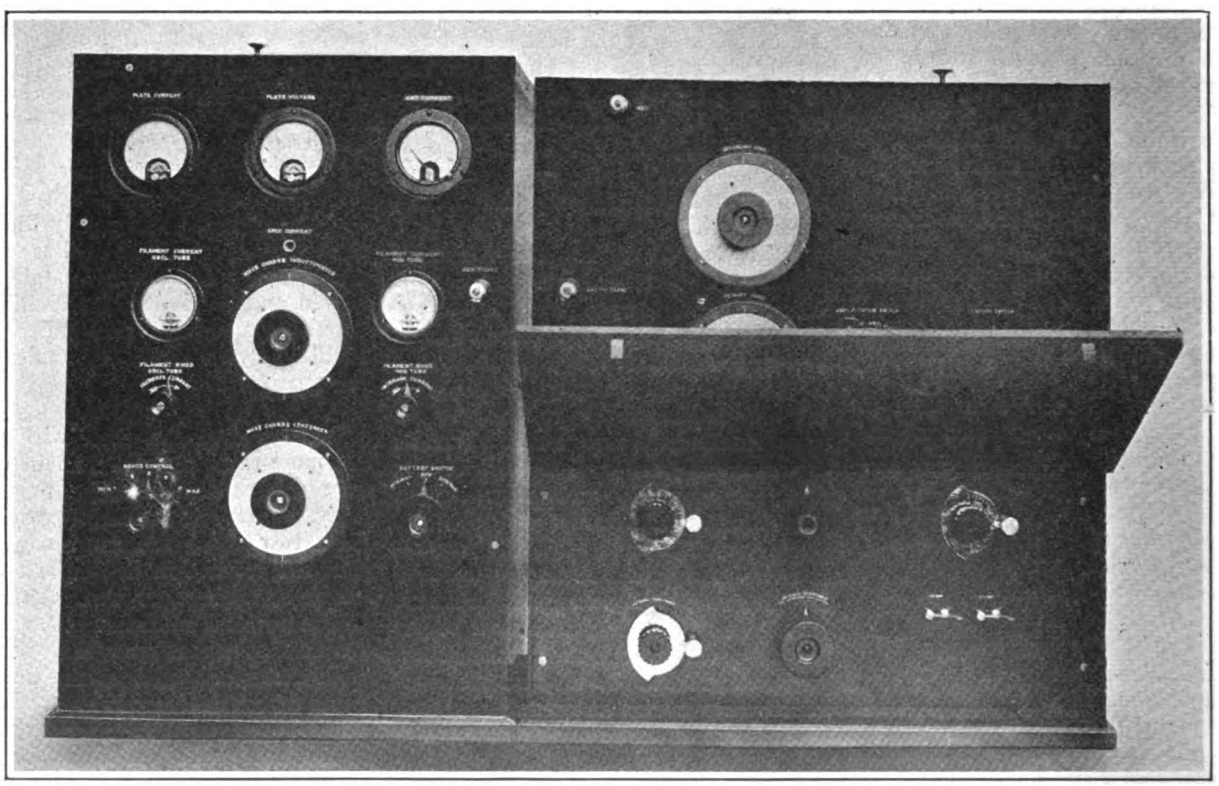


Fig. 1. The complete duplex radio telephone system, comprising a transmitter, receiver and dummy antenna

Digitized by Google

balancing of the circuits can be obtained, so that the transmitter does not affect the receiver to any great extent even though both circuits are associated with one and the same antenna.

the Navy based on the second method. Figure 1 shows a photograph of such a set, which consists of two units, A and B.

The Unit A, to the left, comprises the

and the other as a modulator tube. The Unit B, to the right, comprises an artificial antenna and the receiving circuit, and the interior of this unit, also looked at from the rear, is shown in Figure 3.

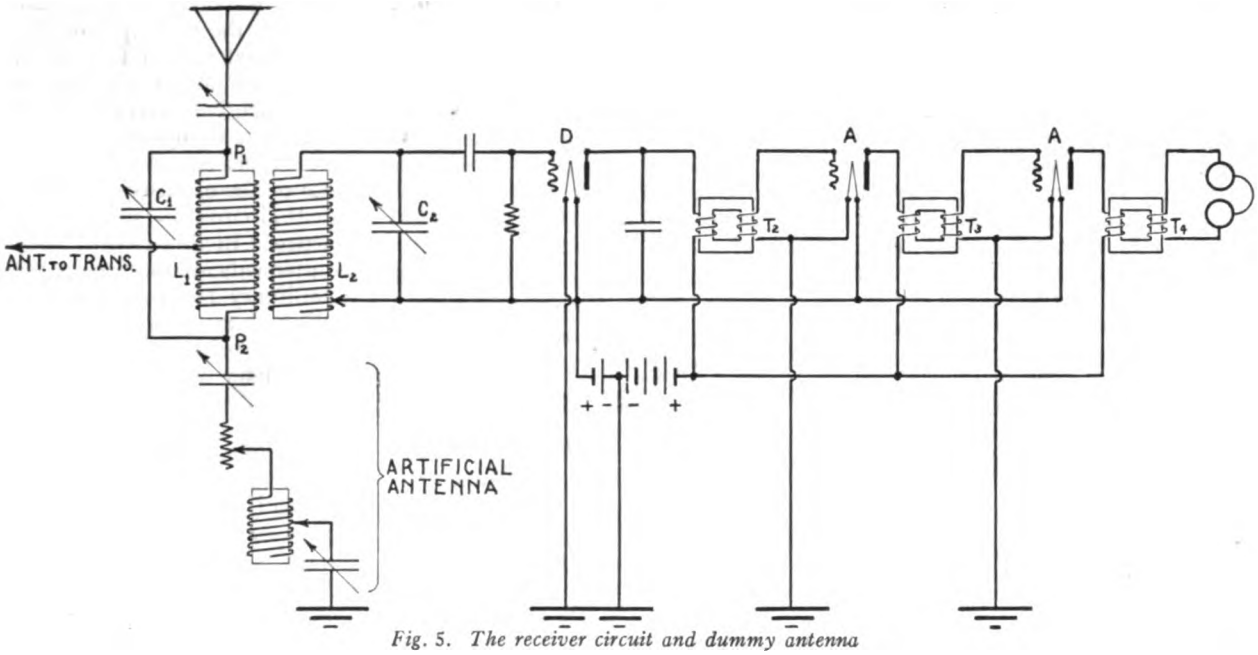


Fig. 5. The receiver circuit and dummy antenna

The Western Electric Company in cooperation with the United States Navy used the first method some years ago in connection with radio communication between Washington and battleships at sea. More recently it has built sets for

oscillation generator with its modulator circuit and as such is the transmitting set. Figure 2 shows the interior of this unit looked at from the rear. It will be noted that there are two vacuum tubes, one of which acts as an oscillator,

In this unit three vacuum tubes are shown, one acting as a detector and the others as amplifiers of the detected signal. In setting up the station it is only necessary to connect a terminal from the Unit A to a terminal on the Unit B;

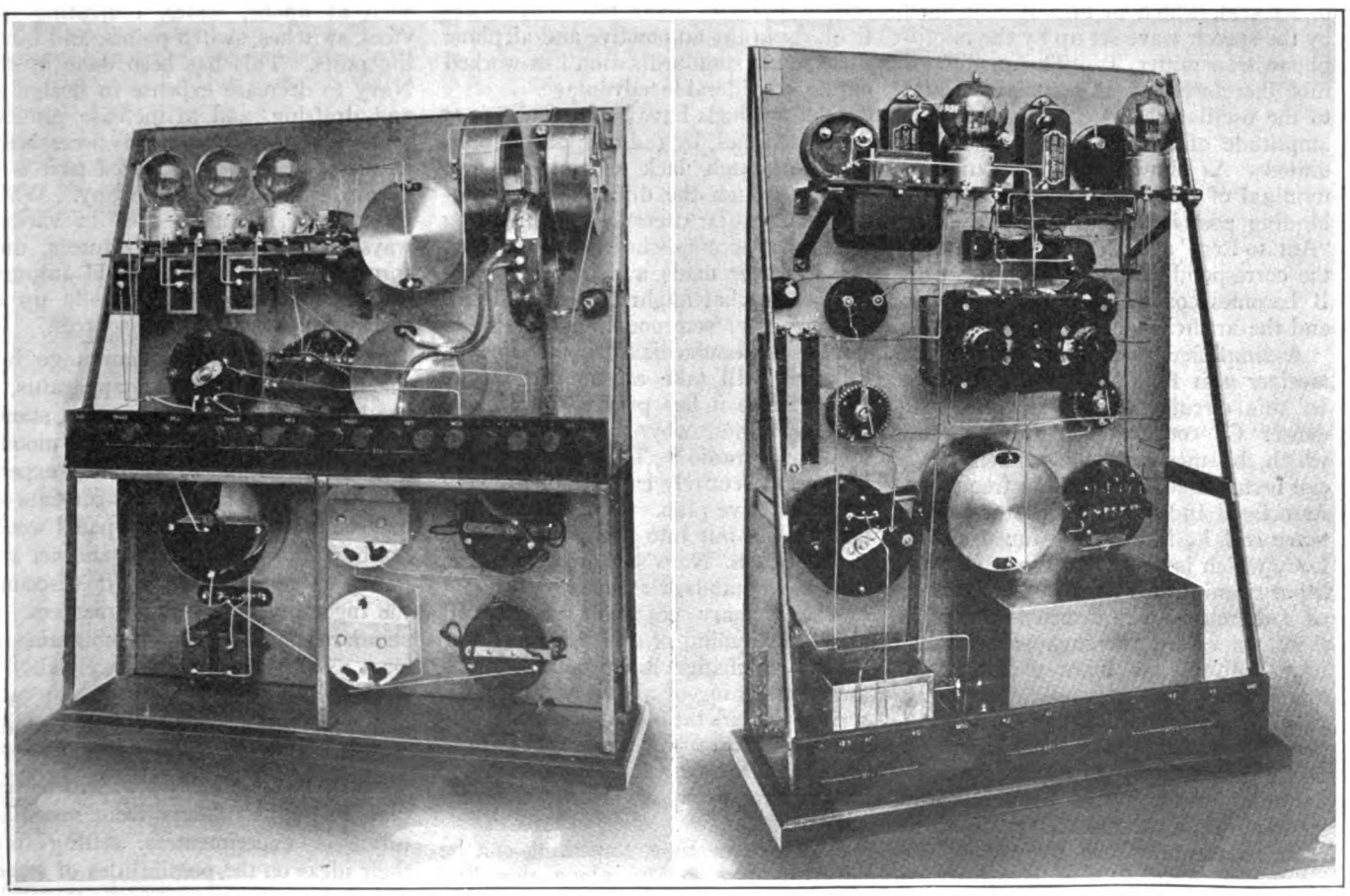


Fig. 3. The receiver is mounted above, and the dummy antenna below. This unit is also completely shielded

Fig. 2. Interior of the transmitter. The rear of the panel is shielded, and the set, when in use, is fitted into a metal case

Digitized by Google

to connect the antenna to a second terminal on the Unit B, and to make two ground connections, one from the Unit A and one from the Unit B. In addition, of course, the usual connections of batteries, transmitter and receiver must be made, provision for these connections being shown in Figures 2 and 3. This particular set is arranged to communicate with any one of three stations.

A simplified circuit diagram of the transmitter unit is shown in Figure 4. A variety of oscillator circuits may be used, one which is particularly useful and which is shown here, is the Colpitts oscillator. This circuit includes a tuned circuit having two capacities in series, the one capacity consisting of a condenser of suitable dimensions and the other capacity being that of the radiating antenna. One terminal of the filament is connected to a point between these two capacities. The plate and grid are connected respectively to points on the inductance L. Power is supplied to the plate circuit by the generator G. Such a circuit will oscillate at a frequency determined by the capacity and inductance of the tuned circuit. These oscillations are modulated by the Heising method, which is shown in the diagram as consisting of a vacuum tube connected in parallel to the oscillator tube. Suitable choke coils E and F are connected to this circuit as shown. The impedance offered by the modulator tube M is determined by the potential of its grid, which in turn is controlled by the speech wave set up by the microphone transmitter T. The modulator tube therefore acts as a variable shunt to the oscillator and thus controls the amplitude of the oscillations to be radiated. As shown in the circuit one terminal of the inductance L goes to a binding post indicated in Figure 1 as "Ant. to Rec." and upon connection with the corresponding terminal on the Unit B becomes connected to the radiating and the artificial antenna.

A simplified circuit diagram of the receiver unit B is shown in Figure 5. In this circuit the coil L_1 and condenser C_1 constitute a tuned circuit which, by means of the condenser C_1 can be tuned to the signaling frequency. Associated inductively with the inductance coil L_1 is a second tuned circuit L_2C_2 which is connected directly to the input circuit of a vacuum tube D acting as a detector. The detected current is then impressed through the transformer T_2 on the input of a vacuum tube A acting as an amplifier, and the output of this amplifier tube is then impressed, by means of a transformer T_3, on the input circuit of a second amplifier tube in the output of which is a transformer T_4, the secondary of which contains the telephone receivers. The amount of amplification obtained can be adjusted by means of the variable resistance in the output circuit of the detector tube. It will be noted that one terminal of the filaments of the tubes are all connected to ground and the other terminals are connected to the positive pole of the filament battery, the negative pole of which is grounded. The filaments are thus supplied with heating current in parallel. The battery B is used for the plate circuits of the three tubes in parallel. From the mid point of the inductance L_1 is a lead going to the binding post marked in Figure 1, as "Ant. to Trans." and is used for connecting the Unit A with the Unit B.

In view of the balanced arrangement oscillations coming from the Unit A to the mid point of the inductance L_1 divide equally, half of the energy going to the antenna and the other half to the artificial antenna. This leaves the points P_1 and P_2 always at equal potentials as far as any disturbances arising in the Unit A are concerned and they therefore produce no effect upon the receiver circuit. Oscillations received upon the antenna, however, are not so balanced and therefore will produce an effect in the telephone receivers.

The essential point of this circuit arrangement is the presence of the artificial antenna, which is naturally made to simulate the actual antenna as closely as possible, both in oscillation and damping characteristics. Obviously the greatest difficulty in a circuit of this type is in the balancing of the two circuits so that P_1 and P_2 will actually be equal potential points. In the designing of such balanced circuits the Western Electric Company has probably had more experience than anyone else because of the extensive use of such balanced circuits in ordinary telephone practice. In this circuit, however, the requirements are much more severe than in ordinary telephone circuits because of the high ratio between the transmitted and the received power.

In a later modification the set is divided into three units, A, B and C, the Unit A being the same as before, the Unit B including the receiving circuit and the inductance L and condenser C_1, and the Unit C including the artificial antenna alone. This arrangement has certain advantages in flexibility. In particular it permits the artificial antenna Unit C to be placed in a more or less inaccessible and useless space, a matter of importance in airplane work.

The Possible Standardization of Radio Equipment

MANUFACTURERS in various lines have found it advantageous to co-operate in the standardization of certain parts of their products. Particularly in the automotive and airplane fields, such standardization has worked out to considerable advantage.

Such methods have been proposed, at different times, by radio engineers, but, partly through lack of interest and partly through the difficulty of bringing the manufacturers together, nothing has been accomplished. In fact, no one has ever made a definite proposition as to what might be standardized.

Obviously, someone must outline a method of standardization before manufacturers will take an interest in the idea. Since it has proved so valuable in other lines, why should it not be applied to radio? There are a number of men entirely capable of drawing up a tentative plan. That such a system can be put into practice is shown by the U. S. Navy's radio piece part method of standardization.

The primary objection which will arise in the mind of each manufacturer is that to change his products means the re-designing of all his apparatus, a serious consideration, of course. Offhand, it might appear impossible to correlate the many special features of instruments from as many different sources.

At the same time, something can be done, unquestionably, along this line which will be of very considerable benefit to the entire field.

In outlining a possible system, consideration must first be given to such things as are used by all companies, such as knobs, scales, indicating devices, switches, switch points, and binding posts. This has been done by the Navy to decrease expense in designing and drafting, and to increase production. It does not mean necessarily, however, that a standardized part is to be made by only one company. While these parts might be used in various ways by different manufacturers, uniformity to this extent would improve the appearance of a set made up of instruments from several sources.

Before too many companies go into the building of sectional apparatus, it would be well to determine on a standard panel size, and a method of mounting. The argument that an experimenter having bought instruments of one company of one size of panel would not buy other apparatus on another size panel, is not sound, for it discounts the ingenuity of the experimenters. A standard panel size or combination of sizes would be very well received.

Other features can be treated in a similar manner by the far-sighted designer.

EVERYDAY ENGINEERING will be very glad to publish letters from manufacturers or experimenters, setting forth their ideas on the possibilities of standardizing radio apparatus, or their reasons for considering it impractical.

Digitized by Google

Radio Tuning Circuits

This Article Points Out Exactly What Happens When a Receiving Circuit Is Tuned to a Given Frequency

THE subject of capacity and inductive reactance was discussed in the May issue, and it was shown that, to obtain the maximum power, in watts, in an alternating current circuit, the current and voltage must be in phase, a condition obtained by using such a combination of inductance and capacity that the impedance is zero.

TUNING TO A GIVEN FREQUENCY

Let us take a slightly different angle on this question of radio tuning circuits, to show more exactly what happens when a receiver is tuned to an incoming signal. First, we shall assume that the transmitter is working on 3,000 meters or 100,000 cycles. Since the secondary circuit is simple, we shall discuss it first.

An inductance of 4,000,000 cms. or 0.004 henry is employed, with a tuning condenser of 0.0001 to 0.001 mfd. From (5) the reactance of the inductance, at 100,000 cycles, is

$X_1 = 2\pi \times 100{,}000 \times 0.004,$
$X_1 = 2{,}512$ ohms inductive reactance.

To balance this 2,512 ohms of inductance reactance, the condenser must be varied until a value is found which gives a capacity reactance of 2,512 ohms. Then, from (6), the reactance will be zero. The following table shows the reactance, at 100,000 cycles, of the condenser:

$C_{mfd.}$	X_c
0.00010	15,920
0.00020	7,940
0.00030	5,315
0.00040	3,980
0.00050	3,180
0.00055	2,890
0.00060	2,650
0.00065	2,450
0.00070	2,270
0.00075	2,120
0.00080	1,980
0.00085	1,870
0.00090	1,760
0.00100	1,592

This table is plotted in Fig. 5. The capacity reactance table and curve show that, as the frequency is increased, the reactance decreases. Another curve is given of the total impedance, or the value $(X_c - X_1)$, as indicated in the following table:

$C_{mfd.}$	X_c	$-$	X_c	$=$	X
0.00010	2,512		15,920		$-13{,}408$
0.00020	2,512		7,940		$-5{,}428$
0.00030	2,512		5,315		$-2{,}803$
0.00040	2,512		3,980		$-1{,}468$
0.00050	2,512		3,180		-668
0.00055	2,512		2,890		-378
0.00060	2,512		2,650		-138
0.00065	2,512		2,450		$+58$
0.00070	2,512		2,270		$+242$
0.00075	2,512		2,120		$+392$
0.00080	2,512		1,980		$+532$
0.00085	2,512		1,870		$+642$

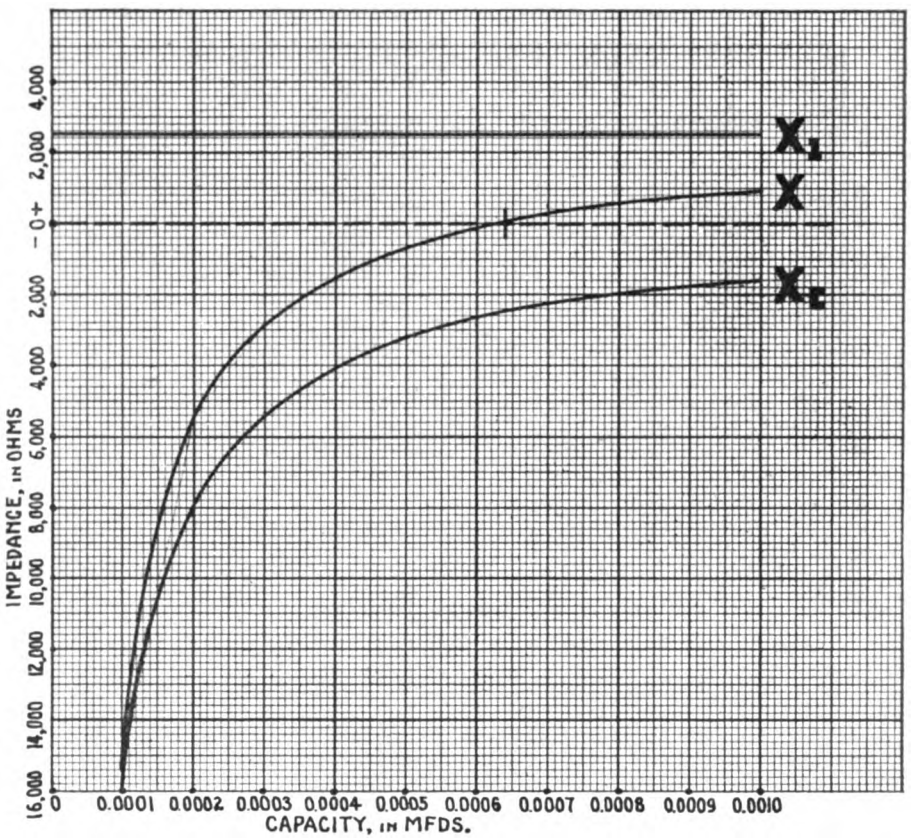


Fig. 4. The inductive reactance is constant, while the capacity reactance is varied above and below resonance

0.00090	2,512	1,760	+	752
0.00100	2,512	1,590	+	922

An examination of the table and curve shows that, with approximately 0.00065 mfd. and the 4 mh. coil, the reactance to 100,000 cycles is zero. Also from

$$\lambda = 59.6\sqrt{L_{cms.} \cdot C_{+mfd.}},$$

the wavelength with these values is

$$\lambda = 59.6\sqrt{4{,}000{,}000 \times 0.00065}$$

or $\lambda = 3{,}030$ meters.

In other words, the wavelength of the circuit, when its reactance to the incoming frequency is zero, is the same as the wavelength of the transmitter.

TUNING THE TRANSMITTER TO THE RECEIVER

In operating practice, the transmitter is never tuned to the receiver, though this is done in adjusting wavemeter to a receiving circuit. Perhaps a coil of 10,000,000 cms. or 0.01 henry is connected with a condenser of 0.001 mfd. or 0.000000001 farad. The wavelength of such a circuit, from (9), is 5,960 meters. A wavemeter is coupled to the inductance, and varied from 4,000 to 8,000 meters. Let us see what the inductive and capacity reactances are at this range of wavelengths or frequencies. The frequencies corresponding to various settings of the wavemeter are:

Wavelength	Frequency
4,000	75,000
4,500	66,700
5,000	60,000
5,500	54,600
5,750	52,200
6,000	50,000
6,250	48,000
6,500	46,200
7,000	42,900
7,500	40,000
8,000	37,500

Then the inductive, capacity, and ef-

Digitized by Google

fective reactances at these frequencies are:

Frequency	X_1	— X_c	= X
75,000	4,710	2,120	+ 2,590
66,700	4,190	2,390	+ 1,800
60,000	3,770	2,650	+ 1,120
54,600	3,430	2,920	+ 510
52,200	3,280	3,050	+ 230
50,000	3,140	3,180	— 40
48,000	3,020	3,310	— 290
46,200	2,900	3,450	— 550
42,900	2,690	3,720	— 1,030
40,000	2,510	3,980	— 1,470
37,500	2,360	4,240	— 1,880

Fig. 5 shows these three values plotted. Above the zero line is the inductive reactance, and below, the capacity reactance. The third curve gives

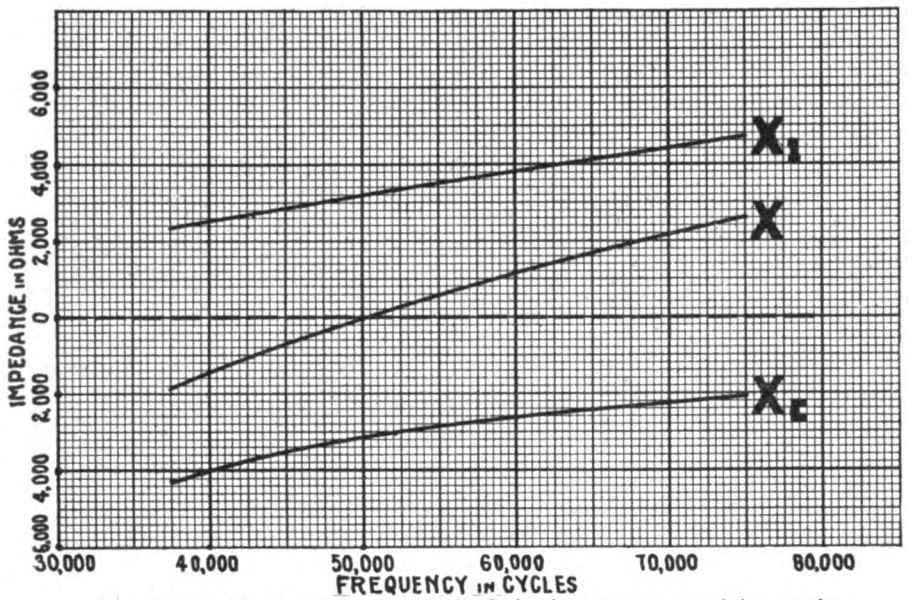


Fig. 5. Showing the reactance of a fixed circuit over a range of frequencies

the effective reactance. When the transmitter is adjusted to the wavelength to which the receiver is tuned, that is, 5,960 meters or 50,400 cycles, the effective reactance is zero, and the current is only limited by the direct current resistance of the circuit.

Why the Secondary Condenser of an Audion Receiver Should Be Small

Statements have appeared several times to the effect that, because the audion is a voltage operated device, the secondary tuning condenser should be small. Just why this is, if it is, may not be apparent to the average experimenter.

Suppose that a resistance of 10 ohms is in a circuit carrying 2 amperes. If a voltmeter is connected across the resistance, it will measure

$$E = I R \qquad (10)$$

or $E = 2 \times 10$

$E = 20$ volts

as shown by the meter.

Again, if two resistances of 2 and 8 ohms are in series carrying 2 amperes, the voltage across each one will be found from (10) to be 4 and 16 volts. Thus, in a series circuit, the total voltage drops across the individual parts equals the applied voltage. The higher the resistance, the greater the voltage difference between the terminals of the resistance up to a point where the circuit is practically open.

Now let us go back to an alternating current circuit. By increasing the inductance and decreasing the capacity, let us keep the effective reactance zero at 100,000 cycles or 3,000 meters.

$L_{cms.}$	X_1	$C_{mfd.}$	X_c
10,000,000	6,283	0.000253	6,283
9,000,000	5,654	0.000281	5,654
8,000,000	5,026	0.000316	5,026
7,000,000	4,398	0.000361	4,398
6,000,000	3,770	0.000422	3,770
5,000,000	3,140	0.000506	3,140
4,000,000	2,513	0.000633	2,513
3,500,000	2,200	0.000723	2,200
3,000,000	1,885	0.000843	1,885
2,500,000	1,570	0.001010	1,570
2,000,000	1,257	0.001270	1,257
1,500,000	942	0.001700	942
1,000,000	628	0.002530	628

It is obvious from the table that, if the capacity is increased and the inductance reduced to maintain the same wavelength, the impedance of the condenser is reduced. The voltage across the condenser varies with its impedance. Therefore, if a large condenser is employed, the drop across the condenser is lowered and the voltage applied to the grid of the audion is reduced.

MEASUREMENT OF HIGH FREQUENCY RESISTANCE

(*Continued from page* 253)

resonance, the inductive reactance of the coil cancels the capacity reactance of the condenser and the current is limited only by the resistance. The current is maximum and produces a maximum voltage across the condenser through which it flows.

Place the switch S in the position 2 and adjust C_v until the reactance of C_v cancels the reactance of L_u and the current in the total circuit becomes a maximum again. In this case the same driving E.M.F. exists and the current is limited by the sum of the resistances R and R_u. This reading of the galvanometer will obviously not be as high as the first, due to the addition of the resistance R_u.

This at once suggests a method of determining the resistance R_u. Suppose the switch S is now thrown to position 1 and circuit L_u R_u C_v replaced by the resistance which is varied until the same voltage across C_p, as indicated by the galvanometer reading G_2, is obtained. When this condition obtains the substituted resistance is equal to the resistance of the coil.

FEED BACK EFFECTS IN AMPLIFIER CIRCUITS

WHEN your amplifier sings and howls, go over your wiring. If the connections of the detector and the subsequent circuits are parallel or close together, the coupling between them causes the circuits to react upon each other. This effect is often caused by switches or connectors. If the trouble is not remedied by spacing the wires and putting them at right angles, anti-capacity switches are required.

COMMUNICATION FROM LYONS, FRANCE

THE radio station at Lyons, France, is equipped with a 250 k.w. arc and a 350 kw. Bethenod high frequency alternator. It is understood the alternator will soon be used to the exclusion of the arc set, though the latter is now doing practically all the work.

Below is the schedule on which the station is now operating, the time indicated being Greenwich mean time:

12.00 midnight to 3.30 A. M.

Duplex communication at 15,500 meters wavelength with Annapolis (NSS), which operates on 16,800 or 18,000 meters, and also with New Brunswick (NFF), which operates on 13,600 meters.

3.30 A. M. to 4.30 A. M.

Press new at 8,000 meters.

5.30 A. M. to 6.30 A. M.

Press news at 8,000 meters.

9.10 A. M. to 9.00 P. M.

This period is for duplex work with America, though the schedule is not entirely settled.

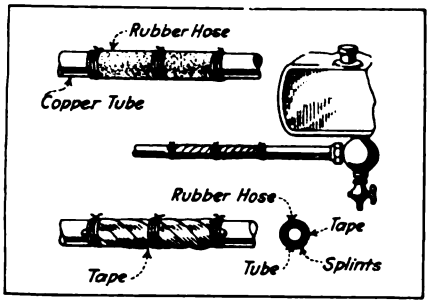
9.00 P. M. to 10.00 P. M.

Press news to Holland, in the French language, transmitted at 8,000 meters.

Digitized by Google

STOPPING FUEL-PIPE LEAKS

ONE of the simplest emergency methods is to utilize a section of rubber tubing which is slipped over the meal pipe, but if the break be in the center of the line and the rubber hose light-walled, the vibration would tend to chafe the rubber. The latter should be braced by splints and the manner of attachment is shown in accompanying cut. Where this is not obtainable a repair may be made with ordinary friction tape. Light splints or strips of wood are laid lengthwise on a first double winding of tape and in the same direction as the pipe and the outer tape wound as depicted, being tied with twine or copper wire. The wrapping should be smug where the break occurs to prevent leakage of the fuel. A small crack may be treated in a similar manner or by using soap and tape as the former is not affected by gasoline; in fact, a piece of this material is invaluable in the tool kit. Shellac may also be used in conjunction with tire tape. Any piece of rubber hose that will go over the pipe may be used to join the broken pieces of tube temporarily together.



LIGHT ABSORBING PROPERTIES OF WALL-PAPER

THE color of wall-paper used in a room may decide whether one lights one or more lamps. White walls absorb only thirty per cent of the light, but nearly everyone wants some color that is easier on the eye. Chrome yellow absorbs only thirty-eight per cent. Paper of an orange shade robs one of fifty per cent of his light. It is when one gets into reds and greens that the light begins to dim. A dark-green wall-paper, so restful to the eye, absorbs eighty-two per cent of the light; and paper of a deep chocolate color leaves only four per cent of the light rays for use. Its power of absorption is ninety-six per cent.

Norway is credited with the longest aerial power cable, which spans a stretch of water in one of the fiords. There are three cables with a span of 1,384 meters, nearly a mile; the cables are 40 meters above the water at their lowest point; in their crossing they drop 80 meters from the level line. In still weather the tension is four tons; when it blows it may be double this amount.



"$1,000 Saved!"

"Last night I came home with great news! Our savings had passed the $1,000 mark!

"I remember reading one time that your first thousand saved is the most important money you will ever have, for in saving it you have laid a true foundation for success in life. And I remember how remote and impossible it seemed then to have such a sum of money.

"I was making $15 a week and every penny of it was needed just to keep us going. It went on that way for several years. Then one day I woke up! I found I was not getting ahead simply because I had never learned to do anything in particular. As a result whenever an important promotion was to be made, I was passed by. I made up my mind right then to invest an hour after supper each night in my own future, so I wrote to Scranton and arranged for a course that would give me special training for our business.

"I can't understand why I had never realized before that this was the thing to do. Why, in a few months I had a whole new vision of my work! The general manager was about the first to note the change. An opening came and he gave me my first real chance—with an increase. A little later another promotion came with enough money to save $25 a month. Then another increase—I could put aside $50 each pay day. So it went.

"Today I am manager of my department—with two increases this year. We have a thousand dollars saved! And this is only the beginning. We are planning now for a home of our own. There will be new comforts for Rose, little enjoyments we have had to deny ourselves up to now. And there is a real future ahead with more money than I used to dare to dream that I could make. What wonderful hours they are—those hours after supper!"

For 29 years the International Correspondence Schools have been helping men and women everywhere to win promotion, to earn more money, to have happy, prosperous homes, to know the joy of getting ahead.

More than two million have taken the up road with I. C. S. help. More than 100,000 are now turning their spare time to profit. Hundreds are starting every day. Isn't it about time for *you* to find out what the I. C. S. can do for you?

You, too, can have the position you want in the work of your choice, you can have the kind of a salary that will make possible money in the bank, a home of your own, the comforts and luxuries you would like your family to have. No matter what your age, your occupation or your means—you can do it!

All we ask is a chance to prove it—without obligation on your part or a penny of cost. That's fair, isn't it? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6082-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Show Card Writer
Electric Car Running	Outdoor Sign Painter
Heavy Electric Traction	RAILROADER
Electrical Draftsman	ILLUSTRATOR
Electric Machine Designer	DESIGNER
Telegraph Expert	BUSINESS MANAGEMENT
Practical Telephony	Private Secretary
MECHANICAL ENGINEER	BOOKKEEPER
Mechanical Draftsman	Stenographer and Typist
Toolmaker	Cert. Pub. Accountant
Ship Draftsman	Traffic Management
Machine Shop Practice	Commercial Law
Gas Engineer	GOOD ENGLISH
CIVIL ENGINEER	Common School Subjects
Surveying and Mapping	CIVIL SERVICE
MINE FOREM'N OR ENG'R	Railway Mail Clerk
ARCHITECT	STATIONARY ENGINEER
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles

Spanish
French
Italian

Name _____

Present Occupation _____ 7-20-19

Street and No. _____

City _____ State _____

WIRELESS MANUAL

We make a charge of 25c for it issuing a coupon receipt redeemable on a purchase of $5 or more.

No. K-12
Ready May 25

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

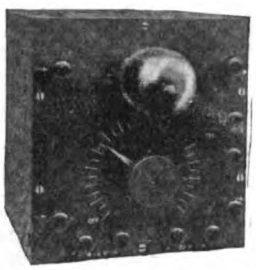
Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble.

Our 180 page combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments.

MANHATTAN ELECTRICAL SUPPLY CO., INC.

New York—17 Park Place
Chicago—114 So. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.

Digitized by Google



RADIO INTERNATIONAL

VACUUM TUBE DETECTOR
or
SINGLE STAGE AMPLIFIER

Single tube Detector and Amplifier Units are among the most useful of the Interchangeable panel instruments in the International Experimental Apparatus Line.

READY FOR IMMEDIATE DELIVERY

AUDION DETECTOR RTD-102-A $15.00

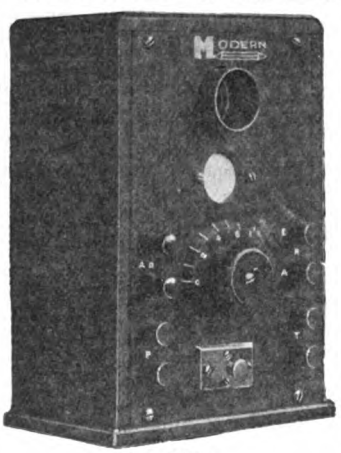
SINGLE STAGE AMPLIFIER RTA-104-A.$26.00

F. O. B. NEW YORK CITY

Write to Dept. 21 for our new completely illustrated FREE six-page bulletin index.

International Radio Telegraph Company
326 BROADWAY NEW YORK CITY

ANOTHER "MODERN"



Type HBD
Vacuum Tube Control Cabinet

Designed and built the "Modern" Way. Price complete less battery and tube,

$15.00

Beautiful mahogany finished case with handsome grained bakelite panel on which is mounted a standard socket, rheostat, grid leak, condensor and switch for arc and spark reception.

THIS INSTRUMENT IS THE LAST WORD IN VACUUM TUBE CONTROL CABINETS.

Prompt shipments from stock.

ORDER NOW.
DETECTOR AND TWO STAGE AMPLIFIER
TYPE HBA.

Our new instrument which surpasses all others. It is in a class by itself. Price complete less tubes and batteries, $75.00.

Look for the "Modern" Trade-Mark. It is your guarantee of complete satisfaction and of the best instruments money can buy.

"Modern" apparatus sold at authorized "Modern" agencies.

MODERN RADIO EQUIPMENT CO.
Designers and Manufacturers of High Grade Radio Apparatus.
ELIZABETH, NEW JERSEY

American Electro Technical Appliance Company
Dept. EM, 235 Fulton Street, New York City

Partial List of What We Distribute:

Loose Couplers, $5.00, $10.00, $15.00, $19.00.
Tuning Coils, 4,000 Meters, $4.75; 1,250 Meters, $3.50.
Crystal Detectors, $1.75; DeForest Type, $2.60.
Murdock Variable Condensers, .001 MFD, $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 MFD, 70c; .003, 90c.
Spark Gaps, 75c, 90c, $2.00.
Oscillation Transformer (Murdock Type), $5.00.
Oscillation Transformer (Signal Type), $16.00.
Lightning Switch, 600 V.-100 AMP., $3.94.
Switch Points 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
Dials (Black), 3" and 3½", 75c; with Knob, $1.25.
White Metal Dials, 3", 50c.
Binding Posts, 9c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
Parkin Rheostats, $1.00.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
All the Cole and Morgan Books.
Hawkins Electrical Guides.
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; DeForest Type, $1.50.
Western Electric Phones, $12.00.
DeForest Coils, All Sizes.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Oscillation Helex, Complete to Assemble, $3.00.
Loads of Other Apparatus On Hand.

RECOVERY OF SILVER FROM OLD CYANIDE PLATING SOLUTIONS

THE baths may be evaporated to dryness, the residue mixed with a small quantity of calcined soda and potassium cyanide and fused in a crucible, whereby metallic silver is formed, which, when the heat is sufficiently increased, will be found as a button upon the bottom of the crucible; or if it is not desirable to heat to the melting point of silver, the fritted mass is dissolved in hot water, and the solution containing the soda and cyanide quickly filtered off from the metallic silver. The evaporation of large quantities of fluid is, to be sure, inconvenient, and requires considerable time, but the reducing process above described is without doubt the most simple and least injurious.

According to the *wet method*, the bath is strongly acidulated with hydrochloric acid, observing the precaution to provide for the effectual carrying off of the hydrocyanic acid liberated as given under gold. Remove the precipitated chloride of silver and cyanide of copper by filtration, and after thorough washing, transfer it to a porcelain dish and treat it, with the aid of heat, with hot hydrochloric acid, which will dissolve the cyanide of copper. The resulting chloride of silver is then reduced to the metallic state by mixing it with four times its weight of pulverized charcoal. The whole is made into a homogeneous paste, which is thoroughly dried, and then introduced into a strongly heated crucible. When all the material has been introduced the heat is raised to promote complete fusion and to facilitate the collection of the separate globules of silver into a single button at the bottom of the crucible, where it will be found after cooling.

If granulated silver is wanted, pour the metal in a thin stream, and from a certain height, into a large volume of water.

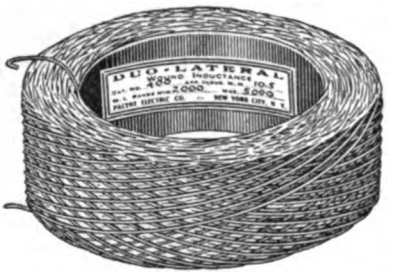
EMERGENCY DIMMER FOR AUTO LAMPS

THE cruising radius for motor trucks is constantly increasing and frequently the drivers are called upon to make deliveries in cities or towns where local ordinances demand a special kind of lamp dimmer, differing from that which the regulation at home requires. Sometimes this causes a lot of trouble for the driver, who must find some means of keeping within the law. In some cases it is possible to use mud, and by smearing it on the glass, the light is dimmed to satisfy the most exact guardian of the peace. Graphite grease or some other substance that makes a greasy smear, also furnishes an excellent emergency dimmer.

Digitized by Google

SOMETHING NEW!
DUO-LATERAL WOUND COILS

THE DUO-LATERAL COILS now being offered for the first time are not to be confused with any other types of machine wound inductances which have been on the market for some time.



The Duo-Lateral Coil made in various sizes for general and specific application has the following distinct advantages which make it superior to any other coil for amateur and commercial work alike.

1. *Lower natural period.*
2. *Lower high frequency resistance.*
3. *Very low distributed capacity.*
4. *Lower direct current resistance.*
5. *Higher self-inductance.*
6. *Mechanically stronger.*

Bulletin PIE, containing valuable engineering data, constants and prices of numerous sizes of Duo-Lateral Coils covering practically every wavelength used, is yours for the asking.

MANUFACTURERS, DEALERS, JOBBERS and DISTRIBUTORS—write for our proposition.

SALES AGENTS for Electrical Products Mfg. Co., A. H. Grebe & Co., Dubilier Condenser Co., Richter and Byrne, Rawson Electrical Instrument Co., The Magnavox Company and others.

PACENT ELECTRIC COMPANY, Inc.

Builders and Specialists in Radio, Electrical and Laboratory Equipment

150 NASSAU STREET Telephone: Beekman 5810 NEW YORK CITY

Federal Radio Accessories

Are the Recognized STANDARDS for Their Respective Uses.

BULLETIN 102 W.A.

Gives full description. Besides it contains valuable information on

AMPLIFICATION of Radio Signals

Send 6c in Stamps today and receive this Bulletin.

FEDERAL TELEPHONE AND TELEGRAPH CO.
1756 Elmwood Avenue
BUFFALO, N. Y.

We're Prompt!

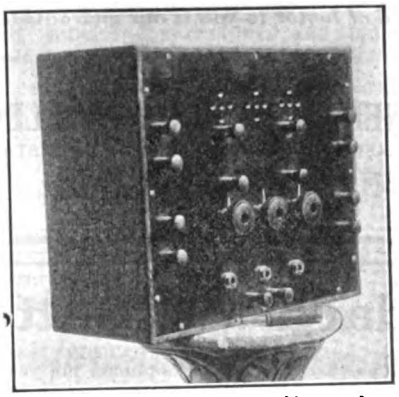
RECO QUALITY

You don't have to wait from three weeks to three months, for the apparatus you order. On everything except apparatus specially constructed to order, you'll have the benefit of

Shipment Guaranteed Within Twenty-Four Hours

Audions and Amplifiers

Audion Control . . $22
Without bulb or B batteries:—
1 Step Amplifier
Without Detector . $28
With Detector . . . $33
2 Step Amplifier
Without Detector . $45
With Detector . . . $50



10-Ampere Reco Key

Mounted on Italian marble base, with solid silver bar contact points, finished in brushed brass or nickel. Absolutely no side play in this Key. A great big special at $6.50 postpaid.

If you want a bright, snappy, monthly bulletin that means something; send us 6c in stamps.

NEW! An Adaptor for Tubular Bulbs—fits any socket; is rugged—simple and 100 per cent. efficient, and positively vibration-proof—Immediate Delivery **$1.50**

Radisco Agents for the South
C. D. BLAIR
P. O. Box 859
Richmond, Va.

The Radio Engineering Co.
Baltimore, Md.

614 North Calvert Street

A NEW DETECTOR

That can either be used as a Panel Unit, as advocated by this magazine or "on the table," and only one knob is used for Position and Pressure. Instantly adjustable to any spot on the crystal. Price includes tested galena. Base 5 ins. by 2½ ins. $2.50. Base 5 ins. by 5 ins. 3 cups $3.00.

Just write for information and list

THE BARWICK RADIO SUPPLY CO.
89 Britannia Ave. Hamilton, Ont., Can.

REWINDING A. C. MOTOR

And all methods for connecting and reconnecting clearly shown in the ELECTRICAL WORKER FRIEND. 66 diagrams with detailed explanatio solving every rewinding and reconnecting proble Electricians and Experimenters will find this be exactly what the name implies "The Electri Workers Friend." Price $4.00 Cash with order (C.O.D.—U.S.A. only).

HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Pen

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

THIS—
the second

Announcement

since our entrance into the Radio and Electrical field, is published to acquaint you with the fact that we have been taken at our word as an organization specializing in

"PERSONAL SERVICE TO THE CONSUMER"

Our efforts will always tend to serve each one of you individually and promptly, through our sales or mail order department, and to this end we have contracted with over ninety per cent. of the leading manufacturers, which means that we will carry everything Radio from Contact Points to Complete Stations.

Among the serviceable and high quality Radio and Commercial Apparatus which we offer you are to be found the foremost products of

Radio Craft Co., A. H. Grebe, Clapp-Eastham, International-Radio Tel. Co., De Forest, W. J. Murdock, J. H. Bunnell, American Radio & Research, Manhattan Electrical Supply Co., General Radio, Acme, Marconi, S. Cohen, Federal Tel. & Tel., Electrose, Brandes, Pacent Electric, Wireless Equipment, Wireless Improvement, Cole & Morgan, books; Wireless Press, books; Endurance Storage Batteries, Marko Storage Batteries, Standard V. T. Batteries, Adams-Morgan, Dubilier Condensors; Firth, Omnigraph; Magnavox and others.

We also carry a large stock of high grade Electrical Apparatus, including a very complete line of Heating Appliances.

You have our most courteous invitation to spend a few moments in our spacious show rooms to look over our complete stock. We will gladly show you any instrument or part you may desire to examine. It will be a revelation to you, besides, it is part of our service.

Our word of honor to you is our guarantee. Let us prove it.

Write Dept. F6 for literature and price lists

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Secretary **J. STANTLEY, Treasurer**

6 WARREN STREET **NEW YORK**

Standard VT Batteries

When you purchase a "STANDARD VT BATTERY" you enjoy that satisfaction that comes from obtaining full value for your money.
Reputable dealers throughout the United States, who have their customers' interests at heart, distribute "STANDARD VT BATTERIES" because they know they are selling the most reliable "B" Battery at a reasonable price. They are in the position to know, and they don't take chances—do you? The next time, buy a "STANDARD VT BATTERY" and understand why it is best.
For your protection, let us caution you to refuse imitations or substitutes. Insist upon the genuine "STANDARD VT BATTERY" with the trade-mark written as shown in the adjacent photograph of Cat. No. 7623 STANDARD VT BATTERY—a very popular size.



RICHTER & BYRNE, Manufacturers, 198 Roebling St., Brooklyn, N. Y.
Pacent Electric Co., Inc., Sole Eastern Agents, 150 Nassau St., New York, N. Y.

Should you know of a worthy young man desirous of obtaining a good technical education and making a good future for himself refer him to our announcement on page 274 of this number.

STAND-BY-LOSSES

A CHARACTERISTIC expression occurs in English engineering literature which expresses very well a source of inefficiency and low yield in mechanical operations. It is "stand-by-losses." It indicates such cases as the maintenance of steam pressure, with consequent expenditure of fuel, when the engine is not running and no steam is being taken from the boiler. An automobile standing at the curb with its engine running "idling" is the appropriate term, is a good example of a "stand-by-losses." A steam-trawler lying to on the fishing grounds is cited by an English contemporary as an example and this loss is taken as a plea in the use of the easily started gas engine in trawlers. There is no trouble in finding far too many cases of "stand-by-losses" in the engineering world. In the household there are numerous examples, and the extensive use of two very expensive sources of heat, gas and electricity, for cooking, is only made economical by the ease with which gas or current is turned off, minimizing "stand-by-losses."

PITH AS A LENS CLEANER

IT is said that any ordinary cleaning medium that can be used is likely to smear and even scratch a lens in the cleaning, the latter being a serious condition in the case of lens used in photographic apparatus, especially when used for photo-micrography or study of structure of metals. A very perfect lens cleaner can be made by using the pith of such plants as sunflower, rush or elder. Strips of the dry pith are cut, and these are fastened with an adhesive to a piece of cork. The pith may be arranged in rows, with small spaces in between. The lens is rubbed gently with the pith and all marks disappear.

The basic process of treating steel consists in general terms in the use of alkaline earths. The linings for the furnaces or converters work so effectually in removing the phosphorous from iron ore that phosphorous is desired for the process in order to provide heat. This impurity, which in other processes it is desirable to keep out of the iron ore, becomes an advantage in the basic process. When the slag from the basic process is finely ground it is used as a fertilizer. If the process is run simply from the steelmaker's point of view the slag may be a very poor fertilizer. Sometimes to make the slag more fusible calcium fluoride or chloride is added to the flux. This reduces the solubility of the phosphate and makes it of less use to the farmer. England is taking up the question vigorously with the idea of making the slag of high value in agriculture.

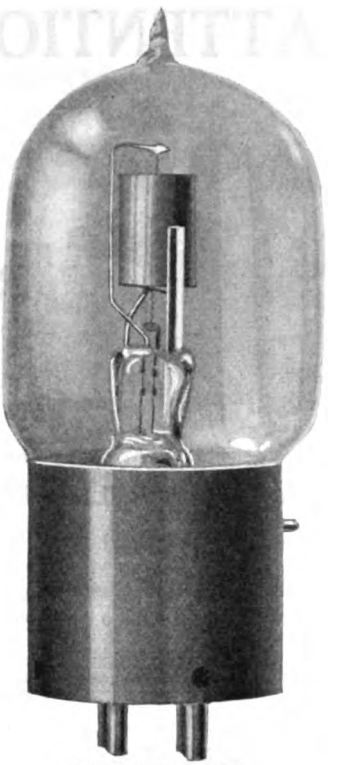
Digitized by Google



The Moorhead Electron Relay

PRESENTING
TWO NEW TYPES OF VACUUM TUBES FOR EXPERIMENTERS

MOORHEAD LABORATORIES


The Moorhead VT Amplifier-Oscillator

THE MOORHEAD PERFECT VACUUM TUBE COMBINATION

—perfected to meet the increasing demand for tubes of superior efficiency, wherein all desirable characteristics are combined without subordinating any essential elements. A combination of two or more *VT tubes as amplifiers* with an *Electron Relay* as the *initial detector* or oscillator is the *ideal receiving combination* for long distance amateur or long wave reception. Both types of tubes are *rugged* in construction and unqualifiedly guaranteed.

THE MOORHEAD ELECTRON RELAY

The Electron Relay is the original tubular vacuum valve brought out by this company in 1915, now supplied with the standard four prong base for convenience. This tube has the familiar "hissing" point and low B battery potential characteristic of the perfect vacuum detector. Of all vacuum tubes the *Moorhead Electron Relay* is the *most efficient spark receptor.*

Price — $6.00 each. Immediate deliveries. Order from your dealer or remit direct to address below.

THE MOORHEAD VT AMPLIFIER-OSCILLATOR

The VT Amplifier-Oscillator is the Navy SE 1444 "hard" tube, and is designed and manufactured expressly for amplification and oscillation purposes. Particular attention is invited to the large amplification constant of this tube. Recent official Navy tests show conclusively that the Moorhead VT tube has a *higher amplification constant* than any other vacuum tube known to the radio art.

Price — $7.00 each. Immediate deliveries. Order from your dealer or remit direct to address below.

Dealers write for prices and particulars.

BOTH TUBES LICENSED UNDER THE DE FOREST AUDION AND FLEMING PATENTS

Amateurs write for descriptive literature.

PACIFIC RADIO SUPPLIES CO.—SOLE DISTRIBUTORS FOR

MOORHEAD LABORATORIES, INC.

Reference—The American National Bank, San Francisco.

638 MISSION STREET - SAN FRANCISCO - CALIFORNIA

EASTERN AGENTS—THE ATLANTIC RADIO SUPPLIES CO.
NUMBER EIGHT KIRK PLACE, NEWARK, NEW JERSEY—PHONE MARKET 1575

Digitized by Google

ATTENTION AMATEURS



The only practical adapter

Price $1.50

RADISCO AGENCY

We make up sets to specifications

Made by the

AMATEUR WIRELESS EQUIPMENT CO.

1390 Prospect Ave., Bronx, N. Y.

Catalogue sent on receipt of 10c, which may be deducted from first order.

AWE NY

Dealers write for proposition

"Sparks" says:

"Lasting Satisfaction

is measured to a great extent by the initial quality of the radio apparatus you purchase."

Our high grade line of Standard-make Commercial and Amateur Radio equipment embodies the latest ideas in design and workmanship which assure you of lasting satisfaction under all operating conditions.

Our Specialty

is rendering you such Service that you may always know your interests will be looked after as to Quality and price.

Call on us when in town. Your wants will be Quickly and Satisfactorily looked after.

Our latest catalog is yours for 10 cents to cover postage. Write for it today.

"Quality Radio Apparatus and service"

The International Electric Co.

Eugene Dynner, President

226-A Fulton Street New York, N. Y., U. S. A.

"PRECISION"

In Every Sense of the Word

Radio Transmitting and Receiving Apparatus of Precise Performance

Instruments Built to Specifications

Standard and Special Equipment for School and Laboratory Use

Hot-Wire and Milliammeters

J. EDW. BROADBELT, Jr.

Maker of

PRECISION RADIO EQUIPMENT

553 E. Thirty-Eighth Street Baltimore, Md.

BE SURE AND ORDER YOUR COPY

OF EVERYDAY ENGINEERING MAGAZINE FOR JULY NOW TO INSURE GETTING IT.

HEAT TREATING ALLOY STEEL

(*Continued from page* 203)

table herewith gives the color and corresponding temperature at which the various tools mentioned are best quenched.

Temperatures for Tempering

The following table gives the required temperature in Fahrenheit degrees to produce certain colors, when tempering hardened steel:

Lathe, shaper and planer tools:
- 430. Very light straw.
- 450. Light straw.

Taps, dies and wood turning tools:
- 470. Dark straw.
- 490. Very dark straw.

Hatchets, chisels, etc.:
- 500. Brownish yellow.
- 520. Yellow tinged with purple.
- 530. Light purple.

Springs, etc.:
- 550. Dark purple.
- 570. Dark blue.

The following table gives the proportional parts of lead to one pound of tin, which when melted will have the required temperature to produce certain colors on hardened steel, by simply immersing the parts to be treated in the molten metal:

	TEMPERATURE	
Color	F. Deg.	Proportions
Very light straw....	430	1¾ to 1
Light straw.....	450	2⅛ to 1
Dark straw.....	470	2½ to 1
Very dark straw...	490	3½ to 1
Brownish yellow...	500	4¾ to 1
Light purple.....	530	7½ to 1
Dark purple.....	550	12 to 1
Dark blue.....	570	25 to 1

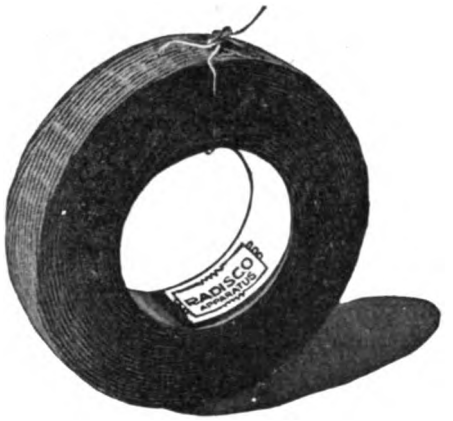
When small work is tempered in large quantities the above method is expensive as the pieces are handled individually and is not as reliable as when the articles are heated in a kettle of oil, using a thermometer for indicating the temperature or in a lead pot furnace. A piece of perforated metal is used to keep pieces away from the bottom of the oil kettle, though a wire basket will serve the purpose even better. As soon as the parts are raised to the required temperature they are quenched to cool.

Case Hardening

When an article of low carbon steel is to have a hard surface it is not possible to treat it by merely heating and quenching, as there is not enough carbon in the steel to insure proper hardening. One process of treating such materials is known as "case" hardening and consists of covering the surface while red hot with some material which forms a coating or case steel, which can be hardened by quenching, as in previous processes. Small parts, such as nuts, bolts, cones, etc., may be case

(*Continued on page* 268)

Digitized by Google



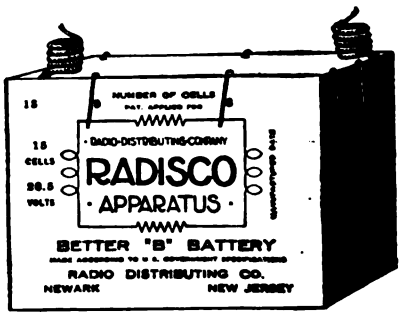
Two Famous
RADISCO SPECIALTIES

RADISCO COILS

conceded by several well known Radio Men to be far superior to any similar type of Inductances. Made in seventeen sizes, tapped and plain. Wave length range from 200 to 20,000 meters, priced from 70c to $4.85. Plentiful supply in stock at all Radisco Agencies.

RADISCO BETTER "B" BATTERY

is made according to Government specifications in two (2) sizes—3¼x2x2½" and 6½x4x3". A first-class 15 cell, 5 group battery, VARIABLE VOLTAGE (Pat. applied for) is a special feature of this battery which enables you to provide critical voltage regulation for your vacuum tube by means of a switch connection with cells, taps of which have been taken off. Very economical and convenient. If one cell goes bad just test each group of 3 cells and short circuit the bad one. Price, small size, $1.40. Large size, $2.40, at any agency, or if ordered by mail include postage for 2 pounds on small size and 5 pounds on large size.



RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the RADISCO COILS, Better "B" Batteries and are our Agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace

ATLANTIC CITY, N. J.
Independent Radio Supply Co.
118 So. New Jersey Ave.

BALTIMORE, MD.
Radio Engineering Co.,
614 North Calvert St.

BEINVILLE, QUEBEC, CAN.
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street.

BROOKLYN, N. Y.
Kelly & Phillips Electric Co.,
312 Flatbush Ave.

BRONX, NEW YORK
Amateur Wireless Equipment Co.,
1390 Prospect Ave.

CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.

EUREKA PEORIA ILLINOIS
Klaus Radio Co.

HAMPTON, N. H.
Delancey Felch & Co.,

LOS ANGELES, CALIF.
The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.
K. & L. Electric Co.,
427 Olive Street.

NEW ORLEANS, LA.
L. A. Rose,
121 Camp St.

NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street.

NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave.
"8HA"

PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets.

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.
45 Washington Street.

PITTSBURGH, PA.
Radio Electric Co.,
4521 Forbes St.

SCRANTON, PA.
Shotton Radio Mfg. Co.,
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street.

TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street.

WASHINGTON, D. C.
National Radio Supply Co.,
808 Ninth St., N. W.

WICHITA, KAN.
The Cosradio Co.,
1725 Fairmount Ave.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY : : Newark, New Jersey

Digitized by Google

A GOOD WAVEMETER
AT A MODERATE PRICE



TYPE B. Q. WAVEMETER

is accurate, simple and rugged. Comprises a portable oak case 5¾" x 8¼" x 6½" with hinged cover, bakelite panel, balanced condenser, buzzer, detector, switch, binding posts, and two 2-unit inductance windings, range 200 to 2000 meters.

Price $27.50

These meters are in stock for immediate delivery, and are carried in stock by most good dealers.

Bulletins E and F sent for 4c Stamps list our complete line of high grade, moderately priced apparatus for the radio laboratory. Bulletin R lists the Cambridge Rectifier for Storage Battery Charging.

CLAPP-EASTHAM CO., 131 Main Street, Cambridge, Mass.

EXPERIMENTAL
· SCIENCE ·

· CHEMISTRY ·

A New Magazine of Science for the Experimenter and Practical non-Technical Man.

RADIO

· PHYSICS ·

First Issue out May 5th. $1.50 per year; Canada $1.75, 'New and Original.'

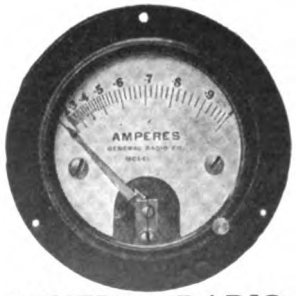
WRITTEN BY AUTHORITIES

Literature Sent on Request

Send In Your Subscription NOW!

Experimental Science Publishing Company
710 Fourteenth Street Washington, D. C.

OF SPECIAL INTEREST TO AMATEURS!



We have a number of GENERAL RADIO CO. HOT WIRE AMMETERS range 0-2.5 amperes which were left on our hands at the termination of the war. These instruments are of the flush type, calibrated, and in good condition, exactly like a large number supplied by us to the U. S. Army Air Service.

We also have a few ammeters of the same type, range 0-1 ampere, adapted to use in measuring the filament current of vacuum tubes or low power transmitting sets.

While they last, $5.00 will bring you either range, although our regular price is $10.00.

Dealers write for our proposition

GENERAL RADIO **COMPANY** **CAMBRIDGE, MASS.**

Arnold

Loose Couplers

Combination Loose Couplers Parts and accessories.

Send 4c stamp for literature which is sure to interest you.

J. F. ARNOLD 2082 Lexington Av., N.Y. Established 1910

RADIO APPARATUS
on the
INSTALLMENT PLAN

Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.

J. DONALD VANDERCOOK
LOMBARD Box 442 ILLINOIS

HEAT TREATING ALLOY STEEL

(*Continued from page* 266)

hardened by heating red hot and covering with a thin layer of powdered cyanide of potassium, and when this melts, the article is again heated to a red heat and plunged in water. While the above process is suitable for hardening a few small pieces, it is not recommended for large quantities of work, as the results would not be uniform and the process would be too expensive, besides, the hardening is superficial and only a thin skin.

If many small pieces are to be case hardened at the same time, they may be treated in much the same manner as in box annealing. Granulated raw bone, and granulated charcoal should be mixed in equal proportions and a layer of this mixture placed in an iron pot box to the depth of one or one and one-half inches. A layer of the articles to be treated is then placed in this and these are covered with more material, the same care being observed in packing and with regard to test pieces as with other processes. After the container has been sealed with fire clay luting, it is placed in a carburizing furnace and the temperature maintained at a point which will keep the pieces at a bright red heat for periods varying with the degree of the surface hardening desired. Generally carbon will penetrate the surface of wrought iron or low-carbon steel one-eighth inch in 24 hours, but as it is seldom necessary to harden any deeper than one-thirty-second inch, the work may be taken out after four or five hours. After small pieces are heated the contents of the pots may be emptied directly into a tank of brine around which there is a constant circulation of water to keep it cool. If great toughness is required, the packing material is sifted out and the pieces quenched in oil. Large pieces must be dipped one at a time and can be wired so that they can be removed from the hardening box when desired. There has been great development of late in scientific heat treatment, which will be described more at length in other articles of this series. The processes which have been described are simple ones which are of particular interest to the practical mechanic or repairman and make clear what is meant by heat treatment.

(*To be continued*)

ED. NOTE. The next instalment will outline the construction of various forms of furnaces used in heat treating and explain how to distinguish the various types.

Digitized by Google

SOME WICONY PRODUCTS

Audion Control Panel
Audion Amplifiers
Audion Accessories
Complete Receivers and Accessories
Complete Transmitters and Accessories

COMMERCIAL EXPERIMENTAL wicony RADIO PRODUCTS EDUCATIONAL LABORATORY

DEALERS

If you are a reliable, progressive dealer, it will pay you to write us.

Write today.

Your Holidays

You can do more during your vacation than in all the evenings you have spent on your station during several months. It will not only be a recreation but will improve YOU and YOUR STATION.

Sent on Approval for Comparisons

In order to help you choose the "best wireless value per dollar" we will ship you any Wicony product on 5 *days' approval.* If, after receiving it, you are not satisfied in every respect, ship it back within five days and we will refund your money. We want you to see the inside design and workmanship of the apparatus as well as that showing on the outside.

You may have the Wicony bulletins and cover for the small sum of 10c. If you have not received yours, write immediately to be put on our "bulletin mailing list."

WIRELESS IMPROVEMENT COMPANY

Radio Engineers, Manufacturers and Distributors

47B West Street **New York, N. Y.**

To the Radio Engineer Radio Manufacturer Radio Amateur

You cannot afford to do without the

PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS

In it, you will find all the latest information on **Transmitters, Receivers, Bulbs, Radio Telephony, Elimination of Strays,** and every other **important radio topic.**

Subscription per year { **$9.00 (in U. S.)** / **9.60 (abroad)**

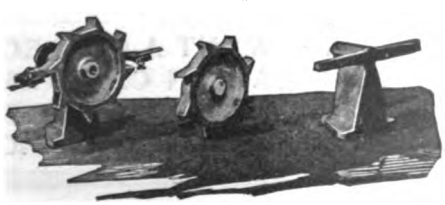
Address

Secretary,

INSTITUTE OF RADIO ENGINEERS

COLLEGE OF THE CITY OF NEW YORK

WILCOX ROTARY GAP



Belt-driven — Well quenched
Solid balanced rotor — Short leading spark
Large steel shaft — Clear tone
Long brass bearing — High Efficiency

COMPLETE $10.00

Postpaid

The WILCOX LABORATORIES Inc.

Lansing Dept. D Michigan

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 6084-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ELECTRICAL ENGINEER
- Electrician
- Electric Wiring
- Electric Lighting
- Electric Car Running
- Heavy Electric Traction
- Electrical Draftsman
- Electric Machine Designer
- Telegraph Expert
- Practical Telephony
- MECHANICAL ENGINEER
- Mechanical Draftsman
- Ship Draftsman
- Machine Shop Practice
- Toolmaker
- Gas Engineer
- CIVIL ENGINEER
- Surveying and Mapping
- MINE FOREM'N OR ENG'R
- ARCHITECT
- Architectural Draftsman
- PLUMBING AND HEATING
- Sheet Metal Worker
- Navigator
- CHEMICAL ENGINEER
- SALESMANSHIP
- ADVERTISING MAN
- Window Trimmer
- Show Card Writer
- Outdoor Sign Painter
- RAILROADER
- ILLUSTRATOR
- DESIGNER
- BUSINESS MANAGEMENT
- Private Secretary
- BOOKKEEPER
- Stenographer and Typist
- Cert. Pub. Accountant
- Traffic Management
- Commercial Law
- GOOD ENGLISH
- STATIONARY ENGINEER
- CIVIL SERVICE
- Railway Mail Clerk
- Textile Overseer or Supt.
- AGRICULTURE
- Poultry Raising
- Automobiles
- Spanish
- French
- Italian

Name_____ 7-28-10

Present Occupation_____

Street and No._____

City_____ State_____

Recognized as the largest and best

Service Radio School

INCORPORATED

Send ten cents for descriptive catalogue to Dept. E, 900-902 Penna. Ave., N. W., Washington, D. C.

Digitized by Google

G. A. STANDARDIZED SUPPLIES

STANDARD BAKELITE PANELS

The highest grade of insulating material obtainable. The use of standard sizes of panels makes possible the interchangeable design of equipment.

Size	1/8 in. Thick	Weight	3/16 in. Thick	Weight	1/4 in Thick	Weight
2½x 5 ins.	$0.30	½ lb.	$0.45	½ lb.	$0.60	½ lb.
5 x 5 ins.	.60	1 lb.	.88	1 lb.	1.16	1 lb.
5 x10 ins.	1.18	1 lb.	1.76	1 lb.	2.30	2 lb.
10 x10 ins.	2.35	1 lb.	3.50	2 lb.	4.60	2 lb.
10 x15 ins.	3.50	2 lb.	5.25	2 lb.	6.85	3 lb.

Accurately cut, always kept in stock. Shipping charges extra.

G. A. STANDARDIZED AIR CONDENSERS

Rugged design, with a consequently permanent calibration is an outstanding feature of the G. A. Standardized Condensers.

Losses as high as 50 to 75% of the energy of received signals are common to condensers having end plates of moulded composition, fibre, or metal with insulating bushings. Losses in the G. A. condensers can be neglected because these heavy end plates are cut from extra grade sheet Bakelite.

Like the other G. A. instruments, these condensers are expensive because they are designed for men of such discrimination that they will not take something just as good, but demand the best.

For vacuum tube transmitters G. A. condensers are practically the only ones available to experimenters which will stand high voltages and heavy currents without breaking down.

SPECIFICATIONS: Small size, 0.00001 to 0.000585 mfd., 29 plates, overall height 3⅛ ins. Large size, 0.000015 to 0.00115 mfd., 59 plates, overall height 6⅝ ins. Bakelite end plates 3¾ ins. diameter. Exceptionally heavy adjustable bearings. Moving plates keyed to shaft. Shaft ¼ in. diameter, protrudes 1 in. from end plate. Hole in end threaded for 6/32 screw. Will take Radisco or Grebe knobs.

PRICE: Small size.....$ 8.85 wt. 2 lbs.
Large size..... 13.65 wt. 4 lbs.
Calibration curve for either size.....$.50

G. A. Standard H. F. Cable for Receivers and V. T. Transmitters

10 No. 38 cable, D.S. covered, for receiving coils. Good for 2-bank winding. 40 turns per inch. Price per 100 feet $0.60.

20 No. 38 cable, D.S. covered. Gives greater signal strength and sharper tuning than solid wire, 35 turns per in., 100 feet $0.95.

3 x 16 No. 38 cable, D.S. covered. Must be used for V.T. transmitting inductances for maximum efficiency 20 t.p.i., 100 feet $2.00.

No. 24 S.S.C. wire,	¼ lb.,	$0.50—	½ lb.,	$1.00—1 lb., $2.00
No. 26 S.S.C. wire,	¼ lb.,	0.60—	½ lb.,	1.20—1 lb., 2.40
No. 28 S.S.C. wire,	¼ lb.,	0.75—	½ lb.,	1.50—1 lb., 3.00
No. 30 S.S.C. wire,	¼ lb.,	0.90—	½ lb.,	1.80—1 lb., 3.60

SEND 3c IN STAMPS FOR G. A. BULLETIN JUST OFF THE PRESS.

MONEY BACK GUARANTEE ON EVERY ORDER

G.A.

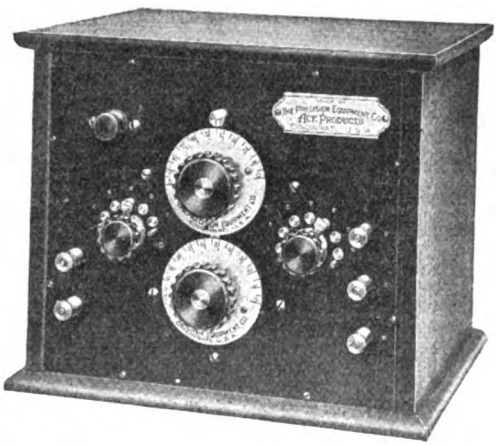
QUICK SERVICE ABSOLUTE RELIABILITY

The General Apparatus Company

4310-A Broadway at 183rd St. New York City

"YOU'D BE SURPRISED"

at the distance, strength of signal and freedom from Q. R. M. you get with Ace equipment. The type T. T. Tuner is *the kind* you want for that extreme long distance work thru the worst Q. R. M. Doc Ace has the right dope when he says "You may pay more, but you can't buy better."



Type T. T. Regenerative Tuner, range 150 to 2750 meters, F.O.B. Cincinnati — $55.00

THE PRECISION EQUIPMENT CO.

2437 Gilbert Ave. Dept. B Cincinnati, Ohio

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 33rd St. *Valparaiso, Indiana*

RADIO APPARATUS

Distributors of reliable Radio apparatus for experimenters in every branch of the Radio field!

"Pittsco" The sign of service.

PITTSCO

"Remember" We carry an immense stock.

HONEY-COMB COILS

LITZENDRAHT WIRE.		(While they last.)
LL-75	330-1030 meters	$1.60
LL-100	450-1460 "	$1.70
LL-150	660-2200 "	$2.00
LL-200	930-2850 "	$2.10
LL-250	1300-4000 "	$2.30
LL-300	1550-4800 "	$2.50
LL-400	2050-6300 "	$2.80
LL-600	4000-12000 "	$3.00
LL-750	5000-15000 "	$3.20
LL-1000	6200-19000 "	$3.50
LL-1250	7000-21000 "	$3.90

Note:—These are the genuine DeForest litz coils.

INDUCTANCE COIL MOUNTINGS FOR HONEY-COMB COILS

No. LC-101 DeForest, mounted on oak base with gears to hold three coils....$13.00
No. LC-201 DeForest, same as above but with primary condenser switch mounted on base $15.00
No. LC-100 Same as LC-101 but without base $10.00
No. ULC-100 Same as LC-100 but mounted on unit panel $10.75
No. ULC-200 Single inductance coil mounting on unit panel..... $2.00
No. ULC-300 Double inductance coil mounting on unit panel..... $4.80
No. ULC-400 Triple inductance coil mounting on unit panel..... $5.60

DE FOREST UNIT PANEL UNITS

No. US-500 Primary condenser or variometer switch $3.00
No. UCS-1500 Loading or Bridging condenser $6.25
No. US-200 Master anti-capacity switch.. $4.40
No. S-200 Master anti-capacity switch unmounted $3.00
No. UD-100 Crystal detector with crystal. $4.30
No. UR-100 Audion tube receptacle..... $2.95
No. US-500 "B" battery switch..... $3.00
No. UF-100 "A" battery filament rheostat $3.80
No. US-400 Tickler or audion-ultraudion 3 point switch $2.25
No. U-200 "A" battery switch and telephone jack $3.25
No. U-300 battery switch and telephone binding posts $2.20
No. U-100 Grid variable condenser and leak $7.75
No. UCV-500 Secondary variable condenser $7.75

Important! Every article sent to any part of the U. S. A. Postage prepaid. We want your business. Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

12 Park Square Dept. F.
BOSTON, MASS., U. S. A.

Telegraph Pictures

BY ELECTRICITY

A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.



L. J. LEISHMAN CO. Dept. L, Ogden, Utah

AMBITIOUS YOUNG MEN

WHO WANT A COLLEGE EDUCATION CAN READ OUR ANNOUNCEMENT ON PAGE 274 TO ADVANTAGE

Digitized by Google



Indicating Dials

Make your radio apparatus up to date. Indicating dials now available at a reasonable price.

Made of fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. Have bevelled edge. We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

If your dealer cannot supply you send us his name with your order. Immediate deliveries.

3 inch Dial only.....75 cents Postpaid

3 inch Dial with Knob mounted..$1.30 Postpaid

OUR NEW CATALOG now ready for distribution contains 24 pages of real, live, up to the minute illustrations, news and descriptions of all standard Radio parts, including the above Indicating Dial.

Sent anywhere upon receipt of 10c.

For sale at all Radisco Agencies and by

A. H. Corwin & Co.

4 West Park Street **Newark, N. J.**

"Ask Anyone Who Has Used It."

What Our Patrons Say:

"I have had my phones about three years, and they still can make "POZ" (Nauen) roar."
(Name on Request.)

Brandes Wireless Headset



Superior, 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOG M

C. BRANDES INC. 32 Union Square, Room 822, New York

WIRELESS RECEIVER SPECIALISTS

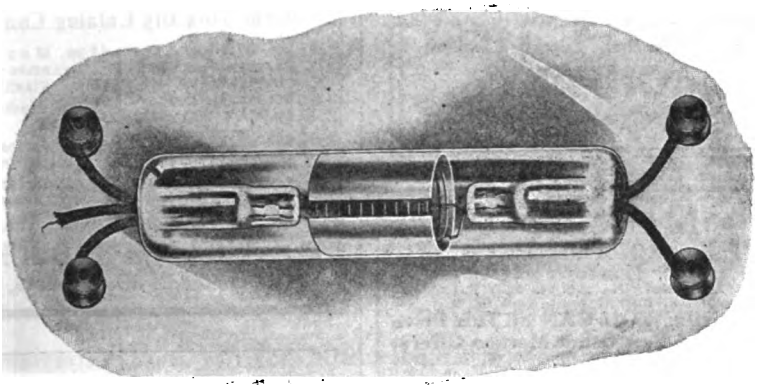
Licensed by De Forest

AUDIOTRON

The Original Tubular Vacuum Amplifier

The AudioTron vacuum tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos 841387 and 879532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.



PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

Laminated closed core, two coil type

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO., Lick Bldg., San Francisco, Calif.

Radio Apparatus

The Mutual Purchasers Association offers you membership on a dividend earning plan, whereby anyone buying thru the association automatically becomes entitled to a coupon check which is a dividend and is acceptable as cash, upon anything else you buy.

Our membership exceeds 1900 and is growing daily, and they are earning dividends and getting other benefits of the association, such as hookup data and information on anything pertaining to radio.

We can furnish radio material and parts advertised in this magazine at manufacturers' catalog prices.

Write Department E.M. for application blank and general information on how to earn these dividends.

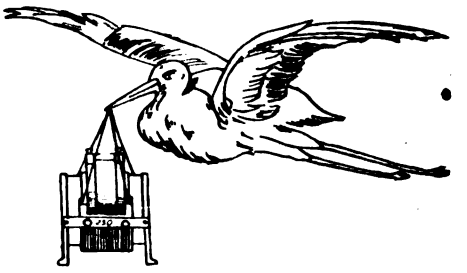
No application fee.

MUTUAL PURCHASER ASSOCIATION

2 & 4 Stone Street New Yor

Digitized by Google

THE
ACME APPARATUS COMPANY
announces the birth of another
RADIO TRANSFORMER
named **ACME 250** weight 13 pounds



250 watts, 250 miles—a mile per watt

ACME 250 has inherited the high efficiency, excellent operating characteristics, rugged construction and attractive appearance of its older brothers, and has come to fulfill the demand for a transformer which, though it may not present as good a front, can make itself heard in any company.

The ACME cry is 800 cycles strong.

Price .....$16.00 Dressed $13.00 Undressed

110 volt 60 cycles ¼ KW

ACME APPARATUS COMPANY
24 Windsor Street, Cambridge 39, Mass.

Make Your Own
ELECTRICAL APPARATUS



SAVE ½

It is easy to make your own at home with the aid of these 4 up-to-date books that you can understand. Each has over 72 pages and over 60 illustrations, 3 color cover, size 5 x 7 inches.

HOME MADE ELECTRICAL APPARATUS
In Three Parts

VOL. 1—Contains working drawings and directions for making all sorts of Static Machines, Static Apparatus, Home-made Batteries, Storage Cells, Transformers, Rectifiers, etc.
VOL. 2—Contains working drawings and directions for all sorts of Voltmeters, Ammeters, Galvanometers, Switches, Rheostats, Wireless Telegraph Apparatus, Tesla Coils, Wireless Telephone, Electroplating, Experiments, etc.
VOL. 3—Contains working drawings and directions for making all sorts of Dynamos, Motors, Electric Engines, Miniature Lighting Plants, Wireless Telegraph Apparatus, Tesla Coils, Wireless Telephone, Electroplating, Experiments,
HOME-MADE TOY MOTORS—Gives complete details with working drawings for making 12 simple but operative electric motors. Several built from sheet "tin." Others with castings.

35c each postpaid any THREE **$1.00**

GET THEM NOW
PRICE MAY ADVANCE ANY DAY

COLE & MORGAN, Inc., Publishers
Dept. U.13, 188 Greenwich St., N. Y.

BURGESS "B" BATTERIES

SEVERAL SIZES FOR SPECIAL WORK



SEND FOR CATALOGUE
BURGESS BATTERY COMPANY
HARRIS TRUST BLDG.- CHICAGO, ILL.

MERACO
EQUIPMENT

"MERACO" PERFECT B BATTERIES
Are made in three sizes and are fully guaranteed. Our circular will interest you. Send for it.

Buy WHILE YOU CAN at This Price
Here Are a Few Other Meraco Offers:

Hard rubber, ⅛, 3/16, ¼, ⅜, ½, in., $1.40 per lb.
Bakelite grade xx, natural, $2.90 per lb.; black, $3.00 per lb.
Flexible rubber tubing to slip over leads, 4c per foot; $3.50 per 100 ft.
Note: Postage must be included, as extremely low prices prohibit shipment otherwise.

MERCURY RADIO APPLIANCE CO.
672-A Broadway, Brooklyn, N. Y.



Silicon detector, $1.50 — Galena detector, $1.50



DUCK'S No. 14 264 Pages
Electrical and Wireless **Catalog**
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

Send for
HALCUN Radio Catalogue
Full Line of Amateur Requirements

Halcun Radio Co.
San Francisco, Calif.
Formerly Haller Cunningham Elec. Co.

"POROX"
"Trade Mark"

High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.

Special Batteries made to order also duplicating of foreign batteries.

Prices on request.

ALBERT MULLER
8758 Queens Boulevard
Jamaica, Long Island, N. Y.

Digitized by Google

DEFOREST

Here's a Receiver with Eight Distinct Advantages

DeFOREST Agencies are located in all Principal Cities. Ask your regular Electrical Dealer to get you DeFOREST Apparatus.

A COMPLETE, compact and inexpensive Receiving Set having improvements and refinements which increase efficiency and eliminate many objectionable features of receiving apparatus.

No longer is it necessary for you to have two or three expensive, inconvenient and cumbersome tuners spread all over your operating table when working all wave lengths. With this new DeFOREST tuning system you can work any and all wave lengths with the one tuner shown at the right. This Set has distinct advantages of minimum table space and of convenience in coupling not equalled in any other type of apparatus. The entire Set is complete in the two cabinets shown here. The Genuine DeFOREST "Honey Comb" Coil System of Tuning is employed—no superior system has ever been invented.

This is a new DeFOREST production embodying a unique and superior tuning system. Possession of this Set means more efficient and satisfactory operation; more pleasure and practical benefit for every Amateur. Its price is remarkably reasonable for the quality of apparatus and the distinct advantages the Set offers. Find out more about it at once—

Send for a DeFOREST Manual

a 36-page book containing full information about this and many more DeFOREST instruments, as well as giving much useful information for the Amateur. Mailed anywhere upon receipt of 10 cents.

DE FOREST RADIO TELEPHONE AND TELEGRAPH CO.
Inventors and Manufacturers of High Grade Radio Apparatus
1403 Sedgwick Ave., New York City
Lee De Forest, Inc., Western Distributors
451 Third Street, San Francisco, Cal.
(Shipments Direct from San Francisco Stock)

These Eight Advantages

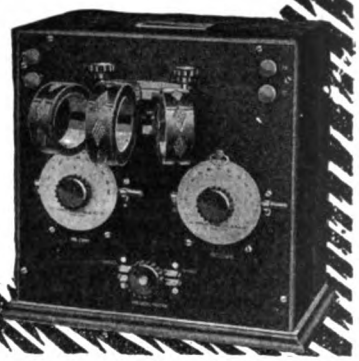
are not duplicated in any Receiving Set at double the price:

1—Responds to any wave length, 150 to 25,000 meters.
2—More flexible in coupling.
3—Lower distributed capacity; less high frequency resistance and decrement values.
4—Eliminates cumbersome switches, inefficient taps and losses from dead ends.
5—Vernier Air Condensers of unusual design.
6—Signals come in louder and clearer.
7—Superior in efficiency, workmanship, convenience and appearance.
8—Requires minimum table space; note sizes of cabinets.

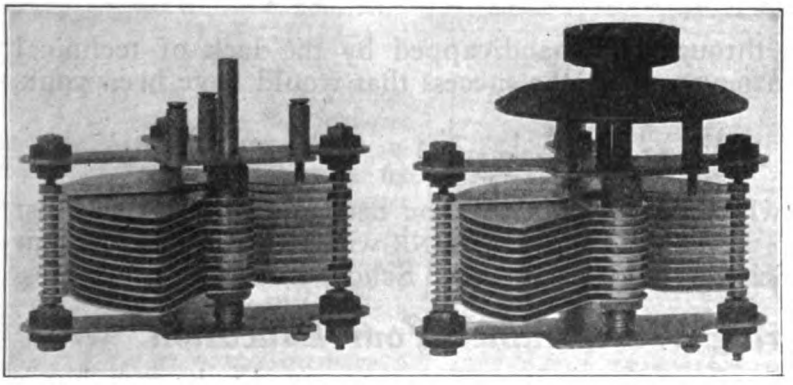
Combination Audion-UltraAudion and One-step Amplifier; Type P-300. Size 12½"x9⅜"x7⅜". Price $73.50. Vacuum Tubes, $7.00 each extra.



Tuner Type T-200. Size 13⅜"x12½"x8". Price $77.50 without Coils.



"THE ATLANTIC RADIO COMPANY VARIABLE CONDENSER"



THE "ARCO" VARIABLE CONDENSER, illustrated above, is made in two capacities—.0005 Mfd. and .001 Mfd. The rotary plates are rounded on one end, affording a straight-line capacity — a valuable feature in wave meter work. The condenser is furnished unmounted only, but with the addition of Dial and Knob, if desired. Dial is of moulded composition, scale in white—0-100 reading. Bakelite Knob. We can guarantee this condenser in every way as to quality, reliability and satisfaction. The low price is decidedly an innovation.

PRICES:

Capacity	Unmounted	With Dial and Knob
.0005 Mfd.	$5.00	$6.00
.001 Mfd.	6.25	7.25

"BULLETIN 14"—describing and illustrating the best in RADIO EQUIPMENT will be mailed upon receipt of 10 cents in stamps. This amount may be deducted on your first order of $1.00 or over.

ATLANTIC RADIO CO., Inc.
New England Distributors "Radisco" Products
88 BROAD STREET BOSTON 9, MASS.

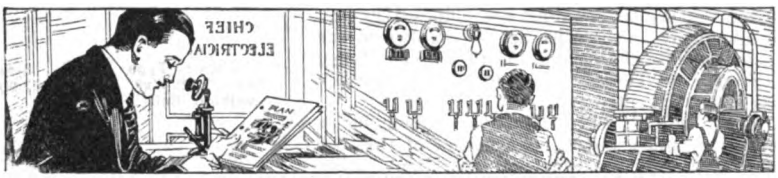
Digitized by Google

DEALERS

We shall be pleased to send our revised schedule of prices and discounts on request. Delivery on our standard equipment can be made immediately from stock, subject to prior sale.

WIRELESS SPECIALTY APPARATUS CO.
131 State Street **Boston, Mass.**

Become a Chief Electrician



CHIEF ELECTRICIANS ARE SCARCE, THOUSANDS ARE IN DEMAND. WHY NOT PREPARE NOW? YOU ARE CAPABLE OF EARNING

$60 to $125 a week

AS ONE OF THE LEADING CONSULTING ENGINEERS OF THE EAST I know exactly how to train men for positions of this kind. It is my SUCCESSFUL METHOD OF HOME STUDY COMBINED WITH MY OWN PERSONAL ATTENTION THAT HAS PUT HUNDREDS OF MY GRADUATES IN PROMINENT ELECTRICAL POSITIONS THROUGHOUT THE COUNTRY.

Apply immediately for my SPECIAL OFFER of this month.

H. K. BLATCHLEY & CO.: CONSULTING ENGINEERS. Liberty Building, 152 Temple St., New Haven, Conn.
Kindly send me full particulars of your Home Study Course.

Name ..... Address .....

YOUR FUTURE IS ON THE SEAS



Be a Ship Officer

Join America's Mighty Merchant Marine

Hundreds of first, second and third mates, masters and captains are needed by the big shipping companies and America's great merchant marine.

Salaries up to $412 per mo. and living expenses.

Ships flying the American flag pay the biggest salaries of any in the entire world.

Learn Navigation at Home or on Board Ship.

Captain Warren Sheppard's Course on Ocean Coast and Lakes Navigation is now ready. It is a life time of practice placed before you for quick mastery. Captain Sheppard was instructor for the United States Shipping Board during the war. All of his students received licenses—from third mate to master. Not one failed. He offers this same sure method to you at a very low price. You cannot fail.

Valuable Booklet FREE

Fill out the coupon below and return to us. A 36-page booklet telling how you may become a ship officer at a big salary will be sent you free. Don't delay. Officers urgently needed.

FREE COUPON.

World Technical Institute
Dept. 12, Fuller Bldg., Jersey City, N. J.

Gentlemen:—Send to me free booklet, "Your Future is on the Seven Seas."

Name .....
Address .....
.....

Are You Going to Give Up a College Education

BECAUSE YOU CAN'T AFFORD IT?

Will you allow yourself to go through life handicapped by the lack of technical education, knowing that you can never attain the success that would have been yours if you had gone to college?

NO!

If you have the stuff in you of which success is made you need not think of the cost of going to college, for EVERYDAY ENGINEERING MAGAZINE will pay your expenses at any University, College, Trade School or Correspondence School in the United States.

Everyday Engineering Will Finance Your Education

in return for all or a portion of your spare time. It may seem too good to be true, but it is no less a fact—Four years at college with all the opportunities of learning, with the social life, which, in itself, is of tremendous importance in the life of every man.

To make arrangements for starting this coming fall, write immediately to the "Circulation Department", EVERYDAY ENGINEERING MAGAZINE, stating the name of the University to which you want to go, the course you are desirous of taking and the approximate cost for the scholastic year.

Here is your chance. It is up to you to take this opportunity now.

EVERYDAY ENGINEERING MAGAZINE
2 West 45th Street **New York City, N. Y.**

Digitized by Google

CARBON DETERMINATION BY ELECTRIC RESISTANCE

A METHOD, new in principle and extremely simple, has been recently brought out by J. R. Cain and J. C. Maxwell for determining the amount of carbon in steel. It is claimed to be accurate within one-tenth of one per cent. The details were published by the authors in the September, 1919, issue of the *Journal of Industrial and Engineering Chemistry.*

The fundamental principle of the method which, it is believed, is of wide application, is the change of electrical resistance brought about in a standard solution by the precipitation into it of another substance. This substance is, in this case, carbon dioxide, obtained by direct combustion of the metal. The standard solution is barium hydroxide of known electrical resistance. Hence the underlying chemical equation is:

$$Ba(OH)_2 + CO = BaCO + H_2O.$$

The increase in the resistance is due to precipitation of barium ions. Not only is the principle new, the assembly of apparatus is also new, and offers many advantages for technical work over the methods hitherto in use for the measurement of electrolytic resistance. These require a complicated and expensive set of apparatus. Other new features are: The application of the "nomograph" for the graphical representation of resistance data and the use of special conductivity cells with adjustable electrodes to facilitate the manufacture of any number of such cells without the same cell constant.

WESTINGHOUSE EQUIPMENT FOR SOUTH AMERICAN RAILWAY ELECTRIFICATION

FOR the Paulista Railway electrification in Brazil, the Westinghouse Electrical International Company announces the obtaining of contracts for four locomotives—two for passenger service and two for freight service. This electrification will initially be 28 miles in length, but later it is expected to make extensions which will include a distance of 100 miles.

The passenger locomotives have a one-hour rating of 2,000 h.p. and weigh 121 tons. They will be operated from a 3,000-volt, direct-current overhead trolley system and will be complete with regenerative control. They are designed for a maximum speed of 65 miles per hour and have a track gauge of 5 feet 3 inches. The freight locomotives have a one-hour rating of 1,500 h.p. and will weigh 87 tons. They are also operated from a 3,000-volt, direct-current overhead trolley system and will be complete with regenerative control. The maximum speed will be 40 miles per hour and the gauge five feet three inches.

To cut down the cost per cut

250% More Work

In power hack sawing, compound acts more as a coolant than as a lubricant. Cutting heats the blade, and the purpose of the compound is to prevent the temper of the blade being drawn.

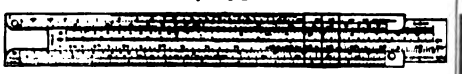
A few drops of oil or a scanty flow of compound simply tends to hold the chips in the cut and is frequently responsible for broken blades. Whatever you are using for a coolant, compound, or water, see to it that the work is flooded except when cutting iron castings. If you use compound, keep it thin and well agitated. Actual tests have proven that the use of compound will increase the amount of work accomplished by 250 per cent.

Get a copy of the Starrett Hack Saw Chart "MB" pick the right blade, put on the weight, see to it your S P. M. are right—and watch your cutting cost decrease.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL. MASS.



Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $2.00.

An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO., Niles, Mich.

STURDY

THAT'S WHAT YOU'LL SAY when you see this new handy Utility Chest. Built with a solid oak frame, and joints that are not dovetailed, but lock-cornered for extra strength. This chest is a sturdy keeper of tools; bang proof, knock proof, and weather proof. Auto-mechanic, electrician, lineman, will find the right house for his tools in this

UNION Utility Chest

Note tray that lifts with cover, yet fits snugly when cover is closed. Strong handle, hinges, hardware.



Write for Catalog

prices and name of ne dealer. Sold on "Satisfaction or Money-Back" guarantee.

UNION TOOL CHEST CO., Inc., 34 Mill St., Rochester, N. Y.

UNION TOOL CHESTS

AMAZING OPPORTUNITIES in the Airplane Industry

Right now is your opportunity to get into the greatest industry the World has ever known. Thousands of new positions opening up everywhere in this attractive new field. Never before have ambitious men had such a glorious chance. Send Coupon at once—find out how our wonderful Course in Practical Aeronautics will give you the knowledge to enter this new field. Learn at home by mail during your spare time.

Prepare NOW
for these positions
Aeronautical Engineer
Aeronautical Instructor
Aeronautical Contractor
Aeroplane Repairman
Aeroplane Mechanic
Aeroplane Inspector
Aeroplane Salesman
Aeroplane Assembler
Aeroplane Builder

Enormous Demand for Men—Big Pay

If you know Practical Aeronautics, some big Airplane Corporation will want you. Unheard of Salaries are being paid trained men. Act at once. The pioneers are going to reap the big rewards. Automobile history, railroad history, movie history will repeat itself in Aviation.

Special Offer NOW—Send Coupon

Send the Coupon at once for full particulars of our remarkable offer open to you now. We will also send you our big new book "Opportunities in the Airplane Industry." No obligation. Be sure to tear off and mail coupon today.

AMERICAN SCHOOL OF AVIATION
431 S. Dearborn St. Dept. 748A Chicago

FREE BOOK COUPON

American School of Aviation
431 S. Dearborn St., Chicago
Dept. 748A

Gentlemen: Please send me full particulars of your remarkable offer, also your new big book "Opportunities in the Airplane Industry." I assume no obligation.

Name.....

Address.....

Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mc. St., El Paso, Texas.

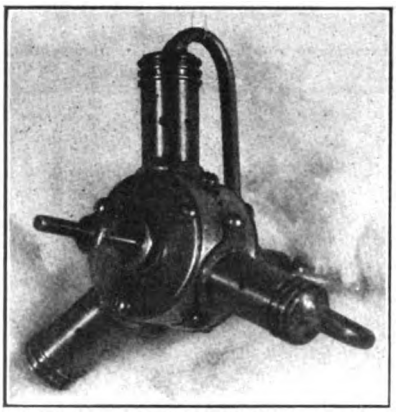
SET OF 11 SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

Compressed Air Motors



THE new and improved method of propelling your model aeroplane. Manufactured of the finest materials. Workmanship guaranteed. Special propellers for the above motors. Send stamp for descriptive circular of these wonderful motors. We manufacture everything for the model aeroplane builder. Give us a trial and be convinced.

HEC AEROPLANE CO.

302 East 49th St. New York City

NOW YOU CAN FLY!

A REAL AEROPLANE AT LOW COST



THE DELERAY D-5 SPORT PLANE

Wing Span 18 ft. Speed 35-65 m.p.h.

Planned by men with 4 years' experience in Designing successful U. S. Government planes. Equipped with 15 H.P. engine (practical engineering made it possible for this biplane to be flown with only 8 H.P.) Use your own motorcycle engine if you wish.

Send $6.00 for complete set of 18 large detailed blueprints, actual duplicates of our shop drawings, showing exactly how each part is made and fitted.

DELERAY AIRCRAFT WORKS

AEROPLANES ENGINES PARTS

FREEPORT, LONG ISLAND, N. Y.

Don't Scrap Aluminum Parts

Save them with SO-LUMINUM. New, great welding solder, stronger than aluminum, perfect substitute for acetylene, welding—¼ time and cost. Use gasoline torch or soldering iron. No flux required. Booklet on request. Sample bar $1.00. Used and endorsed by United States Army and Navy, British Munitions Board and leading aeroplane and motor truck companies.

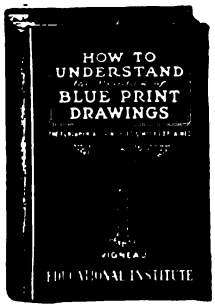
SO-LUMINUM MANUFACTURING CO.

1790 Broadway New York

UmakeM

Airplanes Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 8th Ave., N.Y.



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr., U. S. Rubber Co.'s Mech. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE, YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
160 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 Illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 137 Rowland Bldg., Detroit, Michigan

HIGH SPEED AND ALTITUDE

A RECORD average speed of 155 m.p.h. has been maintained by a Breguet airplane equipped with a Renault 300 h.p. engine and the Rateau supercharger in a flight from Paris to Lyons, according to advices from Paris under date of April 14th. The distance was covered in 1 hr. 50 min. The high speed is attributed to the fact that Lieutenant Roget, the pilot, flew at an altitude varying between 17,000 and 20,000 feet.

At sea level the speed of this machine is only 93 m.p.h., so that by going to the higher altitude a gain of more than 60 m.p.h. on the average speed was obtained. At this height it was not necessary for the pilot and his mechanician to use oxygen masks and, with the use of the Rateau turbine compressor, there was no falling off in the engine power. It would appear that the wind did not assist in attaining the increased speed, for on the day of the flight the weather bureau reported that the direction was from south to north, or against the machine, with an average velocity of between 16 and 19 feet per second. This experiment appears to justify the prediction of Breguet that with air-tight cabins and the use of the Rateau compressor it would be possible to attain an altitude of 50,000 feet and fly at a speed of 250 m.p.h.

QUICK DRYING LACQUER COATINGS

SPEED of production on some products demanded the use of finishes that would dry within a few minutes, and cellulose lacquers or "dopes" were adopted with successful results. Such "dopes" were already in use for making moisture resistant and rendering taut the fabric wing surfaces of aircraft. They were composed of either cellulose acetate or cellulose nitrate dissolved in volatile solvents. For aircraft work their composition resembled those shown below:

Cellulose Acetate Dope

Methyl acetate	60%
Methyl ketone	10%
Benzol	15%
Acetone	10%
Diacetone alcohol	5%

Each gallon of dope made with the above liquids contained approximately seven to nine ounces of cellulose acetate, one ounce triphenyl-phosphate, and very small quantities of chemicals such as benzyl acetate, benzyl benzoate, and urea.

The various stabilizers and other solid ingredients in the dopes were used for specific purposes (such as to increase fire resistance and flexibility, or

Digitized by Google

to prevent the development of free acid or "blushing"), but are not usually required where the "dopes" are to be used only as protective coatings.

Cellulose Nitrate Dope

Butyl acetate	20%
Ethyl acetate	50%
Benzol	30%

Each gallon of dope made with the above liquids contained from six to eight ounces of cellulose nitrate.

Cellulose nitrate "dope" is greatly improved as a protective coating by the addition of from five per cent to seven per cent of castor oil or treated tung oil. Greater elasticity of film and slower evaporation result.

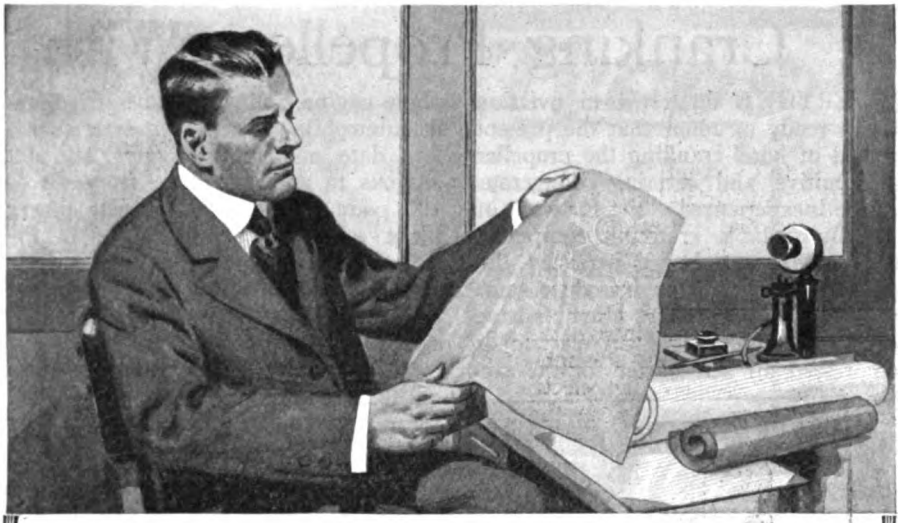
It is quite possible that cellulose nitrate lacquers made on the above basis will find application in peace times for certain specific purposes where quick drying, hard and elastic films are required. They may be admixed with pigments to produce colored coating which dry to a flat, washable surface. When mixed with aluminum powder or zinc powder, quick drying, hard primers for metal are formed. These may be used satisfactorily as the base for many metal finishes. As substitutes for shellac on some types of work they should also prove of value.

It should be pointed out that cellulose lacquers or enamels are not as durable as these made with oil or varnish. They are, however, useful for certain purposes where the longevity may be partly sacrificed to obtain rapid drying.—*Scientific American.*

TEST SHOWS BENZOL DOES NOT INJURE INTERNAL COMBUSTION ENGINE PARTS

AN official report has been issued by the Automobile Association of England on the 10,000-mile benzol road test carried out on a touring car. The trial was organized with a view to discovering whether benzol of N. B. A. specification does or does not result in bad effect upon the modern internal combustion engine; examination of the engine and its parts at the end of the 10,000 miles produced no evidence of ill effects. Owners of both touring cars and business vehicles have been using benzol for many years with satisfactory results, but this is the first occasion on which a lengthy, searching and official test has been made.

The Sperry parachute weighs but 12½ pounds, and descends at the rate of 12 feet per second. This is the rate which would be reached in jumping from a height of less than three feet.



Mechanical Engineering

Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered those with special training.

There is an easy, delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. The most important thing you have to do is to mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6083-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

SHIP BY TRUCK

Motor Cartage.

One to Five-ton Trucks.

Hauls made to any point in United States and Canada.

Rates by hour, day or contract.

W. H. SQUIRES
1561 Woodward Avenue
Detroit, Mich.

Speed Lathe $7 Complete Swing 7 ins. 24 in. metal bed
Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.
M. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

Mathematics Made Easy

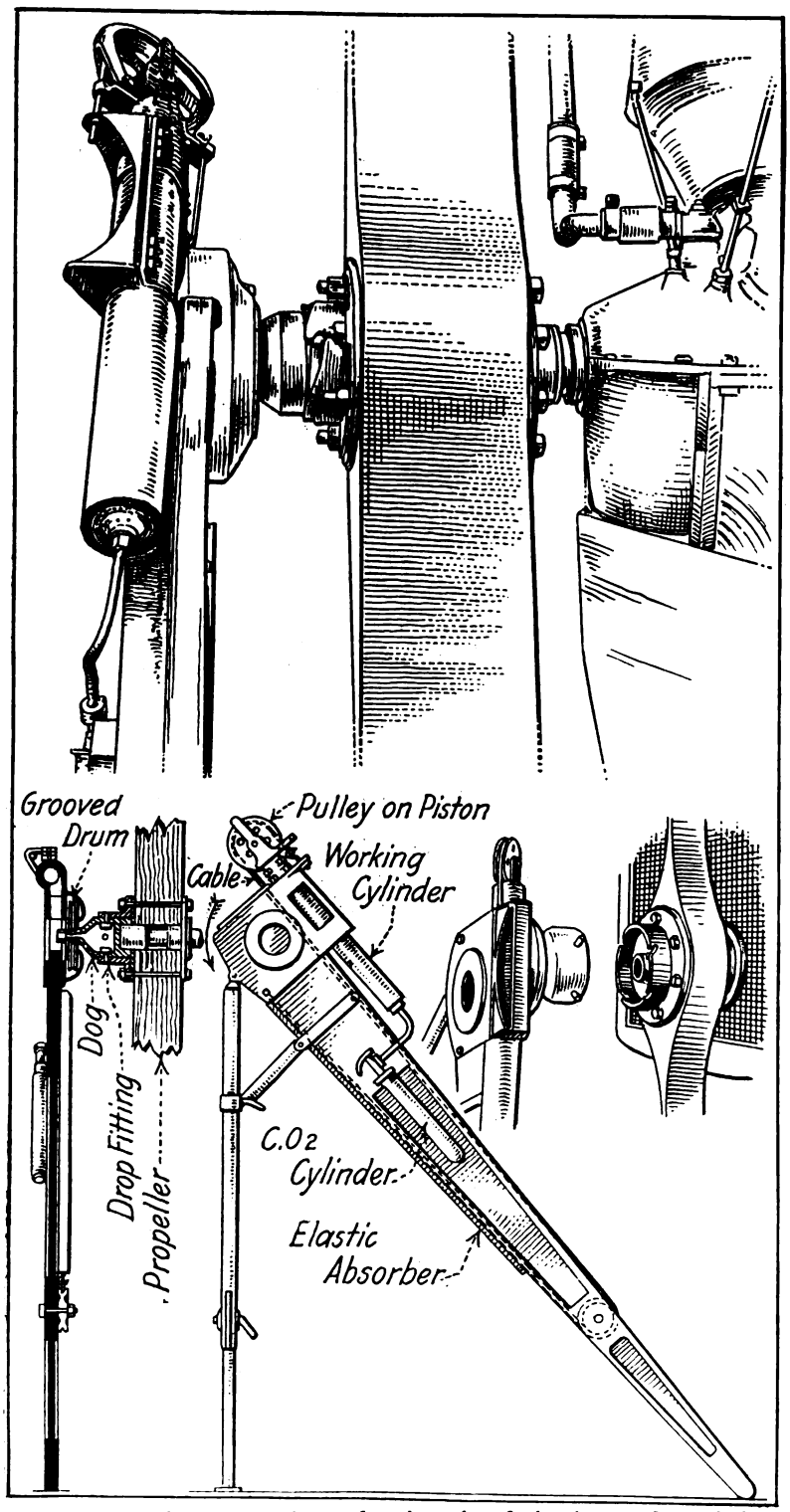


The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only $1.00 postpaid. Order today before you forget.
Dept. U, L. J. LEISHMAN CO., Ogden, Utah

Digitized by Google

Cranking Propellers With Bottled Gas

EVERYONE interested in aviation is ready to admit that the present method of hand-cranking the propeller is primitive and certainly dangerous for the inexperienced. Yet for want of a really suitable cranking equipment this crude practice has persisted despite many attempts to introduce some mechanical means. Some attempts have been along the line of an electric or compressed air self-starter for the airplane engine, following types tried out in automobile practice; but even at this late date airplane designers are not anxious to add anywhere from 40 to 100 pounds of weight to their power plant especially if the plane is intended for military service. The preference has been given to portable propeller swingers, which could be carried about the airdrome and used for cranking any machine.



Diagrams showing construction and action of a device for cranking airplane engines by compressed air or gas. Upper drawing shows cranking clutch engaged with propeller

One of the most compact airplane propeller swingers is that invented by a Frenchman, M. Odier, and illustrated in the accompanying drawings which are reproduced from the *Scientific American*. In the first place, the weight of this propeller swinger is by no means excessive, so that one man can carry it about. It is compact and safe to handle. Briefly, the Odier starter consists simply of a two-leg stand carrying at its upper end a long steel cylinder and piston. Attached to the extremity of the piston, which projects outside the cylinder, is a pulley over which a cable is passed, having one end fastened to the cylinder and the other end wound four times round a grooved drum and then secured to an elastic absorber. The grooved drum is mounted on a short shaft having a bell-shaped extremity on which four projections are placed symmetrically around the periphery in such a way that they can be made to engage with sloping recesses in a standard fitting mounted on the boss of the propeller or tractor screw. The mechanism is actuated by turning a valve which releases the contents of a flask of carbon dioxide gas into the working cylinder. The gas pressure against the piston causes it to actuate the propeller and turn it over briskly by means of the cable and clutch mechanism. As soon as the engine starts, the clutch is released automatically just as that at the end of an automobile hand starting crank is. This device is much simpler than the automobile with propeller swinging attachment used on some American aviation fields.

NON-CORROSIVE FLUX

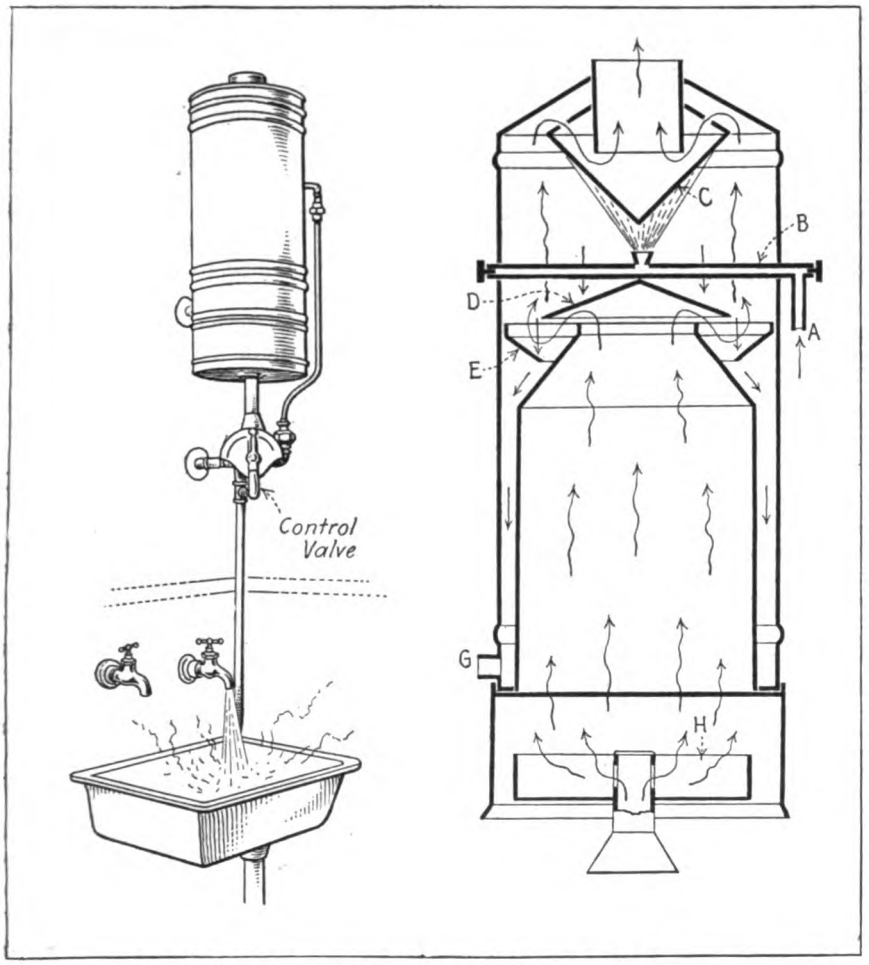
THERE is no absolutely non-corrosive flux on the market, but the nearest approach to this ideal is probably attained by the use of a compound of rosin and stearic acid. The Naval Aircraft Factory has been using for some time past a flux composed of 75 per cent stearic acid and 25 per cent rosin. It is practically non-corrosive but it is not quite so powerful as the commercial fluxes; at the same time it is very satisfactory if the men do not expect to rely on it to actually *clean* the surfaces. The average commercial flux is composed largely of ammonium chloride, although the manufacturers sometimes claim to have a "secret" composition. Ammonium chloride is very hygroscopic, thus causing accelerated corrosion in the presence of moisture.

Owing to the high prices of crude oil and its distillates, many scientists are working on the problem of producing a synthetic fuel.

Digitized by Google

Instantaneous Water Heater

THE accompanying cut illustrates a new type of water heater that is being made for the trade by a Canadian firm. The principle used in heating the water is that of bringing the hot gases from the burning fuel into direct contact with the water in its passage from the inlet to the outlet of the container. This method provides for the utilization of every heat unit produced by the gas, and when properly regulated there is absolutely no loss of heat. The flow of the water and the consumption of gas can be easily regulated and the control of both is obtained by the single lever shown directly in front and a little below the container.



Diagrams showing installation and construction of simple, instantaneous water heater

This water heater requires no cumbersome tank, and can be supported by the fittings that are used to secure it in position on the wall or any other convenient location. The water does not lie stagnant while not in use, as there is practically no water in the tank at any time, the outlet being at the lowest portion of the water chamber. Even when in use the water passing through is virtually in suspension and very little weight is ever placed on the appliance. This permits the container to be made of light sheet steel that permits of instantaneous heating of the water when heater is operating.

The construction of the heater is shown in the line sketch. The cold water enters at A and passes into the cross pipe B and out at the opening in the middle where it is sprayed against the inverted cone C, thence dropping in succession to the baffle plates D and E and on to the inclined roof F of the inner portion, from where it flows down the side to the lower level to the outlet G. It will be seen that the heat—shown by the staggered arrows—must pass directly through the sheet of water as it drops from one baffle to another, thus absorbing all the heat of combustion.

In a recent book by a French author, American methods are the topic. The writer says that in factories the Americans are profuse of everything except time; the Germans save on time and material and spend on plant; the French economize on everything except time. He says that the Americans overwork machinery so as to scrap it and replace it by the most advanced kind.

Tycos-

The care with which *Tycos* Temperature Instruments—Indicating, Recording and Controlling—are made, the grade of materials used in their manufacture, and the type of artisans who produce them, all contribute to *Tycos* dependability.

Tycos Products embrace:

Indicating Thermometers
Recording Thermometers
Controlling Thermometers
Pyrometers
Pressure Gauges
Time Controls
Hygrometers
Hydrometers
Barometers
Vacuum Gauges
Thermographs
Oil Testing Instruments
Laboratory Glassware
Compasses
Household Thermometers
Altimeters
Actinometers

Which particular instruments are you interested in?

(H H-3)



Taylor Instrument Companies
ROCHESTER, N.Y.
There's a *Tycos* and *Taylor* Thermometer for every purpose



Be a Draftsman!
Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

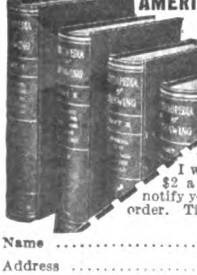
Shipped on 7 Days' FREE Trial
CYCLOPEDIA OF DRAWING
4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D 35A Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D35A
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

Digitized by Google

Pattern Work in Wood and Metal

Prompt Service Guaranteed

Mail Order Work Solicited

Perfect wood or metal patterns made for any of the machines or model engines described in Everyday Engineering Magazine.

BRING YOUR PATTERN PROBLEMS TO US

We solicit the work of experimenters, inventors and model makers. Quotations gladly made upon the receipt of drawings and specifications. Patterns both large and small made for any part no matter how intricate or complicated.

Have you had the sad experience of taking a set of home-made patterns to the foundry only to have the foreman laugh and tell you that they are made wrong? Let us save you this embarrassment.

Our charges are reasonable, our service prompt and courteous.

U. S. PATTERN AND MFG. CO.

64-66 High Street, West. Detroit, Mich.

MODEL AIRPLANE ENGINES

3 Cylinder Rotary Compressed Air Engines.

⅝ in. bore, ½ in. stroke
½ in. bore, ½ in. stroke
⅝ in. bore, ½ in stroke

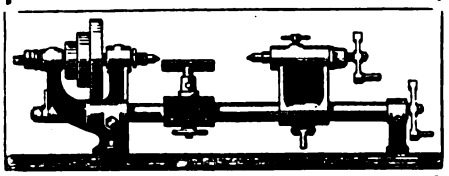
6 Cylinder rotary steam engines, steel cylinders, tobin bronze pistons, aluminum crank case.

½ in. bore, ½ in. stroke

Send stamp for descriptive circular.

MODEL MACHINE SHOP CO.
415 East 71st St. New York City

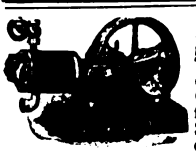
6 INCH BENCH LATHE



Model Shop Equipment

Castings or finished machine. Shop tools and supplies. Designs for Model Boats. Drawings of U. S. Destroyer. Ready for immediate shipment. Stamp for catalog.

Huhn Mfg. Co., 594 Elm St., Arlington, N. J.



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.

MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg.. Chicago, Ill.

MODEL ENGINE CASTINGS

For engines described in previous numbers of "Everyday Engineering." Castings made in Bronze or "Duralite." Model water pumps also supplied.

J. E. CARRINGTON
49 So. Clinton St. East Orange, N. J.

A Necessity for Every Shop

"The Samson No. 3 Bench Punch," with a powerful leverage of 24 to 1, is intended for work beyond the capacity of the "Samson Hand Punches," and will punch holes from ⅛ to ⅝ in. in soft metal up to 12 Gauge. Extra sets punches and dies size ⅛, 3/16, ¼, 5/16, and ⅜ in. easily inserted and removed, (maximum punching capacity 3/16 in. through 12 gauge soft metal.)



Equipped with 3-16-inch Punch and Die unless Otherwise Specified. Price $15.00 F.O.B. Factory

Catalog of Complete Line Sent on Request.

The Machine Appliance Corporation
351 Jay Street, Dept. Eng. BROOKLYN, N. Y.



THE HURD 7 INCH HAND SHAPER

Rough Castings or Finished Machine

Send 25c for construction blue prints or $1.00 for complete set of detailed blue prints. This amount will be deducted from first order. Send stamp for circular.

MODEL TOOL WORKS,
906 West 3rd St.,
Plainfield, N. J.

ALUMINUM CAN BE SOLDERED WITH SUPREME BRAND ALUMINUM SOLDER

FLOWS AT 500° FAHRENHEIT
REQUIRES NO FLUX

Used by General Electric Company, Worthington Pump Company, Hale & Kilburn Company, Bethlehem Shipbuilding Corp., National Lead Company, and hundreds of other manufacturers and repair shops.

Instructions for using with each bar.

Price $3.00 per Pound in Half Pound Bars.

SEND FIFTY CENTS FOR 2-OUNCE SAMPLE BAR.

VANDAM SPECIALTY COMPANY
Grand Central Palace New York City

PULVERIZED FUEL IN BRAZIL

SOME details of the use of pulverized coal on railway locomotives in Brazil are available from a report presented at the semi-annual meeting of the American Society of Mechanical Engineers. Two hundred and fifty locomotives have been equipped with pulverized coal and a number of tests were made that gave satisfactory results, full boiler pressure having been maintained throughout the test runs. The average analysis of the coal is given as follows:

	Per Cent.
Moisture	7.93
Volatile Matter	29.80
Fixed Carbon	43.07
Ash	19.20

The average number of thermal units per pound is 10,225. It was only by the adoption of a pulverized fuel system that the utilization of Brazilian coal became possible. This solution has therefore led to the development of the native coal fields of the country through the establishment of steamship and railway lines.

The report is very encouraging and is a positive proof that the same results could be obtained in many districts in other countries where the coal deposits may be of an inferior quality, but which could be utilized by the application of a comparatively economical process of pulverization that would render the coal available for the purposes desired.

DRESS SNAP FASTENERS IN ELECTRIC WORK

SNAP fasteners are much used by dressmakers in places where buttons formerly held sway. Now it is suggested that their use be extended to light types of electric work. By using them as terminals of wires, one part on each wire, or one part on a wire end and the other part on any place to which the wire is to be connected, a most convenient and neat system of connecting and disconnecting results. Especially is the use of these little appliances to be recommended for light or experimental work, where small wires only are used. The two parts are to be soldered to any desired places in the circuit.

The well known action of magnesium-lead alloys in the presence of air has been suggested as a possible basis for making nitrogen gas. An alloy of 15% magnesium and 85% lead rapidly oxydizes in cold or moist air, falling to a black powder, which gradually becomes lighter in color, it is presumably a mixture of the hydrates. This is the action, which is suggested for the manufacture of nitrogen gas; simple exposure of air to the alloy would absorb the oxygen of the air and leave the nitrogen. An alloy of 65% of lead with 35% of magnesium boiled in water evolves hydrogen, the magnesium alone oxydizing. This gives a way of making hydrogen gas in conditions when other methods requiring chemicals or extensive apparatus might not be applicable.

Digitized by Google

$1.00 per Tire allowed if you bring us this Ad

GOODYEAR

SERVICE STATION
(At Jamaica and Far Rockaway)
LET US QUOTE YOU
on any tire made. We stock:—

Always the BEST at the RIGHT price.

GOODYEAR
PENNSYLVANIA
GOODRICH
GLOBE
McCLAREN
HORSE SHOE RACINE
NORWALK-CORD
MARTIN-CORD
KELLY-SPRINGFIELD
(At New York)
UNITED STATES, etc.

Supplies AT COST to tire patrons. IT WILL PAY YOU to trade with:—

JAMAICA TIRE & RUBBER CO., INC.

136 West 48th Street.....New York
Hillside and Flushing Avenues.....Jamaica, N. Y.
1868 Central Avenue.....Far Rockaway, N. Y.
43 East Main Street.....Patchogue, N. Y.
"Largest, because we serve best".

DANGER
HIGH-VOLTAGE

BOYS Get the most attractive warning sign made. Your den is incomplete without it. Printed in bright red on white stiff cardboard. 7¼" x 11¼". Reduced to 10c each, in coin only. Send stamp for postage. Don't buy plain printed signs. Satisfaction guaranteed or money back. Sent unbent.

BECK NOVELTY HOUSE
Dept. D, 1298 Carroll Street, Brooklyn, N. Y.

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, *"Value of Sales Letters."*

Ross-Gould Mailing Lists St. Louis

A USEFUL BOOK

FOR THE AMATEUR ELECTRICIAN

Electric Bells

By M. B. Sleeper. A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. Both the electrician and the experimenter will find in this book new material which is essential in their work. 124 pages. Fully illustrated.

Norman W. Henley Publishing Co.
Dept. EE, 2 West 45th Street, New York

See Our Special Subscription Offer on Page 198 Valuable Books Given Away Free

Save 65% 5000 Mile Gtd Tires
PUNCTURE PROOF TUBE FREE



The genuine satisfaction Durable Tires have given car owners year after year is responsible for this year's enormous demand. Durable Tires are reconstructed tires, reinforced with four extra layers of stoutest fabric. Every tire is entirely wrapped and protected. We include FREE with each tire 1 puncture proof inner tube which we guarantee against punctures for one year. Written guarantee enclosed with every tire.

Prices include Tire and Free Tube

30 x 3	$ 7.35	32 x 4½	$11.90
30 x 3½	8.45	33 x 4½	12.45
32 x 3½ S. S. only	9.05	34 x 4½	13.10
31 x 4	10.30	35 x 4½	13.35
32 x 4	10.65	36 x 4½	13.85
33 x 4	11.10	35 x 5	14.85
34 x 4	11.45	36 x 5	14.95

RELINER FREE WITH EVERY TIRE

State whether you want straight side or clincher, plain or non-skid. Send $2.00 deposit for each tire ordered, balance C. O. D., subject to examination, or 5 per cent discount if full amount is sent with order.

DURABLE TIRE & RUBBER COMPANY
2406 W. Chicago Ave., CHICAGO, ILL.

FREE Puncture Proof TUBE 6000 Mile Guarantee



UNION TIRES represent the highest standard in reconstructed tires. Their reinforcement of 4 extra layers of fabric reduces greatly blowout and puncture possibilities. Over 200,000 in use. To further increase mileage, we include with every tire ordered **A PUNCTURE PROOF TUBE FREE** that under ordinary conditions will last ten to 20,000 miles. Our 5,000-mile tire guarantee certificate with every tire.

Prices Include Tire and Tube

30x3	$7.40	32x4½	$12.00
30x3½	8.50	33x4½	12.50
32x3½ S.S. only	9.10	34x4½	13.15
31x4	10.35	35x4½	13.40
32x4	10.70	36x4½	13.85
33x4	11.15	36x5	14.85
34x4	11.50	37x5	14.95

Reliner Free With Every Tire

State whether you want straight side or clincher, plain or non-skid. Send $2 deposit for each tire ordered, balance C.O.D., subject to examination, or 5 percent discount if full amount is sent with order.

UNION RUBBER COMPANY
Dept. 239, Racine Ave. & 15th St., Chicago

SAVE MONEY!

A High Grade

INNER TUBE FREE

6000 MILES Guarantee



Economy Reconstructed Tires made by our new special process are guaranteed to give good service because the best materials are used in their construction. Our tires are guaranteed for 6,000 miles and we give a FIRST quality inner tube free with every tire ordered from us. Our tires are reinforced with extra plies of fabric making them strong so they resist punctures and blowouts.

RELINER IS FURNISHED WITH EACH CASING AT NO EXTRA COST.

THESE PRICES INCLUDE CASING, RELINER AND TUBE.

30x3	$7.15	33x4	$11.00	35x4½	$13.15
30x3½	8.25	34x4	11.25	36x4½	13.50
32x3½	9.00	32x4½	11.75	36x5	14.50
31x4	10.15	33x4½	12.25	37x5	14.50
32x4	10.45	34x4½	12.00		

State with your order whether a straight side or clincher, plain or non-skid tread. Send a deposit of $2 for each casing ordered. Balance C. O. D. subject to examination. 7% discount if full amount is sent with order. References furnished if desired.

UNITED ECONOMY TIRE CO.
205 West 48th Street New York City

UmakeM Club You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 19 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.
W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 5th Ave., N. Y.

WANTED

Want ads for thousands of trained Automobile Repairmen are appearing in all the papers all over the Country. New Garages and Shops are badly needed everywhere. If you are earning less than $30 a week—YOU SHOULD LEARN THIS TRADE.

You Can Earn $150 to $400 a Month

Come to this school and learn. We teach by actual practice on all kinds of cars. A few weeks time learning will fit you for a position in a garage, service station, or you can start in business for yourself. (No colored enrollments solicited.)

WRITE FOR FURTHER PARTICULARS

DO IT TODAY SEND IN COUPON

BUFFALO AUTO SCHOOL, No. E.E.I.
463-471 Connecticut St., Buffalo, N. Y.
Please send me full particulars of your complete Automobile Course.

Name..... Age.....

Street or R. F. D.....

City..... State.....



"Get the Coaster Wagon With 'Auto-Wheel' on the Sides-Tom"

Don't let them sell you any other kind. The Auto-Wheel is the genuine Coaster wagon—and it's the only Coaster that will admit you to our Auto-Wheel Club.

With the Auto-Wheel you can join our club and take in all our good times. You know it's a big, speedy coaster—so strong that it will carry a 1,000 pound load with ease—so fast that it will beat any other wagon made.



Prize Contests

Our new MAGAZINE for boys tells of the prize contests we are holding periodically. We'll send you a copy of the magazine if you will send us the names of three coaster dealers, mentioning which one handles the wagon with

"Auto-Wheel"

on the sides. We'll also send you a booklet telling you all about our Auto-Wheel Club, which you can organize.

The Buffalo Sled Co.,
159 Schenck Street,
N. TONAWANDA, N. Y.
In Canada: Preston, Ont.

You Can Save $50.00



By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

$8.93 and up Parcels Post Paid

LIBERTY TOP & TIRE CO., Dept. E3, Cincinnati, O.

Digitized by Google

Useful Books on Mechanical Subjects

Electro-Deposition of Metals

By George Langbein and William T. Brannt

The new eighth edition of this volume, which has been completely revised, considerably enlarged and entirely reset, is now ready. It is a complete and comprehensive treatise, written from a scientific as well as practical standpoint and especially intended for the practical workman, wherein he can find advice and information regarding the objects to be plated while in the bath as well as before and after electroplating. This volume is the foremost book on the subject in the English language and covers electro-plating and galvanoplastic operations, the deposition of metals by the contact and immersion processes, the coloring of metals, lacquering, and the methods of grinding and polishing as well as descriptions of the voltaic cells, dynamo-electric machines, thermopiles, and of the materials and processes used in every department of the art. Particular attention has been paid to all important innovations, and it has been endeavored to include all of the latest practical methods of plating, as well as the most recent machinery and apparatus. It is a ready book of reference and a practical guide to the workshop.

Octavo, 875 Pages, 185 Illustrations.

Price $7.50

Complete Practical Machinist

By Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations

Price $3.00

Metal Worker's Handy-Book of Receipts and Processes

By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations

Price $3.00

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.

Publishers of Mechanical and Industrial Books

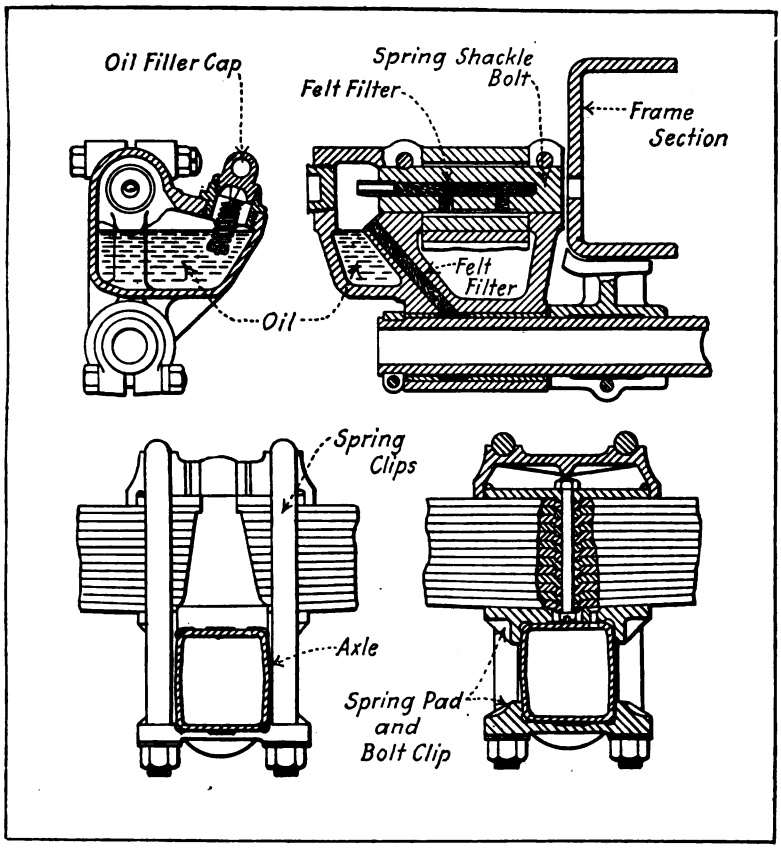
2 West 45th Street, New York, N. Y.

MAGAZINE OILING FOR SPRING SHACKLES

THE method of spring-bolt lubrication, as applied to the 1½-ton Service truck model, is illustrated in accompanying cuts. A reservoir is cast into the spring shackle or bracket as a container for the lubricant and holds oil sufficient for a month of ordinary usage. Oil finds its way from the reservoir to the spring bolts through a system of holes drilled in the spring shackles and bolts. These holes are sufficiently large to avoid the possibility of clogging and are filled with felt packing to resist and regulate the flow of oil.

The spring bolts use oil only when the truck is in motion. To prevent surplus oil being delivered to the bolts when the truck is idle, the oil holes do not open directly into the lubricant in the reservoir, but come out at a point above the oil level. The holes, therefore, depend upon their supply from the splashing of the lubricant while the truck is in motion. The oil feed is also restricted by the felt packing to a flow just sufficient for the needs of the spring bolts. The reservoirs are filled through openings covered by caps that are held securely to their seats by springs. The reservoirs can be conveniently filled at the same time the engine crankcase is being given attention.

To prevent misalignment of the spring leaves which take the driving and braking torque reaction in trucks using the Hotchkiss drive, they are made cup-shape at the center bolt in this truck, as illustrated, so that when the spring is assembled all the leaves are fitted into one another, making it impossible for one leaf to slip over the other. A plate on the top leaf is dovetailed into the spring and held in perfect alignment with the spring seat on the axle by the spring clip pad, which in turn is tied to the spring seat by risers straddling the spring at each side and registering in slots provided in the clip pads.



Two new ideas for increasing life of motor truck mechanism. Magazine oiling at top insures constant lubrication of chassis parts. A secure method of spring retention shown below the oiling scheme

---

For portable or small size storage batteries, such as used on automobiles, a charging rate of one ampere per kilogram of lead in the plates is recommended. Too much surcharging is not approved. A quarter of an hour or twenty minutes gassing is given as a proper limit. A discharge rate of one and a half amperes per kilogram is prescribed as a maximum. The voltage should not go below one and eight-tenths volts to the cell. Desulphation may, if the sulphating is not too bad, be effected by filling the battery with weak sulphuric acid (3° Beaumé), after removing the regular fluid, and charging it at half the regular rate. When bubbles appear the charging is stopped and the battery is allowed to stand an hour. Then it is again charged until bubbles appear. It may be regarded as desulphated when, on starting to charge, bubbles are immediately given off. When this point is reached the weak acid is removed and replaced with 24° to 26° Beaumé acid. If the battery is to be stored, it should be charged, emptied and filled with distilled water and stored in a dry place.

Digitized by Google

FURNITURE FOR EXPORT TO TROPICS

FURNITURE, as well as other wood products used in the tropics, is subjected to the attack of insects known as termites. This attack is excessive in South America in the coastal regions north of Rio de Janeiro, and is so certain and so severe that, in the opinion of the Forest Products Laboratory, it is useless even to think of exporting wooden furniture to those regions unless the wood used is naturally resistant to termites or is treated with a poison which will prevent the attack of these insects. There are a number of species growing in Brazil and other tropical regions which are naturally immune to termite attack and which are used in those countries almost exclusively for the manufacture of furniture. None of the cabinet woods which grow in this country, however, possess such immunity.

Of course, in order to compete with the furniture now used in these regions, the United States product must be equally durable. One way of making it so would be to import cabinet wood from the region in question, make it up into furniture here and return it. A similar practice appears to have been very successful among European furniture manufacturers before the war, when much of the furniture sold in Brazil is said to have been manufactured in Europe from Brazilian woods. Another possibility that may be considered is the use of some of the cheaper domestic furniture woods for backs and cores, after thorough impregnation with a poison such as mercuric chloride, and the use of Brazilian termite-proof woods in the form of veneer for facing.

SIX-WHEELED TRUCK

CLAIM is made that actual demonstration and close tabulation of results appear to indicate clearly that the "six-wheel" or tandem rear axle construction with pneumatic tires on all wheels has steadier riding qualities, better traction, is less wearing of road surfaces, has lighter axles, smaller and lower cost tires and greater braking capacity, and the vehicle has greater operating radius.

This form of truck has six wheels, four of which are grouped under the rear end of a chassis in much the same form of assembly as the truck of the steam railroad coach. The development of this machine was due to the strong conviction of P. W. Litchfield, factory manager for the Goodyear Company, which was expressed at a recent joint meeting of the members of the Detroit and Cleveland sections of the S. A. E. held at Akron, that the heavy tonnage truck would be some

(*Continued on page* 284)



NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.



Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$24.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$46.50
1	H. P., 110-220 volts, repulsion, with sliding base	$67.50
2	H. P., 110-220 volts, repulsion, sliding base	$108.50
3	H. P., 110-220 volts, repulsion, sliding base	$124.50
5	H. P., 110-220 volts, repulsion, sliding base	$164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

8 volts, 10 amp.	$16.50
15 volts, 10 amp.	$21.00
40 volts, 6 amp.	$24.50
110 v, 2½ amp.	$24.50
40 volts, 12 amp.	$38.50
110 volts, 5 amp.	$38.50
40 volts, 25 amp.	$58.50
110 volts, 10 amp.	$58.50
Moving Picture Arc Generator	$85.00

Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c. 1750 RPM., complete with base and pulley.

½ H. P.	$42.50
1 H. P.	$59.50
2 H. P.	$72.50
3 H. P.	$84.50
5 H. P.	$102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt. 24 volts, without switchboard	$40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard	$68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard	$75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard	$85.00
110 volts, A.C., 375 watts, 30 volts, without switchboard	$85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard	$110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard	$125.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $19.75 EACH Reg. Value $22.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

Discover Your Talents

What Are You Best Fitted For?

Personal, Mental and Vocational analysis, by Dr. S. S. George, M.A., Ph.D., former U. S. Army expert. Will help you know your mind and what you are best fitted for. Complete course of tests and analysis, with 1,500 vocations classified, will be mailed to you on approval. Send $3.00 for the course postpaid. If it is not satisfactory return it in five days and we will refund your money. Address

The Vocational Guidance Institute
2255 Broadway, New York City

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 35 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46M, E. 12th St., N. Y., U.S.A.

UmakeM Outfit No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.
W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Earn $35 to $100 a Week
BECOME A PROFESSIONAL PHOTOGRAPHER





Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:
MOTION PICTURE—COMMERCIAL—PORTRAITURE
Cameras and Materials furnished free
Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.
N. Y. INSTITUTE OF PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.

BATTERY CHARGING PAYS BIG PROFITS

$150 TO $300 PROFIT EVERY MONTH
Do You Want It?

Now is the time to start your own permanent, profitable battery charging business. Others are making big profits from HB Battery Charging every month. YOU can too. The demand for reliable, high-grade battery charging was never better. Start NOW, with HB Equipment.

MAKE HB BATTERY CHARGING YOUR BIGGEST MONEY-MAKER
It costs only 10c to 15c each to charge batteries—customer pays 75c to $1.50. Figure your profits. All HB Chargers are sturdy, dependable and absolutely reliable. Built of practically wearproof materials. No burnouts, no expensive renewals or repairs. No attention except occasional oiling. Use power from your lighting lines. Big, quick, clean profits, easily made. A size to suit any battery business.

SMALL CASH PAYMENT—BALANCE ON EASY MONTHLY TERMS



HB 6-Battery Charger HB 16-Battery Charger HB 32 Battery Charger

SOLD ON TRIAL UNDER HB ABSOLUTE MONEY-BACK GUARANTEE
You run no risks. If not satisfied after using any HB Equipment 10 days, you may return it and receive all you pay us. The HB Monthly Payment Plan is an additional guarantee.
Check the Charger You Need. Then Mail This Ad. Tear out this ad and mail TODAY for full information. Be the first in your town to have a money-making HB Charger. Don't delay. Act now. Write today.

HOBART BROTHERS CO.
Box EE67 TROY, OHIO
Successful Manufacturers Since 1893

$110 A Month To Start As Railway Traffic Inspector



ONLY THREE MONTHS spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today and they're on the road to still further advancement, so write immediately for Booklet D 4 before you turn this page.
WE ARRANGE FOR A POSITION
Standard Business Training Institute, Buffalo N.Y.

Digitized by Google

THE
Wireless
World

The Official Organ of the Wireless Society of London

Commencing with April 3d, will be published fortnightly in order to adequately deal with the increasing amount of Wireless Experimental and Research Work.

Full of Practical hints and useful information for Wireless Amateurs.

Extensive reports of the Wireless Societies of Great Britain.

Annual Subscription 17s, Post Free

Single Copies 9d, Post Free

To be entirely up-to-date in your knowledge of Wireless you must be a subscriber to The Wireless World.

To the Publisher,
The Wireless World,
12-13 Henrietta St.,
London, WC2, England.

Please enter me as a subscriber to the Wireless World for the period ..... to .....
for which I enclose.....
Name .....
Address .....
Please write distinctly.

SCHNOTER'S
SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit and low price. If your druggist does not carry Schnoter's, Accept No Substitutes. Sent direct upon request of $1.00.
Send for booklet of other styles and prices.
J. C. SCHNOTER & CO.
628 SIXTH AVE. Dept. (E) N. Y. CITY

SIX-WHEELED TRUCK

(*Continued from page* 283)

form having more than four wheels. This is an evolution that may be comparable to the railroad car construction practise of grouping pairs of axles in frames known as trucks and mounting one of these trucks at each end of a car. There was no endeavor made to perfect such a truck design, but careful study was made of the practicality of pneumatic tires for vehicles built to haul heavy freights.

Special interest attaches to tire weight and cost, which are probably the factors that most deeply concern truck owners, and instead of using 48 by 12-inch pneumatic shoes, weighing about 398 pounds each, that are designed for five-ton trucks, with the tandem axle construction four 40 by eight-inch pneumatic tires, each weighing 119 pounds, are used. The four tires weigh 476 pounds against 796 pounds for the "giants," and as they are each 279 pounds lighter they can be handled far more easily, a matter of no small importance when changes are necessary, especially if the work must be done outside of a garage or service station. Not only this, the set of four tires will cost approximately a third less than the two larger tires. And as the same tire is used on all wheels the number of spares is reduced to that which will insure continuous service. This form of truck is still in the development stage, but offers interesting possibilities for future improvement providing it proves out in extended service.

ELECTRIC REDUCTION FURNACES

ELECTRIC furnaces used for heating and fusion of metals are economical more especially in those cases where what the French call white coal or water power is available. White coal is properly, or in the strict metaphorical sense, the streams from snow-clad mountains and from glaciers, or rather the source of such streams, the ice and snow on the mountains. When ore is reduced in a reduction furnace, such as a blast furnace, the coal performs two functions; it supplies the requisite heat and also is the reducing agent which takes up the oxygen of the ore so as to produce metal therefrom. But in the electric reduction furnace a new factor appears; the heat for fusion and for inducing the chemical reaction of reduction is produced by the electric current actuated by the requisite voltage. No coal would be required except for the fact that there is combined oxygen in the ore to be got rid of. Therefore a certain amount of coal is charged into the electric reduction furnace simply to supply the reducing agent. In an electric melting furnace no fuel is needed, the electric energy does everything, for it is simple heating which is required. But if ore, such as iron ore, is to be reduced in an electric furnace, carbon in the form of coal or preferably of charcoal is to be added, otherwise there will be no reduction of the oxide. There is a distinction to be drawn in the two classes of electric furnace. In the melting furnace is it possible to melt the metal without any foreign substance coming in contact with it; this is done in the induction type; an alternating current induces a current through the metal so as to bring it to any required temperature. In the case of the reduction furnace a reducing agent is necessary; this is always coal or charcoal, so that in the reduction of metals there is always some liability of contamination from the impurities of the coal or charcoal, although the latter is practically perfectly pure and will not contaminate the metal perceptibly. The induction furnace is not in extensive use. Its shape, as regards the hearth or crucible, is inconvenient. Arc furnaces are the usual type in the metal industries, and in them the electrodes may be the source of introduction of impurities.

It is the practice to distinguish between arc and conduction or incandescent furnaces. But the fact is sometimes overlooked that what is presumably an arc furnace may have the current of the arc conducted a part of the distance between the electrodes by the charge. In this case, and it is a usual one, the furnace may be looked upon as a combined arc and incandescent furnace. Especially is this the case where one set of electrodes enter the furnace through the bottom, so that the arc really has the upper layer of the charge as one electrode, and the current all goes through the body of the charge, heating it by direct incandescence, to which, however, is superadded the heat of the arc. It is fair to consider the arc the principal source of heat, although the fact, that the charge is eventually so hot, acts to increase its resistance and give it greater incandescing power.

A recent report on iron ore electric smelting in British Columbia has been issued. To produce a long ton of pig iron from one-third to one-half a horsepower year is required, so that a furnace producing fifty tons a day would require 8,000 to 9,000 electric horsepower. It was figured that by getting the cost of electric power down to ten dollars per horsepower year, electric smelting would be profitable. An item of expense cited is the electrodes, which alone, according to Swedish experience, cost about fifty cents a ton of pig iron produced.

Digitized by Google

The Burgess BLUE BOOK

For Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Types, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men. It is being used in technical Schools. Electrical establishments furnish them to their employees to save time. Industrial establishments give them to their customers.

The Burgess BLUE BOOK will be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

Information and Write-ups on Electrical Subjects Supplied. Questions Answered. Problems Solved. Inventions Perfected.

Burgess Engineering Co.
Consulting Electrical Engineering
YORKE BURGESS, President
753 East 42nd St. Chicago, Ill.

ELECTRICITY

Taught by a Practical Man

If you are interested in a HOME STUDY COURSE, which is really an Engineering Service, and well adapted to men who are engaged in the electrical industry, SEND FOR MY CATALOG. Superintendents, Chief Electricians and Foremen, who are interested in the welfare of their men, ARE INTERESTED in what I have to offer. Students may discontinue at any time, if not satisfied, and their payments stop them. PRACTICAL MEN recommend this course. Seventy-five percent of my students are engaged in practical work and find my instruction well suited to their needs. Over 11 percent of my enrollment has been obtained from students.

Burgess Electrical School
YORKE BURGESS, Superintendent
751 EAST 42nd STREET
Chicago, Illinois

"Old Town Canoes"

You can lazy-paddle an "Old Town" all day long. "Old Towns" are light, buoyant Canoes that answer the slightest pressure of the blade.

They are strong, sturdy canoes built for years of service. The "Sponson Model" is safer than a row boat. Write for catalog. 3000 canoes in stock.

OLD TOWN CANOE CO.
946 Fourth St.
Old Town, Maine, U. S. A.



You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 909 Bogue Bldg., Indianapolis

BE AN EXPERT

Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 60, St. Louis, Mo.

NOW 35cts EACH

MODEL LIBRARY SERIES

1. The Study of Electricity for Beginners.
2. Dry Batteries, How to Make Them.
3. Electrical Circuits and Diagrams, Part 1.
4. Electric Bells, Annunciators and Alarms.
5. Modern Primary Batteries.
6. Experimenting with Induction Coils.
7. Electric Gas Igniting Apparatus.
8. Small Accumulators, How to Make and Use.
9. Model Steam Engine Design.
10. Practical Electrics.
11. Inventions, How to Protect and Sell Them.
12. Woodwork Joints, How to Make and Use.
13. The Fireman's Guide to the Care of Boilers.
14. The Slide Valve Simply Explained.
15. The Magneto Telephone.
16. The Corliss Engine and Its Management.
17. Making Wireless Outfits.
18. Wireless Telephone Construction.
19. The Wimshurst Machine, How to Make It.
20. Simple Experiments in Static Electricity.
21. Small Electrical Measuring Instruments.
22. Electrical Circuits and Diagrams, Part 2.
23. Induction Coils, How to Make Them.
24. Model Vaudeville Theatres.
25. Alternating Currents, Simply Explained.
26. How to Build a 20 foot Bi-plane Glider.
27. A B C of the Steam Engine.
28. Simple Soldering, Hard and Soft.
29. Telegraphy for Beginners.
30. Low Voltage Lighting with Storage Batteries.
33. House Wiring for Electric Light.
34. Magnets and Magnetism.
36. Small Windmills and How to Make Them.
37. Collin's Wireless Plans, Part 1.
38. Collin's Wireless Plans, Part 2.

SPON & CHAMBERLAIN
Publishers of Technical Books
120-122 E Liberty Street : New York

Professional Assistance and Consultation

We solicit the patronage of inventors and will give prompt, confidential service in the perfection of ideas. Complete drawings and plans prepared. Specialists in steam and gas engine appliances.

Correspondence Invited.

Let Us Know Your Problem

Bell & Hoyt
1731 Broadway, New York, N. Y.



$95 An Hour!

"Every hour I spent on my I. C. S. Course has been worth $95 to me! My position, my $5,000 a year income, my home, my family's happiness—I owe it all to my spare time training with the International Correspondence Schools!"

Every mail brings letters from some of the two million I. C. S. students telling of promotions or increases in salary as the rewards of spare time study.

What are *you* doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best. Yes, it will! Put it up to *us* to prove it. Mark and mail this coupon *now!*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6085-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name_____

Present Occupation_____ 7-26-10

Street and No._____

City_____ State_____

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.



PATENTS

Before disclosing your invention to anyone, send for blank form, "Evidence of Conception," to be signed and witnessed. Form and information concerning patents free.

LANCASTER AND ALLWINE
225 Ouray Building, Washington, D.C.
Originators of the form "Evidence of Conception"

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney
"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost.
Offices
364 University St. Montreal, Canada
920 F St., N. W. Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

DRAFTING
Inventions and Ideas Developed!
Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE
A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

Mechanical Drafting
EXPERT SERVICE—REASONABLE
E. W. HEANEY & CO.
2105 Monterey Avenue New York City
Telephone Fordham 6249

Window Glass Manufacture

IT is remarkable how little the average person knows about the manufacture of common things in everyday use, and the value of these objects is only realized when we are deprived of their use for any reason. The value of window glass is known to us all, and it is a recognized necessity of our modern life, but how few of us have any conception of the processes involved in its manufacture. It is not generally known that the formation of the thin sheets of glass called for by the glazier follows the rather roundabout formula of blowing the glass into cylinders, to be later slit and flattened out into sheets, but this is the fact. The process outlined has been described in the *Scientific American*, and should be of interest to many of our readers who like to know how things are made.

Lumps of the raw glass are attached in furnaces to the ends of long tubes, and then heated to a sufficient temperature to permit of blowing. The entire blowing cannot be performed in a single operation, both because it is still done by human wind-power, of which no man has enough to blow a complete cylinder of the necessary size, and because the glass will not hold the blowing temperature long enough. In practice this tendency of the glass to cool is actually accelerated, in the first stage of the operation, by water sprays. In this stage the lump of glass adhering to the end of the tube is blown into a more or less indefinite shape, of which little more can be said than that it is roughly globular and quite small. It then goes back to the furnace for re-heating, and after the next bout with a blower it has become considerably enlarged, and assumed the general shape of a pear. The blower during the formation of this big bubble is relieved of the necessity for supporting the entire weight of glass and tube; a wooden form of the appropriate hollow shape is provided for him to rotate the glass in. The third stage of blowing brings the glass into the form of a long cylinder of very even section; so long, in fact, that pits have to be provided for the accommodation of the glass. The blower stands on the edge of these depressions, and holds the long narrow bubble down in them while he works at it.

The ends of the cylinder thus formed, of course, are closed; the blower and his assistant carry the cylinder down a sloping platform and place it in position on a bench, where it is held by wooden wedges. The two ends are removed, and then a rim of molten glass is smeared around the line of cleavage at each end to prevent splitting. This is easily effected by taking a lump of semi-molten glass on the end of a small rod and using the latter as a brush, drawing it about the circumference of the cylinder-end.

With both ends thus opened and made secure against damage, the cylinders are placed, usually three in a row, on a bench. Here they are cut longitudinally by a diamond cutter, a single slit being made in each cylinder from end to end—not two slits. The slit is held open by the insertion of one or two small wedges and the glass now is ready to go to the heating oven for flattening.

It is conveyed into this oven mechanically, and deposited on an iron table with a stone top, which is moved back and forth inside the oven by means of a long rod, protruding through a hole in the oven wall. The "ironer" stands at the door of the oven, and after pushing the glass off the loading frame and on to the table, he works at it with a tool consisting of a long handle with a block of water-soaked wood at the business end. The assistant at the table-controlling rod moves the table back and forth at the ironer's command until the glass has been successfully reduced to a flat sheet.

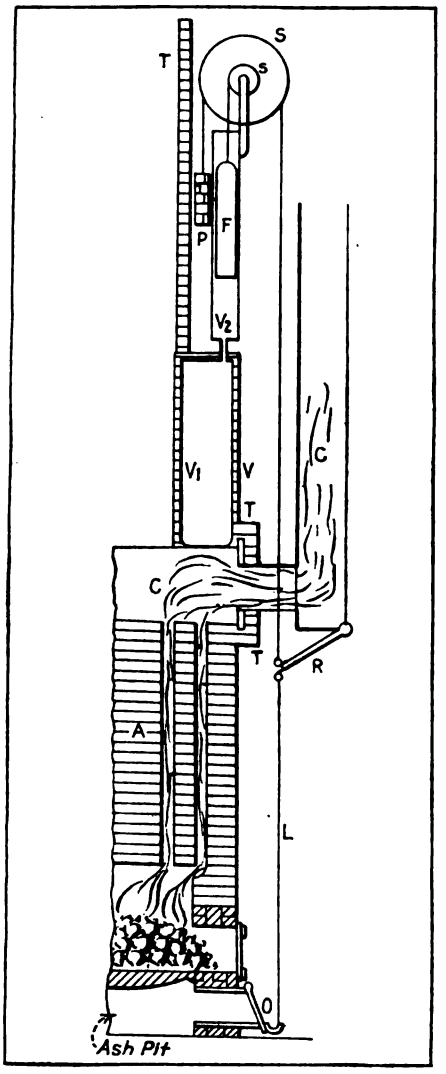
SEAPLANES RESIST WEATHER

AN indication of the worthiness of seaplanes—and, likewise, a demonstration of the practicality of such machines for commercial use—may be obtained from the experience of the naval air detachment of the Atlantic fleet in the winter maneuvers at the southern base. The detachment returned to northern waters with the fleet in April, the six F-5-L seaplanes, the main battle machines of the detachment, having been in continuous service for six months. Although showing hard service, the planes were still in good condition. The machines left the Naval Aircraft Factory in October, 1919, and, until their return to the North, had not had hangar or flying station service. They were cared for on the water or on the beach and were exposed to sun and rain in a tropical climate without protection part of the time during the rainy season. But despite this, no hull failures were experienced and wings were rebuilt and recovered without removal. Despite the fact that the hulls were barnacle covered and the soakage in hulls and wings totaled about 1,000 lb. per unit, the performance and air-worthiness were excellent.

Digitized by Google

HEAT REGULATOR FOR HOT-WATER HEATING FURNACES

THE simple regulator shown in the cut is given in a French contemporary as of home construction. In the cut A is hot-water heater boiler and C, C are the smoke-flue and chimney. The cross-hatched parts, T, T, indicate the hot-water conduits. The vessel, V, surrounded by the hot water, has within it a second vessel of a little less diameter, V_1, and this is surmounted by a



Heat regulator for hot water heating furnaces

still smaller vessel, V_2, in communcation with it by the pipe as shown. F is a float with suspension cord passing over and wound on a pulley or drum, s, and on the axle of this drum is a larger pulley, S, over which passes a cord with a counterpoise, P, at one end while its other lead actuates the chimney damper, R, and the ashpan damper, O. The vessels, V_1 and V_2, are filled with water to a proper level. Changes of temperature affecting the level of the water in these vessels, as it expands and contracts, open and close the dampers. This regulates the draft, reducing it as the furnace gets hotter and increasing it as the heat diminishes.

POTATO RHEOSTAT

A DECIDED oddity in the way of a rheostat is a potato. By thrusting two bars of copper or iron into a potato an adjustable resistance is at hand. By forcing the bars into the tuber, so as to bring their ends nearer together, the resistance of the simple rheostat will be decreased and vice versa. Heavy wires will do excellently for the rods, and the wires of the circuit can be twisted around their exposed ends. A heavy current will operate to dry the potato, it might even go so far as to cook it, so the resistance will be subject to an inevitable increase. It is quite possible that this simple suggestion might be of value. A horticulturist could undoubtedly suggest other products equally available for electric resistances.

ELECTRIC WATER BOILERS

Much interest is being taken in Switzerland in the line of electric heating on the large scale. Boilers are heated by resistance coils, which, in the case of direct current, must be kept out of contact with the water of the boiler by a quartz tube or otherwise, to prevent the production of of hydrogen gas, which might bring about an explosion. If alternating current is used, the liability of evolution of electrolytic gas disappears. So far no explosion has been chronicled and an efficiency of 90% in the generation of the steam has been obtained. This, of course, says nothing about the efficiency at the generating end of the electric system, but, as water power is used for this, the at that point efficiency is not a matter of great concern. In one system a coil of pipe filled with oil is surrounded by the water of the boiler and the resistance coils are immersed in the oil in the lower parts of the tube. It is not considered safe to exceed a temperature in the oil of 320° C. (608° F.). One arrangement is cited in which iron resistances are imbedded in a concrete block, their heat being transferred by means of oil pipes to the water in the boiler. 77% efficiency was claimed for this arrangement. The bakers of Switzerland are said to represent an annual consumption of over 350,000 tons of coal per annum and an effort is made to have them bake by electric heat.

Anti-rust oil, called slushing oil, is used extensively to preserve iron and steel from rusting. It has been found that there is a difference in oils as regards their usefulness in this regard, some adhering better than others. Some leave the surface in spots or areas. It is suggested that a test for adherence should be applied, the oil being applied to polished metal plates and being kept under observation for several days at a range of 60° to 95° F. to see if it adheres.

PRINCE ALBERT *the national joy smoke*

Our exclusive patented process cuts out bite and parch.

THE
RADIO
REVIEW

A MONTHLY RECORD OF SCIENTIFIC PROGRESS IN RADIO TELEGRAPHY AND TELEPHONY

Monthly - Half-a-Crown

Single copies, post free 2s. 9d. Annual Subscription, post paid, 30/- post free.

THE RADIO REVIEW, a new monthly magazine, devoted entirely to the technical side of radio communication.

Edited by Professor G. W. O. HOWE, D.Sc., M.I.E.E., assisted by PHILIP R. COURSEY, B.Sc. A.M.I.E.E.

THE RADIO REVIEW is the Authoritative Journal of Wireless Research. Contributions from the pens of the World's leading Radio Scientists will be a special exclusive feature.

. . . . . .

Editorial and Publishing Offices
12-13, HENRIETTA STREET
LONDON, W.C. 2

UmakeM Lathe You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 1 which includes all Castings and 12 detail blueprints. Complete outfit $25. Net following dimensions: Length over all, 3 ft. 11 ins. Breadth, 13 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

Advertisements in these columns 7c per word, average 7 words to the line. To insert advertisement under proper classification copy should reach us not later than the first of the month.

Agents Wanted

MAKE $30.00 NEXT SATURDAY. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Mich.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

AUTO PARTS. Save 10 to 50% on gears, axle shafts, and other auto parts. We can furnish parts for more than 300 different models. Write us your needs. Money refunded if parts are not satisfactory. Auto Tire & Parts Co., Cape Girardeau, Mo.

Aviation

$175.00 BUYS motors, propeller, wing frames, tail frames and under-carriage for single seater tractor biplane. Brubaker, 522 East 78th Street, New York.

BUILD YOUR OWN AEROPLANE, on installments, materials cut to fit or in the rough. J. Angeles, Centralia, Wash.

CONSULTING AERONAUTICAL AND AUTOMOTIVE Engineers. Inventions analyzed and developed—Designs prepared. Tests. Expert advice. Van Munning & Marx, City College, New York.

Blueprints

BUILD YOUR OWN SPEEDSTER auto body, actual cost $10.00 with my plans, lighter, cheaper, and easier to construct than tin. Send $1.00 for blue print instructions and full details. Marr's Plans, Dept. 5, 1911 Curtis St., Denver, Colorado.

Books

BOOKS DELIVERED FREE. Write today for Illustrated Guide to the Latest Books. Wesley Mills Co., Dept. A, 500 Fifth Avenue, New York, N. Y.

NATURE FACTS married and engaged people should know, full explanation concisely given, 25c. Central Sales, 601 Ninth Ave., New York.

IMPORTANT! Phytotherapy (Herbalism). Herbs and Plants and their Uses in Health and Disease by Dr. Benedict Lust. Illustrated. 52c postpaid. Nature Cure, 110 E. 41st St., N. Y. City.

Business Opportunities

FREE information regarding large earnings, Raising Canaries for pastime. Birdland, Lynnhaven, Virginia.

SUBSTANTIAL Manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $1,500 necessary. Will allow expenses to Baltimore as explained. Address, Treasurer, 416 N. Howard St., Baltimore, Md.

WILL YOU HELP—financially—to place the best Lock-Nut on the market? (Cheap, needs little additional machinery to manufacture, simple and positive.) How many shares at $1.00 each will you buy, subject to when, as and if issued? Rolph J. Lackner, 136 West 49th St., N. Y.

AMBITIOUS MEN—Grasp this opportunity to make money. You can make $5.00 to $10.00 every day in your spare time at home. Not a cheap scheme, agency or soliciting proposition, but substantial business plans. Investigate this today. Address, Business, Box 175, Fredonia, N. Y.

APPARATUS AND CHEMICALS for the laboratory. Write for price lists. Park Scientific Company, 1341 Park Road, Washington, D. C.

Chemicals

EXPERIMENTAL LABORATORIES, fully equipped—$11.00 to $100.00. Payment Plan or Cash. Descriptions and actual photographs free. Write Dept. E-27. Lions Scientific Institute, "Laboratory Outfitters," Mt. Oliver, Pittsburgh, Pa.

Electrical

INSTANTANEOUS Hot Water Heater, attachable any faucet, valuable hospitals, physicians, and dentists' offices, barbers, and home use. Retail $60. Dealers $45. Victor O. Ford Company, 250 West 54th St., New York.

Electric Motors

MOTORS ELECTRIC, no delay, ¼ H.P., 110 volt, 60 cycle, single phase. New, money back guarantee $24.50. We buy motors of various sizes. 25% with order, balance C. O. D. General Distributing Co., 22 West 1st St., Duluth, Minn.

Ford Owners

FORDS RUN 34 MILES per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days' trial. Air-Friction Carburetor Company, 600 Madison St., Dayton, Ohio.

FORD SPEED-POWER EQUIPMENT stocked; 4 Speed Forward Auxiliary Transmissions, Doubles Pulling power, increases speed 40 or 20%; 16 Valve Overhead Cylinder-head; speed carburetors; camshaft, piston rings; light pistons, crankshaft counterbalances; high tension magnetos; underslung fixtures; speed power bevel gears; foot accelerators; steering wheels; wirewheels; disc wheels; metal wheel discs; Ford Fire Chemical Hook and Ladder; 15"-30" Double Universal Wheelbase Extension; 1½-3 ton Side Spring Additional Frame Work Units; Complete Line 1½-5 ton Shaft-Chain Drive Units; Racing Body; Complete Racing Cars $500.-$1750. B. V. Ford Speed-Power Equipment Manufacturers, 250 West 54th St., New York.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

Health Resorts

NATUR KUR—Resort for Natural Life Regeneration, physical, mental and spiritual. Nature cure methods. All drugless and rational methods of diet, cure, reducing and upbuilding. Dr. Benedict Lust, Butler, N. J.

Inventors

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

Male Help Wanted

RAILWAY TRAFFIC INSPECTORS earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM 26. Standard Business Training Institute, Buffalo, N. Y.

FIREMEN, BRAKEMEN, BAGGAGEMEN, $140-$200, Colored Porters by Railroads everywhere. Experience unnecessary. 893 Ry. Bureau. East St. Louis, Ill.

SALESMEN—City or Travelling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association. Dept. 157G, Chicago, Ill.

Miscellaneous

SHAWNEE, OKLAHOMA, a growing city, a good place to live. Write for information. Board of Commerce, Shawnee, Oklahoma.

DETECTIVES EARN BIG MONEY. Travel. Experience Unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

NAME PLATES—To fasten on your umbrella handle. If you should leave it in street car, theatre, etc., you will be notified and can easily get it again. Price 25 cents, postpaid. Mail orders promptly filled. Address, Wallace, Box 315, Brattleboro, Vermont.

MULTIGRAPHS, Addressographs, Duplicators, Sealers, Folders, Less than half price. Guaranteed one year. Pruitt Company, 112-D, North La Salle, Chicago, Ill.

SHOES, Half soled (nailed) 60c; hand sewed 80c; rubber heels attached 30c; best quality material used throughout. We pay postage. Quick service. Satisfaction guaranteed. The Shoe Repairing Co., 489 Woodland Drive, Devon, Conn.

WANT Goodell Pratt Lathe, with Sawtable. Pray, 102 Heath, Somerville, Mass.

Models

BUILD a Model Electric Motor Complete working outfit $2.00. Blue Prints 25c. A. F. Cassel, 53 W. 130th St., New York.

BUILD a Model "Speedster". Complete outfit $2.00. Blue Prints 25c. A. F. Cassel, 53 W. 130th St., New York.

WANTED—Working models, all kinds, anything. What have you—price? Description. McIntosh, 51 Blanch St., Battle Creek, Mich.

Motion Picture Plays & Supplies

$25-$300 PAID ANYONE for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530 St. Louis, Mo.

Motorcycles

USED AND REBUILT Indians, Excelsiors, Harleys. Overhauled and tested by experts. Guaranteed and shipped on approval. We save you big money. We furnish Bank References. Send Stamp for Free List. Floyd Clymer, Dept. 3, "Largest Motorcycle Dealer in Western America," Denver, Colorado.

Patents

PATENTS. Booklet free. Highest references. Best results. Promptness assured. WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS — Herbert Jenner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York. 625 F Street, Washington; Tower Building, Chicago; Hobart Bldg., 582 Market Street, San Francisco, Calif.

PATENTS. In all matters pertaining to invention consult National Institute of Inventors, 118 Fulton St., New York City, having three thousand members. Booklet free.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant Engineers, Washington, D. C.

PATENTS—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years' actual experience; full information upon request. E. P. Fishburne, 322 McGill Bldg., Washington, D. C.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1883. "Inventor's Guide" Free. Franklin H. Hough, 510 Loan & Trust Bldg., Washington, D. C.

"INVENTORS RECORD" and "Bulletin" sent without charge. My free blank form for disclosing your invention simplifies procedure. Send sketch or description for preliminary advice. Wm. H. Mulligan, Registered Attorney, 394 Woodward Building, Washington, D. C.

DON'T LOSE YOUR RIGHTS to patent protection. Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster and Allwine, 237 Ouray Building, Washington, D. C., originators of the form "Evidence of Conception."

Personals

DON'T GO DRY—Make your own Rye, Corn, Bourbon with our essences; 50 glasses $2.00. Malthop extract $1.75; makes 8 gallons fine wholesome beverage. Comply with the National Prohibition Law. Superior Supply Co., 1440 Niagara, Denver, Colo., Dept. 26.

Phonographs

BUILD YOUR OWN PHONOGRAPH—Big saving. We furnish parts and cabinets. Write today for free instructions. Associated Phonograph Supply Co., Dept. V, Cincinnati, Ohio.

Photo Developing

MAIL US 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 283 Bell Ave., Roanoke, Va.

Schools

AMERICAN SCHOOL OF NATUROPATHY—110 E. 41st St., N. Y. City. Become a Drugless Doctor and be professionally successful and financially independent. Send 25c for explanatory literature on this wonderful science of New Rational Healing Art.

HOME STUDY; High School, College and Mechanical Courses. Standard Diplomas. Degrees granted. Prospectus Free. Metropolitan College, Station "A", Boston, Mass.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stammering

ST-STU-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 163 Potomac Bank Building, Washington, D. C.

Stamps

APPROVALS 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

1,000 NICELY MIXED STAMPS from all over the world, cat. up to 20c each, post free 59c. Dayton Postage Stamp Co., East Foxboro, Mass. We buy stamps.

HAVE YOU SEEN THE STAMP HERALD? Finest monthly stamp paper published. Subscription 50c a year, 3 months trial for 10c. Stamp Herald Publishing Co., Dept. E, Indianapolis, Ind.

OLD COINS WANTED. 24 page buying catalogue, 10c. A. Kraus, Kraus Building, Milwaukee, Wis.

Watches

WATCHES REPAIRED. Expert Watch repairing for the public. Write for prices or send for estimate. Include return postage. Henry Dietrich, Watchmaker, Hamler, Ohio.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¼" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotoy Electric, Charlotte, N. C.

Digitized by Google

CONTENTS

VOL. 9 JULY, 1920 NO. 4

COMMON CAUSES OF AUTOMOBILE NOISES—PART 1 297
By Victor W. Pagé, M. S. A. E.
MODERN PRECISION MEASUREMENTS 300
By Harry A. Mount
ELECTRONS AND THE CONSTITUTION OF THE CHEMICAL ATOM 303
By Prof. T. O'Conor Sloane
JET PROPULSION FOR MOTOR BOATS 305
HEAT TREATING ALLOY STEELS—PART 3 306
By Victor W. Pagé, M. S. A. E.
DOMESTIC ILLUMINATING ENGINEERING 309
By Harry A. Mount
A COMPRESSED AIR DRIVEN MONOPLANE 310
By H. C. Ellis
HOW TO MAKE A COMPRESSED AIR MOTOR 312
By V. Davenport
A SIX-CYLINDER AIR MOTOR 314
By A. Bohaboj
MODEL STEAM ENGINE AND BOILER CONSTRUCTION—PART 1 315
By W. A. Helm
GAS HEATED SOLDERING COPPER 317
SWITCHES AND CUT OUTS 318
By Prof. T. O'Conor Sloane
A MINIATURE RAILROAD SYSTEM 320
SHOP PRACTICE 321
Air Pressure Device for the Transfer of Oil—Protecting Molten Metal from Oxidation—Practical Oil Drill—Adapter for Surface Gauge—Hardening Small Carbon Steel Tools—Special Tool Holder—Using Cross-cut Saw as Try Square—Chart for Power Transmitted by Leather Belts—Quick Setting Machine Vise.
NAPIER'S RODS AND THEIR USE 323
By Prof. T. O'Conor Sloane
THE EVERYDAY MOTORIST 324
HOW TO TEST ENGINES FOR HORSEPOWER 326
By Adrian Van Muffling, M. S. A. E.
EXTRUDED METAL 327
UNIFLOW STEAM ENGINE — PICKLING AND CLEANING CASTINGS 329
ELECTRICAL PROGRESS DIGEST 330
SPECIAL APPLIANCES FOR EXPEDITING AUTOMOBILE REPAIRING 332
By Victor W. Pagé, M. S. A. E.
BURNING PULVERIZED FUEL 335
AVIATION BRIEFS 336
London and Paris Aerial Passenger Service—The "Mosquito" and "Sport" Farman Airplanes—Fast Hydro-Aeroplane — Commercial Transport in China.
MANUAL ARTS AND CRAFTS 338
By Charles E. Muller, M. A. E.
Combination Hall Tree—Mission Style Hall Seat
PHOTOGRAPH PROJECTOR MADE FROM CAMERA. 340
By L. B. Robbins
EVERYDAY SCIENCE NOTES 342
TWO-STEP AUDIO FREQUENCY AMPLIFIER 344
By M. B. Sleeper
THE RADIO DEPARTMENT 347
RADIO EQUIPMENT FOR SMALL BOATS 348
TAPPING SINGLE LAYER INDUCTANCES 351
NEW RADIO APPARATUS 352
KNOBS FOR RADIO EQUIPMENT 353
A SIMPLE METHOD OF MEASURING INDUCTANCES OF LOW FREQUENCIES 354
THE BUREAU OF STANDARDS RADIO CLASSIFICATION 356
SEMI-LUMINOUS PAINT 366
BOOK REVIEW 381

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

A Dependable, Instructive Digest of Current Mechanical, Scientific, Automotive and Radio Progress.

Managing Editor VICTOR W. PAGÉ
Science Editor PROF. T. O'CONOR SLOANE
Radio Editor M. B. SLEEPER
Contributing Editors
L. M. CLEMENT *Radio Engineering*
CHAS. E. MULLER *Manual Arts and Crafts*
Advertising Manager STEPHEN ROBERTS
Branch Advertising Office SEARS & IRVING, Peoples Gas Building, Chicago, Ill.
Published Monthly by EVERYDAY MECHANICS COMPANY, INC. New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechanics Co., Inc.

The Age of Precision

THIS is truly the age of precision. We find the importance of precision measurements recognized just as much in practical mechanics as in theoretical science. In this issue the reader will find two articles which deal with the division of units we formerly thought minimum values in the field of mechanics and chemistry, to still more minute quantities, some of which are so small as to be hardly understood by the average human mind.

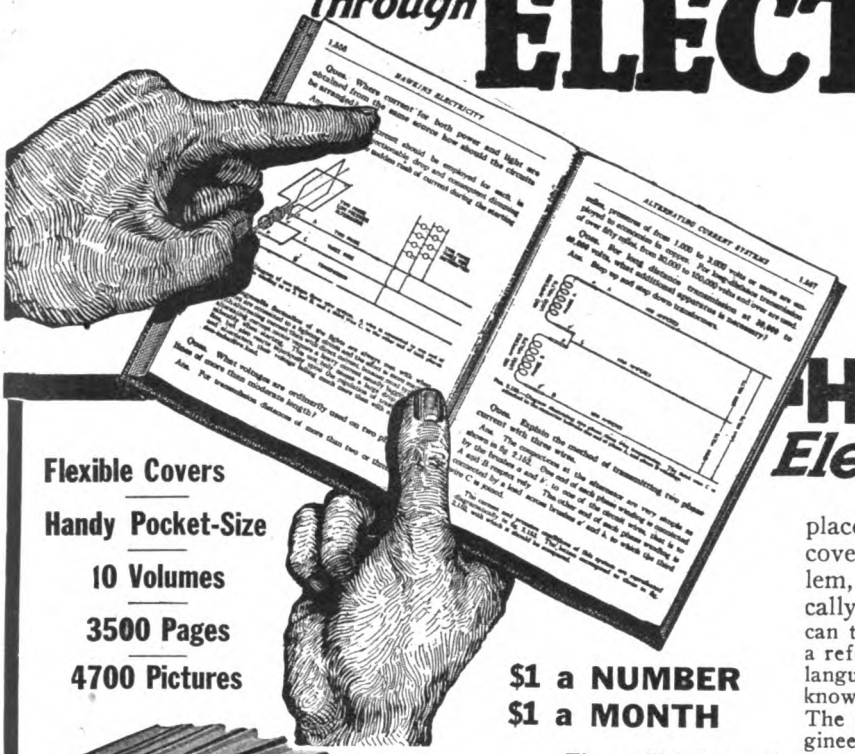
FOR some time past, mechanics and makers of precision instruments have believed that working to one-tenth of one-thousandth of an inch was the practical commercial limit as the most delicate mechanical measuring machine was capable of indicating, with reasonable accuracy, no lower unit than one hundredth of a thousandth part of an inch. New methods of measurement have now made it possible for men of ordinary attainments to measure variations as small as one-millionth part of an inch, and experts to measure accurately to the twentieth of a millionth of an inch.

THE chemist of former times could never get below the atom, so it was considered the smallest possible division of matter; it was held that two or more atoms formed a molecule, and that as an atom could not exist alone, molecules were the smallest unit of independently existing matter, and a molecule was built up of atoms. While the atom and molecule remain the working units of chemistry, the theory of the last few years considers the atom as a very large unit of matter, and as described in a very interesting article in this issue, a new unit of matter is now used by scientific men.

A CORPUSCLE termed the electron that is estimated as being less than one hundredth of a thousandth part of the diameter of an atom, is being seriously considered and talked of by Scientists. The size of an electron may be understood to be exceedingly minute, when an estimate made by a competent authority, who gives a value of one-fortieth of a millionth of an inch as the diameter of an atom, is properly grasped by the mind, a difficult feat for most of us.

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS Electrical Guides

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins.
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Employed by .....

Residence .....

Reference .....July

SEND NO MONEY - USE THE COUPON

Digitized by Google



LEARN WIRELESS

AT HOME QUICKLY AND EASILY

BY MARVELOUS NEW METHOD

A combination course in Wireless Telegraphy and Telephony perfected by the National Radio Institute that will fit you in a few months for a position paying $200 or more a month to start.

Future success assured our graduates. Hundreds of attractive and interesting positions in Commercial Radio Service on Land, Merchant Marine, Railroads, Radio Supply Factories and Laboratories, Lake and Ocean Steamship Lines, Telegraphy Companies, and Aerial Mail Service always ready to be filled. Because of the efficiency of our graduates, they are given first choice, and positions are guaranteed to those who complete the course and secure a license.

Big Money in Wireless Work

Few professions offer the opportunities found in Radio. Any young man with ambition and energy can soon be qualified for exceptional positions by taking our course in Wireless. Your first position will pay you the equivalent of $200 or more a month—$125 in salary, plus living expenses, which by a conservative estimate we place at $100 a month.

There are exceptional chances for rapid promotion to Radio Mechanic, Electrician, Government Inspector, Radio Aid, and Radio Engineer. One of our recent graduates is getting $6,000 a year.

No previous knowledge of Wireless or electricity is necessary to take our course. Our course is easy and comprehensive, and with the help of our Natrometer, you can master Wireless in a marvelously short time—right in your own home, the National Radio Institute way, in your spare time!

Travel Around the World—Your Expenses Paid

If you are eager to travel, anxious to visit foreign countries, and increase your knowledge of world affairs, Wireless offers you the biggest chance you will ever have. You travel on shipboard with an officer's rating, living the life of an officer, eating at the captain's table, and mingling with the passengers. All without one cent's expense to you!

If you prefer to locate permanently at or near your own home, Wireless again offers the opportunity, for you may secure an equally attractive position at one of the many land stations, with Radio companies, Steamship companies, or Commercial houses.

Regardless of how big your desires and plans for your future, Wireless is always in the foreground, offering advantageous and attractive opportunities. Look into it and plan your life accordingly.

This Fine Natrometer Given To You

This wonderful Natrometer automatically sends you Wireless messages as though coming from a radio station thousands of miles away. It is a complete improved sending and receiving set, embodying the same type of instruments as used by the United States Bureau of Navigation in testing applicants for official license. Made especially and exclusively for National Radio Institute students.



Get Your Instructions From Washington—Center of All National Wireless Activities

The National Radio Institute was established in 1914, and was the first in America to successfully teach Wireless by mail. It is established in the heart of national interests—in Washington, the home of the United States Shipping Board—center of all official Wireless activities—and the home of the United States Department of Commerce (Radio Department) which passes upon every first grade government license granted in America, and also issues all permits to erect and operate radio stations.

Our location in the nation's capital, together with the high standing of our school and instructors, and our close communication with government officials connected with Wireless activities, naturally places us in the position of giving our students the very best instruction obtainable. We are also able to be of the utmost help in assisting them secure high type positions paying substantial salaries.

Special Privileges to National Radio Institute Students

Students of the National Radio Institute receive the following:

Complete combination course in Wireless Telegraphy and Telephony—
Special post-graduate course at our large Washington school, if desired—
Five text books, one hand book, forty-six special lessons and eighteen personal examinations—
Large handsome diploma suitable for framing—
Complete automatic Natrometer outfit and carrying case—
Personal help in securing wireless position and endorsement of Institute officials.

Send For Free Booklet

We have prepared a book telling you all you want to know about Wireless and the future it offers you. Startling facts you are interested in are freely discussed. It tells how, during the past six years, we have helped hundreds of ambitious men and women and how we will help you. Send the coupon today or write to the

NATIONAL RADIO INSTITUTE
America's First and Foremost
Established 1914—Dept. 244,
14th and U Streets, N. W.,
Washington, D. C.

NATIONAL RADIO INSTITUTE,
Dept. 244, 14th & U Streets, N. W.,
Washington, D. C.

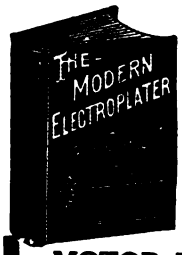
Send me your free book, "Wireless the Opportunity of Today," telling me about the opportunities in Wireless, your Famous Home Study course in Wireless Telegraphy and Telephony, your post-graduate course, and your special Wireless instrument offer.

Name .....

Age ..... Address.....

City ..... State.....

Digitized by Google



HENLEY'S
New Practical Books



MOTOR BOATS AND BOAT MOTORS

By Victor W. Pagé, and A. Clark Leich. (6 x 9.) 524 pages. 372 illustrations. Cloth. Price $4.00.

Indispensable for owners, users, repairmen or operators of motor boats and marine engines.

SHOP PRACTICE FOR HOME MECHANICS

By Raymond Francis Yates. (6 x 9.) 324 pages, 309 illus. Cloth. Price $3.00.

Deals with small tools and machines such as those employed about the home shop.

STARTING, LIGHTING AND IGNITION SYSTEMS

By Victor W Pagé. 815 pages. 492 specially made engravings. 1920 Edition, Revised and Enlarged. Price $3.00.

A practical treatise on latest automobile starting, lighting and ignition system practice. Over 200 wiring diagrams are shown in both technical and nontechnical forms. Complete data is given for locating troubles in all systems, the various steps being considered in a logical way for those without expert electrical knowledge. All ignition systems receive full consideration, starting with the simplest battery and coil forms found on early cars to the modern short-contact timer and magneto methods used with the latest eight and twelve-cylinder motors.

ABRASIVES AND ABRASIVE WHEELS

By Fred B. Jacobs. 340 pages, 200 illustrations. Price $3.00.

A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantage in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering.

HENLEY'S TWENTIETH CENTURY BOOK OF RECIPES, FORMULAS AND PROCESSES

Edited by Gardner D. Hiscox. 1920 edition. Cloth binding. Price $4.00.

The most valuable technochemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts and tells thousands of ways of making money and is just the book everyone should have at this command.

LIQUID AIR AND THE LIQUEFACTION OF GASES

By T. O'Conor Sloane. 400 pages fully illustrated. (1920.) Price $3.00.

The third revised edition of this book has just been issued. Much new material is added to it; and the all-important uses of liquid air and gas processes in modern industry, in the production especially of nitrogen compounds, are described. The book gives the history of the theory, discovery, and manufacture of Liquid Air, and contains an illustrated description of all the experiments that have excited the wonder of audiences all over the country. It shows how liquid air, like water, is carried hundreds of miles and is handled in open buckets.

MODERN ELECTROPLATING

By Kenneth M. Coggeshall. 350 pages, 142 illustrations. Price $3.00.

Anyone interested in practical plating and metal finishing will find this book a valuable guide and complete manual of the art.

EXPERIMENTAL WIRELESS STATIONS

By P. E. Edelman, E. E. (5 x 7) 390 pages, 167 illus. Cloth. Price $2.50.

Answers every question—clears up mysteries of things radio, you have often wondered about.

THE MODEL T FORD CAR, ITS CONSTRUCTION, OPERATION AND REPAIR, INCLUDING THE FORDSON FARM TRACTOR, F. A. LIGHTING AND STARTING SYSTEM, FORD MOTOR TRUCK

By Victor W. Pagé. 410 pages, 153 illustrations, 2 large folding plates. Price $2.00.

This is the most complete and practical instruction book ever published on the Ford car and Fordson tractor. To the 1920 Revised Edition matter has been added on the Ford Truck and Tractor Conversion Sets and Genuine Fordson Tractor. All parts are described. All repair processes illustrated and fully explained. Written so all can understand—no theory, no guesswork. New Edition.

MODEL MAKING

By Raymond Francis Yates. 400 pages, 301 illustrations. Price $3.00.

A new book for the mechanic and model maker. This is the first book of its kind to be published in this country and all those interested in model engineering should have a copy. The first eight chapters are devoted to such subjects as Silver Soldering, Heat Treatment of Steel, Lathe Work, Pattern Making, Grinding, etc. The remaining twenty-four chapters describe the construction of various models such as rapid fire naval guns, speed boats, model steam engines, turbines, etc.

ELECTRICIAN'S HANDY BOOK

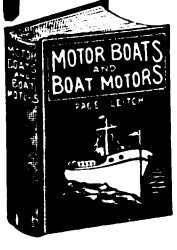
By Prof. T. O'Conor Sloane. 840 pages, 600 engravings, handsomely bound in cloth. 1920 edition. Price $4.00.

This work has just been revised and much enlarged. It is intended for the practical electrician who has to make things go. The entire field of electricity is covered within its pages. It is a work of the most modern practice, written in a clear, comprehensive manner, and covers the subject thoroughly, beginning at the A B C of the subject, and gradually takes you to the more advanced branches of the science. It teaches you just what you should know about electricity. A practical work for the practical man.

WESTINGHOUSE E. T. AIR-BRAKE INSTRUCTION POCKET-BOOK CATECHISM

By Wm. W. Wood, Air-Brake Instructor. Cloth. 1920 edition. Price $2.50.

A practical work containing examination questions and answers on the E. T. Equipment. Covering what the E. T. Brake is. How it should be operated. What to do when defective. Not a question can be asked of the engineman up for promotion on either the No. 5 or the No. 6 E. T. equipment that is not asked and answered in the book. If you want to thoroughly understand the E. T. equipment get a copy of this book. It covers every detail. Makes air-brake troubles and examinations easy. Fully illustrated with colored plates, showing various pressures.



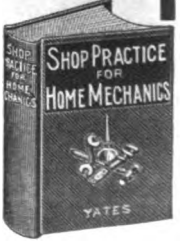
These Are the Books You Should Procure

All Up-to-date and Reliable

Any of these books sent prepaid on receipt of price. FREE—1920 Catalogue of Practical Books—Send for a Copy

The Norman W. Henley Publishing Co.

2 WEST 45th ST., NEW YORK



Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Use One of These Libraries
10 DAYS FREE

Now is the Time to Get Ready for Bigger Pay Industrial America is teeming and throbbing with the greatest activity in its history. Every day hundreds of men in small positions are raised to bigger responsibilities and bigger pay. A search is being made everywhere for men who have the necessary training to assume these new responsibilities.

A McGraw-Hill Home Study Course Will Prepare You Quickly The McGraw-Hill Home Study Courses are founded on actual work as it is done in the great fields of engineering which they cover. No space is wasted with higher mathematics and theory. Only facts, written so that you can understand them. About one hundred thousand men are now using them as a daily guide. They are equally valuable to the expert and the beginner.

Not One Cent in Advance
Small Monthly Payments If You Are Satisfied

No matter what your age is, where you are located, or how limited your means, you can succeed through one of the McGraw-Hill Home Study Courses. Everyone contains a complete education on the subject covered. No matter how much you might pay for books or courses you cannot acquire knowledge that will advance you more rapidly and surely than a McGraw-Hill Home Study Course.



Power Plant Library

Power plant practice complete, including mathematics, boilers, engines, electricity, turbines and refrigeration. Now the most used engineers' library in existence. Has enabled thousands of men to pass the most rigid examinations. 2,500 pages, 1,500 illustrations. Eight handsome volumes, bound in the tough T pattern of cloth, as durable as leather. **Price $16, payable $2.00 per month.**

Factory Management

A set of books written by leading authorities, to help men fit themselves to take complete charge of the shop or factory. Covers industrial organization, administration, purchasing, manufacturing costs and accounts, engineering of shops, factories and power plants. 6 volumes 2,300 pages fully illustrated. Bound in semi-flexible karatol. **Price $20, payable $2 in ten days and $3 per month.**

Croft Library of Practical Electricity

Without question of more practical value than anything of the kind ever attempted in the world of electricity. Enables you to know electricity as experts know it. Mathematics, practical electricity, electrical machinery, central stations, wiring for light and power, wiring of finished buildings, illumination. 8 flexible volumes, pocket size, 3,000 pages. **Price $20, payable $2 in 10 days and $3 per month.**

Iron and Steel Library

The high positions in the great iron and steel world are now attainable through this library, which is written by authorities actually engaged in this work. Metallurgy, foundry work, blast furnaces construction, operation and products, refractories. A complete iron and steel library. Seven volumes, over 3,000 pages. Fully illustrated. **Price complete $24, payable $3 per month.**

Machine Shop Library

Machine shop practice complete. Written by eight practical men, well known in the machine shop world. Now the standard in America. No other set of books on the subject ever equalled it in popularity. Mathematics, drawing and design, composition and heat treatment of steel gears, tool work, grinding, jigs and fixtures, screw machines, dies, etc. 9 volumes, 3,000 pages. **Price $20, payable $2 in 10 days and $3 per month.**

Metal Mining Library

Herein is brought together in nine flexibly-bound volumes the very meat of metal mining practice in America. Examinations, principles of mining, timbering, thousands of working details, ore dressing, surveying, accounting, costs. All the information you need to reach the high positions in the mining world. The most intricate problems solved by plain words and illustrations. **Price $24, payable $3 per month.**

Coal Mining Library

Coal mining and colliery practice complete, including outside and inside work—both mechanics and engineering. Of assistance to every man in the business, from the lowest paid man to the operator. It is now looked upon as a necessity, and as containing the secrets of success in coal mining. 8 volumes. 3,000 pages. 1,700 illustrations. **Price $20, payable $2 in 10 days and $3 per month.**

Radcliffe's Electricity

A three-volume compact set of books on the practical side of electricity. In question-and-answer form, for quick reference. This course is somewhat condensed, and will be found of special value to those interested in electricity as used in power plants. 700 pages of facts, illustrated and carefully indexed. **Price $6, payable $1 per month.**



Any Library Shipped on Ten Days' Trial—At Our Expense. Merely Return the Coupon

Look at the illustrations of the libraries at the left and right of this page. Then refer to the coupon, check the library you want, fill out the blank spaces carefully and return to us. After receiving the books, go over them carefully. Keep them ten full days. See how much knowledge you can gain from them within ten days. If then you decide you cannot afford to be without them, send us the small monthly payments called for. If on the other hand you do not want them, return at our expense. But pay no charges. We bear shipping expenses both ways.

Pay only $1 to $3 per month if you are satisfied

Free Examination Coupon

McGRAW-HILL BOOK CO., Inc., 239 W. 39th St., N. Y.

Gentlemen: Send for ten days' free inspection the Library I have checked below:

- [ ] Croft's Electricity, $20—payable $3 per month.
- [ ] Machine Shop Library, $20—payable $3 per month.
- [ ] Iron and Steel Library, $24—payable $3 per month.
- [ ] Mining Library, $24—payable $3 per month.
- [ ] Coal Mining Library, $20—payable $3 per month.
- [ ] Power Plant Library, $16—payable $2 per month.
- [ ] Factory Management, $20—payable $3 per month.
- [ ] Radcliffe's Electricity, $6—payable $1 per month.

If satisfactory I will send first payment in ten days and the same amount each month until paid. If not wanted I will return the books at your expense.

Signature .....

Residence address .....

City and State .....

Your employer .....

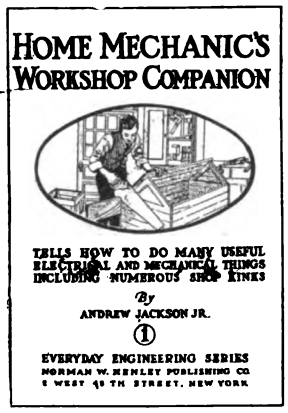
His address .....

Your occupation ..... ED 7-20

Digitized by Google

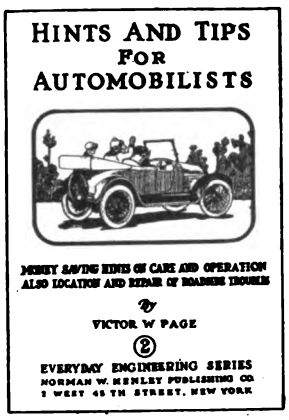
A SPECIAL OFFER TO OUR READERS

ANY ONE OF THESE BOOKS WILL BE SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION



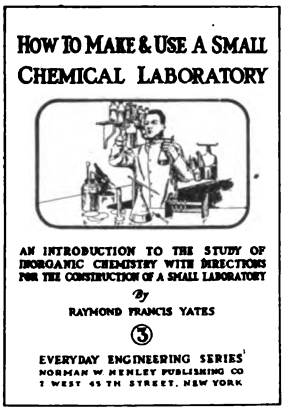
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.



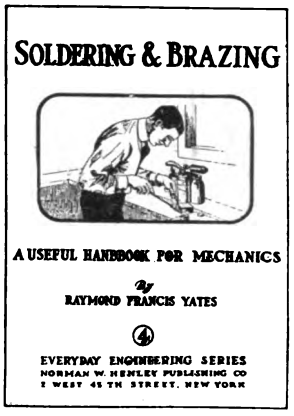
For the Automobile Owner or Driver

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints.



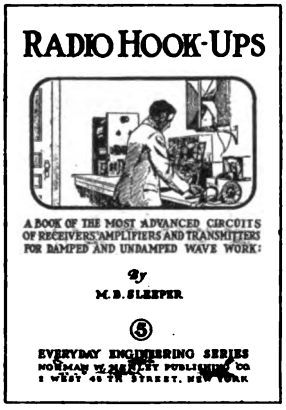
For the Student Chemist and Experimenter

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.



For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work.



For the Radio Experimenter and Amateur

In this book the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuit diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details.

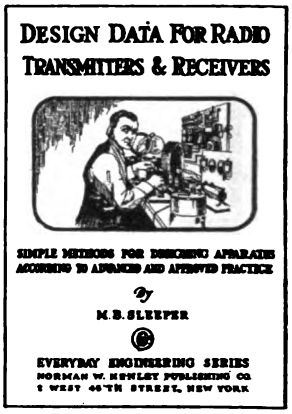
ALL of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest.

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOUR OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

Fill Out the Special Blank Below
Check Off the Title Desired and Mail with Your Remittance

Special Circular Describing These Books Sent on Request

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man —the Mechanic and the Radio Experimenter.



For the Radio Engineer and Student

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45TH STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for ..... years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the ..... issue. I enclose $....., and
(Date of issue)
according to your special offer send me copy of book checked off.

Name .....

Street .....

City .....

State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS Check off title desired here		
1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google

Health-Strength-Beauty Thru Renulife VIOLET RAY Treatments at Home

A recognized scientific effective means of handling your own case is afforded by the RENULIFE VIOLET RAY HIGH FREQUENCY GENERATOR. It is so designed and made that anyone can apply the wonderful corrective, upbuilding forces of the VIOLET RAY. This pleasant POWERFUL form of electricity has done and is doing wonders in relieving and eliminating pain and suffering. You owe it to yourself to investigate—find out the facts. Get our new booklet explaining the nature of the Violet Ray—its uses, benefits, and applications—send the coupon below at once.

WHAT USERS SAY

"The Renulife Violet Ray High Frequency Generator is superior in efficiency because of its perfect character and control of current, compactness and perfect insulation. The smallness and lightness of Electrode holder is also a great advantage." "The doctor told me that the trouble was hardening of the arteries. I would not be without it for all the money in the world." "I cannot recommend it too highly." "I have been using mine now for a week for Sciatica and I am highly pleased with results." "I think it is one of the best little machines that was ever invented." "I have used it with excellent results for the restoration of hair and stiff and sore rheumatic finger joints." "Am well pleased with the Generator, and the kind treatment received from your Company." "My Generator has stopped my neuritis." "Every house should have a Renulife Violet Ray High Frequency Generator for the treatment of Neuralgia; Neuritis; Sore Throat; Kernels in Neck; Cramps; Headache; Stiff Neck Muscular Soreness; Rheumatism; Paralysis—in short, pain of all kinds."—M. D.

"I have been much relieved by the use of your Violet Ray Generator."

"It is fine for insomnia."

"I find it such a help in nervousness."

"I would not part with it for five times the price. It is sure a little wonder."

"I am more than pleased with the Generator, the whole family are using it."

THIS TYPE of Violet Ray instrument makes possible a light, convenient handle and permits large efficient units to be used contained in handsome case.

OUR NEW BOOK

JUST OUT. This latest edition explains in detail, with many illustrations, the uses and benefits of Violet Ray. You should have one. Free for the asking.

SEND FOR BOOK!

THOUSANDS OF VOLTS

No Shock—No Harm—Simply Great Benefits

Current from your light socket is transformed into the most powerful, effective purifying Health and Beauty giving agency; yet as painless and pleasant as a ray of sunshine. Made safe for use in any home, on infant or weakest invalid. Attacks the deep seated source of diseases, at the same time relieving the aches and pains which may be the annoying symptoms. Learn how this modern form of electricity—The Violet Ray—so acceptable to the human body actually saturates the whole system with invigorating life-laden forces, bringing back normal conditions. You may treat the local area but results are not confined to that part alone—the blood, nerves, tissues are revitalized, toned and restored.

Send for the Booklet—full of information—that tells the story so you can understand it.

Natures Own Aid

What is the strange relation between electricity and life? Some declare electricity *is* life. We do not know. But life cells do welcome and respond marvelously to electricity in the form of Violet Rays. It works with nature to restore where many other methods fail. It treats fundamentally and therefore is specified by physicians for a wide range of ailments—for rheumatism, neuritis, nerve and blood disorders—etc., etc.—both chronic and acute. See the list on coupon and ask for full particulars. Blood is brought to area treated—enriched and purified—assimulation and digestion improved—functions restored to normal. Combines the benefits of electricity, vibration, exercise, stimulation, and oxidation. Get the information as to what you may expect from the Violet Ray. Its astonishing low price places it within the reach of all. The Trial Plan *proves* its value, in actual use. Receive full information by return mail.

Renulife Electric Co., Inc.

1907 Marquette Building, Detroit, Mich.

Chicago Office, Room 410, 123 West Madison



Treat Your Own Face and Scalp as well as Specialists



Strengthens—Revitalizes—Builds up



Pain and Ache Eradicator—Without Equal



For Catarrh, Throat, Lungs—also Anemia

LOWEST PRICED Efficient VIOLET RAYS

Several Models for Home and Professional Use



High Class Sales Distributors Write for Proposition

OZONE Inhalations

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1907 Marquette Bldg., Detroit, Mich.

Please send without obligation, your book **"Health,"** explaining Violet Ray treatments with Renulife Generators, also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

..Abscesses	..Facial Neuralgia	..Obesity
..Anemia	..Failing Hair	..Pain in Abdomen and Chest
..Asthma	..Female Complaints	..Paralysis
..Arteriosclerosis	..Goitre	..Piles
..Baldness	..Gout	..Pimples
..Blackheads	..Haemorrhoids	..Pyorrhea
..Brain Fag	..Hay Fever	..Rheumatism
..Bronchitis	..Infantile Paralysis	..Scars
..Bunions	..Insomnia	..Sciatica
..Bruises	..Lameness	..Skin Diseases
..Catarrh	..Locomotor Ataxia	..Sore Throat and Throat Diseases
..Colds	..Lumbago	..Sprains
..Chilblains	..Nervous Affections	..Toothache
..Dandruff	..Neuralgia	..Weak Eyes
..Deafness and Ear Diseases	..Neuritis	..Wrinkles
..Eczema		..Warts and Moles
..Enlarged Prostate		

Name .....

Address .....

.....

Digitized by Google



Man alive—Listen!

You can smoke Camels till the cows come home without tiring your taste!

CAMELS bring to you every joy you ever looked for in a cigarette! They are so new to your taste, so delightful in their mellow mildness and flavor, and so refreshing, you will marvel that so much enjoyment could be put into a cigarette!

Camels quality is as unusual as Camels expert blend of choice Turkish and choice Domestic tobaccos *which you will prefer to either kind of tobacco smoked straight!* No matter how liberally you smoke, Camels never will tire your taste!

You will marvel at Camels smooth "body". And, your delight will also be keen when you realize Camels leave no unpleasant cigaretty aftertaste nor unpleasant cigaretty odor!

For your own personal proof, compare Camels with any cigarette in the world at any price.

Camel CIGARETTES

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

R. J. REYNOLDS TOBACCO CO. Winston-Salem, N. C.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 9 JULY, 1920 NUMBER 4

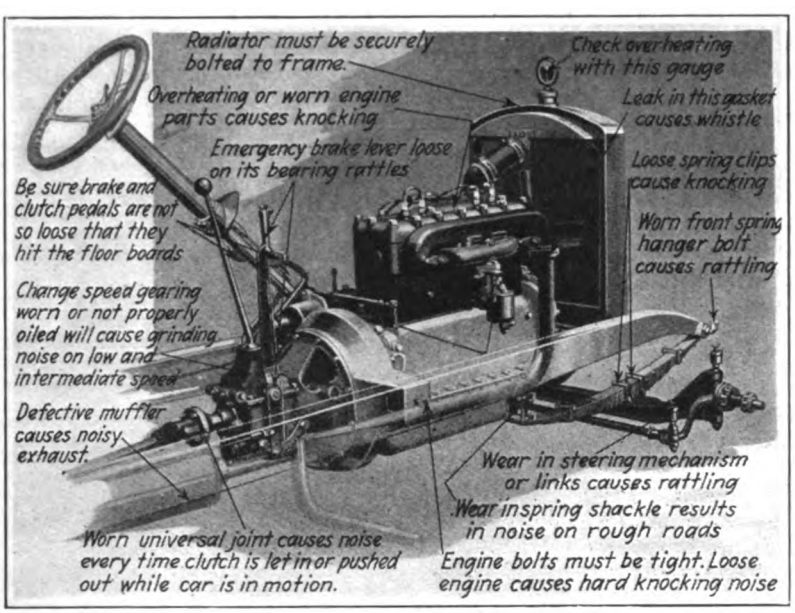
Common Causes of Automobile Noises

A Simplified Exposition for the Man Who Runs His Own Car Describing What Various Noises in an Automobile Are Due To and How To Eliminate Them

By Victor W. Pagé, M. S. A. E.

ONE of the most annoying conditions experienced in motoring is noisy operation. The first year a car is used, providing that due care has been taken in regularly screwing down the multitude of grease cups provided, the motorist will not be annoyed by noise. But after the car has been operated for a season or two, no matter how well it has been taken care of, it will develop a series of rattles and squeaks when it is driven over roads that are not of the best. Some really important noises are due to relatively unimportant parts, so that a driver may be unnecessarily worried by a loud and reoccurring noise when it can be easily fixed by the application of a few drops of oil at the right place.

Automobile noises may be divided into four classes, i.e., those due to the engine, those resulting from wear in the power transmission system, from depreciation in the running gear, and lastly, those due to looseness in the body and auxiliary parts. A number of illustrations which accompany this article have been prepared to bring out in an easily understandable way the various points about an automobile that should be inspected in event of noisy operation. When locating noises, the proper thing to do is to go over the car systematically and inspect all of the points that are apt to be noisy unless properly adjusted and oiled.



Front end of typical motor car showing sources of noise

Body Noise

Among the most annoying of the common noises are the various squeaks and creaking sounds which are usually caused by the various parts of the body or auxiliary members. Most of the body squeaks result from two pieces rubbing together which should be in fixed relation. When a car is first built, the manufacturers interpose strips of felt or leather between the body sills and the frame side members. After a time this material flattens out or beds down and the sills of the body will rub on the dry leather or other padding or parts of the body may come in contact with the metal frame. When the body-retaining bolts are loose, a slight movement of the body is permitted every time a car goes around a corner or whenever it is run over rough roads. This slight movement is all that is needed to produce a pronounced squeaking or creaking noise.

The remedy is a very simple one. If the felt strips are battered down to such a point that the sills can come in contact with the frame at different points, the old pads should be removed and new ones substituted for them. If, however, they are not flattened down very much, a simple tightening of all the body retention bolts is all that will be necessary to hold the parts firmly together.

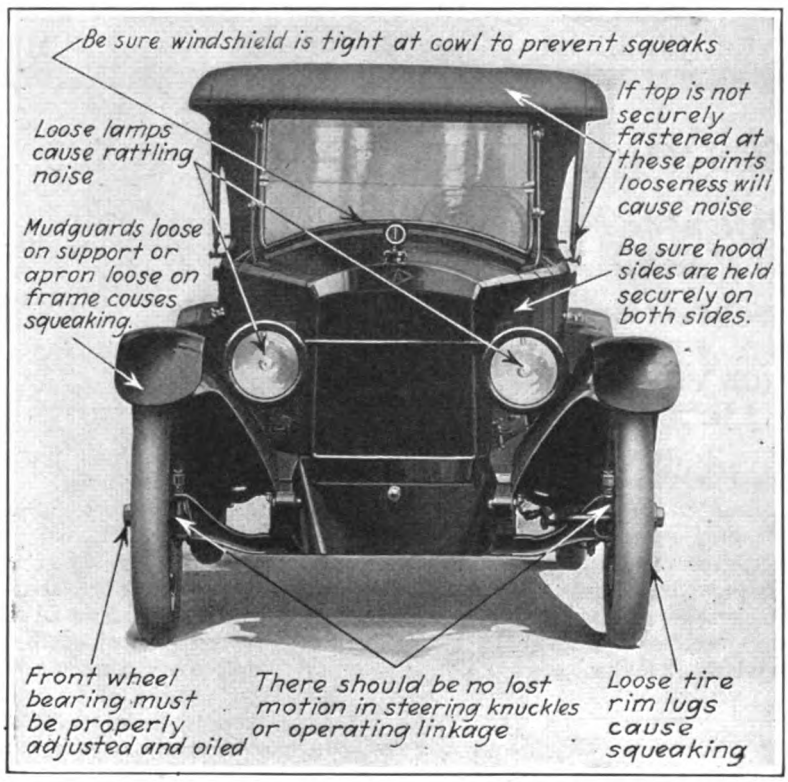
Squeaking Doors

Another common trouble in a body, especially if it is a closed body, is squeaking doors. Sometimes the metal members of the door lock may rub against each other, the door hinges may be dry or the material of which the door is composed may have changed in form sufficiently so that the door no longer fits the door frame accurately. Wherever metal parts come in contact, the squeaking can soon be prevented by applying a few drops of oil at the right places. If the door squeaks and rattles because it is loose in the frame, various expedients, such as installing small leaf springs made from brass strips or clock springs so that they will take up the space between the door and the frame when the door is closed or small pads of rubber which may be cut from an old inner tube may be placed between the door and the body.

Another point about the body that is

Digitized by Google

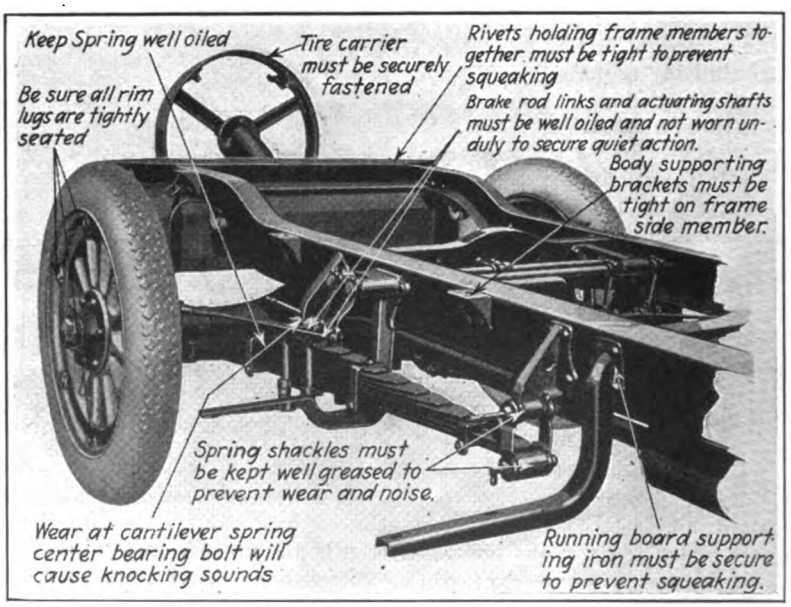
apt to squeak is the windshield. Whenever this causes noise, it is usually because the nuts on the windshield supporting posts are loose. These are placed under the cowl in almost all cars and as they are out of sight, they are apt to be out of mind. It is usually difficult to tighten them up with ordinary wrenches, so socket wrenches should be used to make sure that the nuts are screwed up tightly against the rubber washers and also that the windshield supporting posts are drawn tightly into their sockets or against the rubber washers at their base on top of the cowl.



Front view of automobile showing points needing inspection in looking for noise

Other parts that can cause intermittent noise are the mudguards and side aprons. If the mudguards or their supporting aprons are loose on the body, a rattling noise will result, whereas if the apron-retaining screws are loose where they go through the frame channel members, it is possible for the apron to move against the frame and cause a squeak. On some moderate priced and most cheap cars, the metal of which the fenders and apron are made is apt to be of a light gauge and as the metal is thin, there will be a certain amount of vibration because the parts may not be supported for considerable distances. The metal acting as a diaphragm produces a constant drumming or rattling noise, which in the case of a four-cylinder car keeps time with the running of the engine and vibrates in unison with the motor at certain critical speeds. The only way noise due to light gauge fenders or aprons can be prevented is to prevent the cause by strengthening the unsupported portions with strips of metal or wood securely riveted or bolted to the offending members and to the frame or supporting brackets.

Another cause of rattle that is not often located is the loosening of the points of support of the body at the body braces, also loose motor retention bolts and lost motion at the ball ends of the windshield support posts to which the front bow of the top is held by wing nuts or thumb-screws. Usually these are tightened with the fingers and it is not long before there is a slight loosening which will cause noise. Tighten them with pliers or a wrench to make sure they will not loosen.



Rear end of modern automobile chassis showing frame parts to be looked over

Engine Noise

Considering the power plant as a source of noise, various articles that have been published in Everyday Engineering Magazine have outlined what these noises may be caused by. As a general rule, knocking is due to over-heating or excessive carbon deposits, if it is not produced by worn bearings or other mechanical parts. Knocking due to carbon can be readily prevented by eliminating the cause, and as most engines are now made with detachable cylinder heads, there is no real reason for not cleaning them out as frequently as may be necessary. Of course, knocking due to worn bearings can only be prevented by properly taking up the looseness. Knocking due to over-heating can be prevented by making sure that there is an ample supply of the proper grade of lubricating oil in the engine, that the fan-driving belt is tight, that the radiator is cleaned and none of the hose connections buckled to prevent proper flow of water, that the water pump is circulating the cooling liquid and that the radiator is kept properly filled with water.

In connection with lubrication the point that should be carefully looked after is to see that the oil pump is circulating oil through the system. In most of the modern engines, the pump must work continuously so that all parts will receive the proper amount of oil. If the pump is not working properly, the oil container in the engine base might be full of the proper grade of oil and yet it would not be circulating to the bearing points.

Digitized by Google

Transmission System Noise

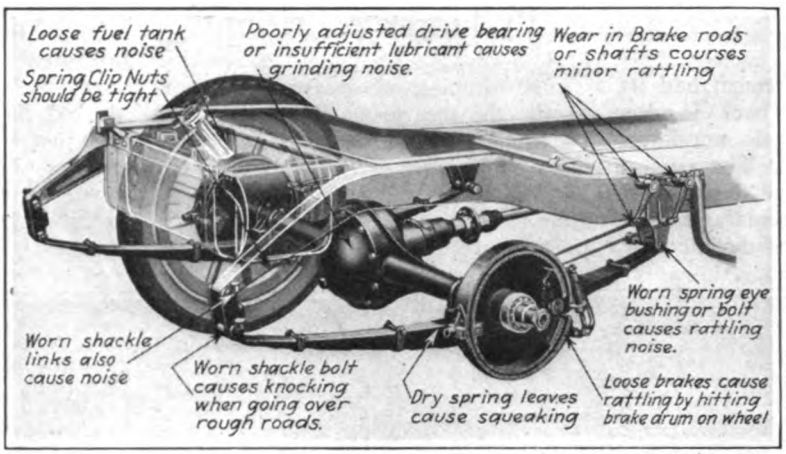
The transmission system is not apt to make any noise when the car is operated on the direct drive or high speed position unless there is considerable wear in the transmission bearings or an imperfect adjustment at the rear axle. When running on low and intermediate speeds most cars will produce noise because of the amount of power transmitted by gears, but this can be reduced to a minimum by filling the gear case with adequate quantities of the proper gear case lubricant.

When the universal joints are worn, one will note a rattling noise every time that the clutch is applied or released, and one will also notice a pronounced rattling if the engine does not run regularly. This is because the lost motion between the parts of the universal joints will be the first taken up and then the parts become loose again under the fluctuations of power delivery. If the engine runs steadily after the looseness is taken up by the initial application of power, the parts will remain in contact as long as the torque is uniform and there will be no noise.

Dry Bearings Squeak

A squeaking noise is sometimes produced by a dry clutch spigot bearing if a cone clutch is used and a dry or worn clutch throw-out bearing on any type of clutch may cause noise. This will be in the form of a squeaking that will be noticed only when the clutch is held out with the foot pedal. If the bearings on either the main or the countershaft of the gear box are worn or broken, there will be a certain amount of rattling noise all the while that the car is being driven. Practically all ball or roller bearings will cause a clicking noise which reoccurs at regular intervals if one of the balls or rollers is broken or if a race ring is cracked.

A grinding noise in the back axle indicates a poor adjustment of the driving gears and may be due to the gears meshing too deeply or not meshing deeply enough. The only way one can prevent rear axle noise is to make sure that the driving gears are in good condition, that they are properly adjusted and that there is plenty of grease in the differential housing.

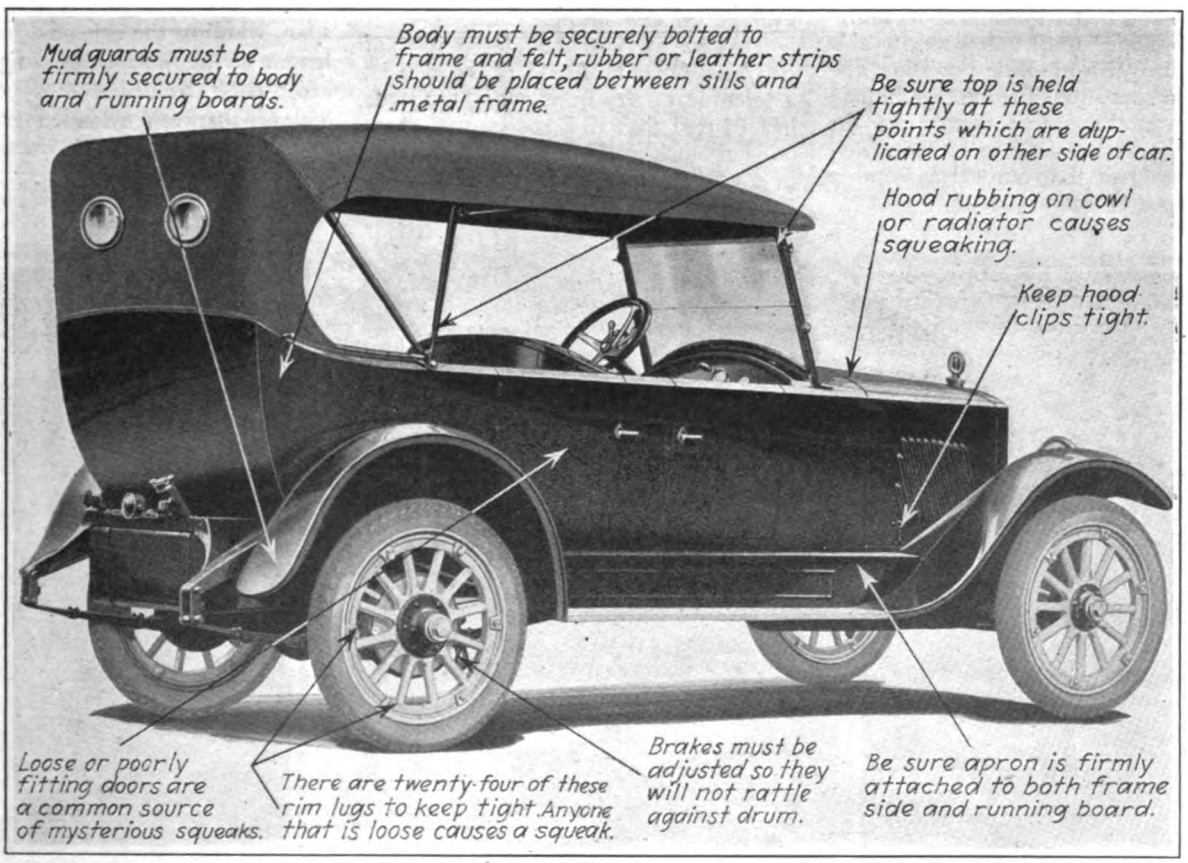


Points in the transmission system and rear suspension that rattle when worn

Chassis Parts Cause Most Noise

The various parts of the automobile chassis are the most common cause of noise, as any looseness in the multitude of links and shackles will cause a rattle. Starting with the front end of the car, the first thing to do is to see that the lamps and lamp-supporting brackets are secure. Another point to inspect is the lamp glass or lens which sometimes become loose in their frames and make a rattling noise all the time the car is operated because of engine vibration. This can be easily prevented by putting packing material, usually in the form of felt

(*Continued on page* 370)



Three-quarter rear view of late model automobile showing parts of body and running gear that contribute their quota to a noisy car

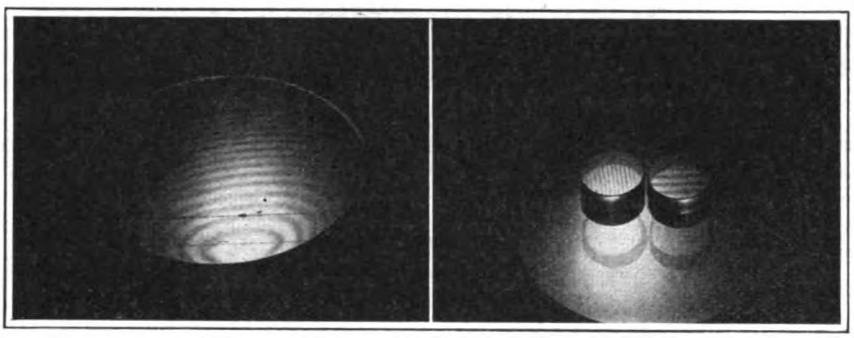
Digitized by Google

Modern Precision Measurements

A Brief and Concise Exposition of the Latest Means of Measuring Minute Distances and the Refinement of Measuring Appliances From the Prehistoric Measuring Stick to Modern Precision Apparatus

By Harry A. Mount

THE art of measurement had its beginning so far back in dim antiquity that we do not know just where it originated. The earliest peoples of which we have record used crude measuring instruments and built their houses and measured distances by more or less crude standards. Undoubtedly, the first measuring instruments were nothing more than sticks or stones cut or broken to a common length. In fact, notched sticks have been taken from excavations of ancient sites and these appear to have been the crude ancestors of our yardsticks.



Photographs taken to show interference bands used in measuring by light waves

Just as the necessity for a standard of measurement grew as the ancestors of our race first learned to build houses and boats, so the measuring instrument itself has been made more and more accurate and better systems of measurement developed until today we are able to measure with absolute precision distances so small that the average human mind cannot conceive them. At the same time we are able to measure distances so great that our earth seems a puny speck in comparison.

The simplest of measuring instruments, the measuring stick, or "cubit rod" had its origin way back before the dawn of history. Even Noah laid out his ark in cubits. But it is a far cry from the ancient measuring stick to the precision measuring instruments of today with which it is possible to measure with absolute accuracy so tiny a distance as a twenty-millionth of an inch—a twentieth part of a millionth—a distance so small as to be beyond the average understanding.

To give an understandable idea of just how far a millionth of an inch is, a scientist of the Bureau of Standards has figured that if a rod of tool steel, one-half inch in diameter were clamped in a vise, so that the free end projected twelve inches; and that if an ordinary house-fly should alight on the tip of the rod, the fly's weight would bend the rod just a millionth of an inch! An ordinary human hair would have to be divided into about three thousand equal parts to get pieces a millionth of an inch in thickness. But you or I, equipped with modern apparatus, and given a few minutes instruction, could measure the thickness of that infinitesimal piece of hair very accurately.

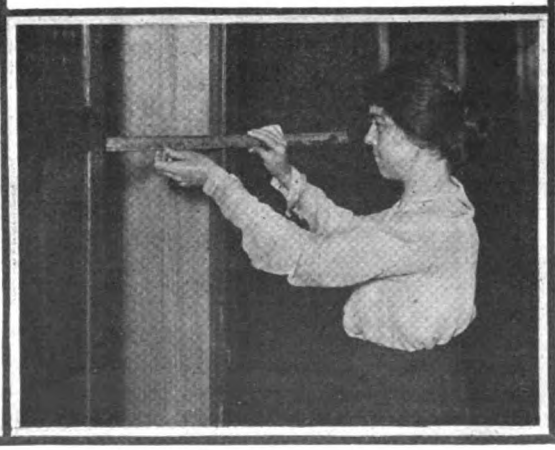
Early Measurements Derived from Body

It is interesting to note that our present English system of measurement was derived directly from the dimensions of the human body. The earliest known systems of measurement were built something like this: digit, the width of a finger; palm or handbreadth, width of the palm; span, width of the extended hand; foot, length of the foot; cubit, length of the arm; pace, length of a step; fathom, distance between extended arms. For longer distances, a day's journey served as a convenient gauge.

But as the need for some sort of



The yardstick of the housewife need not be accurate to less than one-sixteenth of an inch. A skilled machinist can work to the hundredth of an inch with caliper and steel scale. Micrometer calipers will measure to one-tenth of a thousandth of an inch





Digitized by Google

standards of measurement grew, rude measuring devices were invented. At first these were simply notched sticks. Probably one of the oldest existing measuring instruments is a notched stick taken from a very ancient Egyptian tomb by excavators for the Metropolitan Museum of Art. Later forms of Egyptian "cubit rods" which have been found were made of stone and fairly accurately divided.

It is probable stone measuring rods were used in constructing the pyramids. The great pyramid of Ghizeh, built 4000 years B. C., seems to be accurately constructed and it stands today as a record of the system of measurement used by the ancients. In fact, the Anglo-Saxon system of measurement was derived directly from its dimensions. But until very recent times the dimensions of the human body were used as standards of measurement. In England, as late as the reign of Henry I, the English yard was the length of the sovereign's arm. The custom also prevailed in other countries and since kings were not cast all in the same mould there was great confusion as to standards of measurement which varied with the physical peculiarities of the reigning monarch.

Later standards of measurement, as the need for uniformity and accuracy grew and better measuring instruments were made, were fractional lengths of the earth's diameter and the arc of a pendulum. Other attempts to set invariable standards were made by finely engraving two parallel lines on metal bars. But as soon as measuring instruments of sufficient accuracy were made, it was found that these standards varied under different tempertaures or other conditions. The advancement of science, and indeed of civilization itself, has kept pace step by step with our ability to measure distances accurately.

Accurate Measurement a Recent Development

It has been only within very recent years that accurate measurement was an everyday matter. Old mechanics remember the day when men who could fit parts, such as bearings, accurately, received higher pay than his fellow workmen and he closely guarded the secret of his ability. His was almost a separate trade. Then came the micrometer caliper and today very accurate machine shop work is regularly done to a ten-thousandth of an inch. In the most accurate machine work, such as making the micrometers themselves, dividing engines are used which are accurate within a hundred-thousandth of an inch. But the human element of uncertainty enters so largely into such fine measurements that in at least one big shop where accurate measurements are required, it is the practice to have three workmen make the measurement and then to average the results.

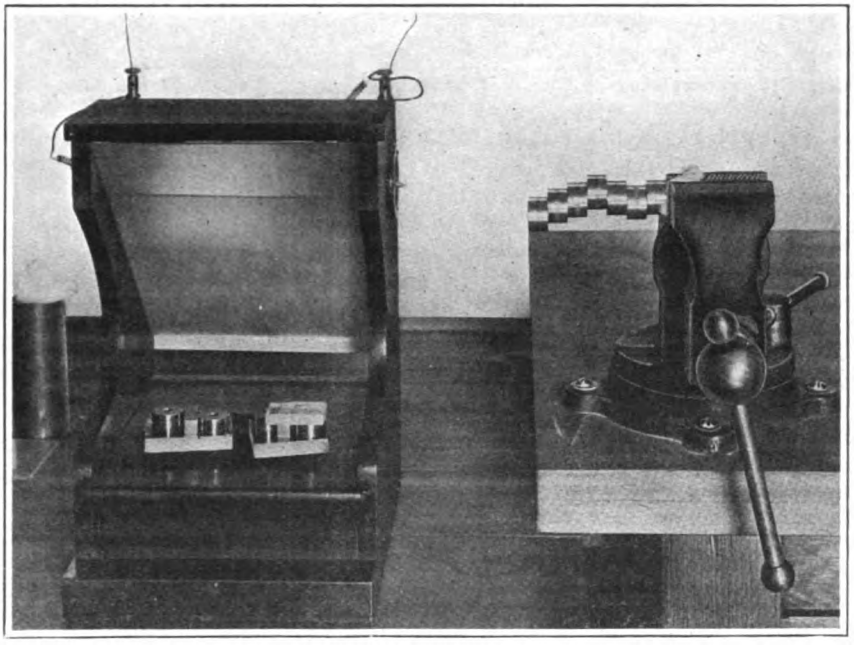


Precision measuring machine will measure to one-hundredth part of a thousandth of an inch

Use of Light Waves

Then came the interferometer method of measurement, developed by our Bureau of Standards during the war. The length of a wave of light is used both as a standard of measurement and in making the actual measurement. The length of that light wave never varies. It is the same at the North Pole as at the Equator. The new method determines with absolute precision variations of a millionth of an inch and the human element is entirely eliminated. With extreme care variations of a twenty-millionth part can be noted.

But what of it? What difference can it possibly make to you and me if a few scientists have gotten together and figured out a way to measure a millionth of an inch? It means, first of all, that we have progressed a long way from yardstick days. Not that we will ever measure the garden fence or lay the kitchen linoleum to a millionth of an inch. But we will have better and more enduring sewing machines, better bicycles, longer-lived automobiles and more reliable airplanes because accuracy in the fabrication of their components insures all of the desirable qualities.



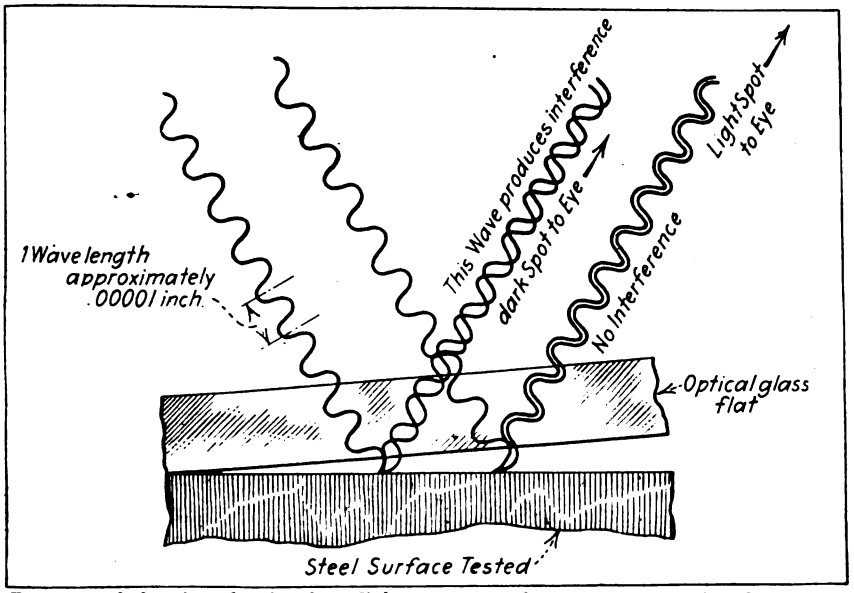
At the left, the simple apparatus used in measuring by light waves is shown. The group of gauge buttons at the right have such accurately finished surfaces they adhere together with force enough to support their own weight

The micrometer gauge is not to be discarded. But micrometers get out of

Digitized by Google

adjustment. As they are used, the measuring faces wear away and they have to be readjusted. So it is with all other types of accurate gauges used in machine shop practice, and accurate standards are necessary to reset them when worn.

Heretofore we have used gauge blocks that were very expensive and accurate to about a hundred-thousandth of an inch in making the corrections. Now we have available gauge blocks that cost less than a tenth as much and are accurate to a millionth of an inch. This means that we will have more uniformly accurate measuring tools and consequently a more uniform product. This is extremely important in quantity production where



Exaggerated drawing showing how light waves can be used in measuring flatness of surfaces

pieces made in one department have to fit those made in another, and where spare and replacement parts have to be procured from factories thousands of miles away from the ultimate consumer of their product. But just how is it possible to measure a millionth of an inch? The method is not complicated. Briefly it is this:

Measuring a Millionth of an Inch

It is known that the waves of sodium light, produced by burning common salt in a flame, are one fifty-thousandth of an inch in length. We need not worry about how that was discovered. Suffice to say that it is a fact and that the length of the light wave is always the same.

Suppose we wish to test a steel surface for flatness. A simple piece of clear glass, ground on one side so that the surface is optically flat, is the only tool required. The steel is placed under the sodium light and the glass is pressed in close contact. Immediately a series of alternately dark and light "interference bands" varying in number and contour with the surface become plainly visible. These bands are caused by the interference of light waves reflected from the lower surface of the glass with those reflected from the surface of the steel. It has been determined that the dark bands are caused by a quenching of the light, due to the two sets of waves getting "out of step" when one set crosses the air gap between the glass and the steel.

It has been further determined that these interference bands occur at every half wavelength of light, so that each band represents a variation of a hundred-thousandth of an inch in the steel surface. If the bands are straight and parallel it indicates the surface is perfectly flat. If the bands are curved, they indicate minute hills and valleys in the steel surface, just as the lines on a contour map represent hills and valleys.

In measuring the length of a piece of steel, the piece to be tested is placed on a perfectly flat surface beside another piece of known length. The glass is placed across the two and by observing the interference bands it is possible to tell whether the two pieces are of exactly the same length, or how much they are at variance. By the use of an instrument called an interferometer, which operates on the same principle, the calculations can be reduced to so small a quantity as a twentieth of a millionth of an inch. So far the most practical application of the method has been in the making of precision gauges.

Outfit for Shop Use

A Boston concern has just placed on the market a complete outfit intended for shop use in inspecting flat surfaces and for length measurements by the interference of light waves. The outfit consists of two working optical glass flats, one master flat, and a source of monochromatic light, or light of one wavelength or color.

The light source is a conveniently arranged box containing a tungsten filament lamp. There is provided a special selenium diffusing lens, which cuts out all the wavelengths of the violet, blue, green, orange and yellow light and allows only a very definite red wavelength to pass. A monochromatic light is used because if more than one wavelength of light is allowed to fall on the object being gauged, the interference bands are double and it is more difficult to interpret them. A monochromatic light produces single interference bands, which are sharply defined as alternate light and dark spaces.

The wavelength of this red light is approximately a fifty-thousandth of an inch. The interference bands, however, occur at every half wavelength or every hundred-thousandth of an inch. Thus the unit of measurement is a hundred-thousandth. It is possible, however, to gauge a tenth of that distance with the eye, so that measurements of a millionth of an inch can be made with great accuracy. Finer measurements require more precise methods, but the same equipment may be used.

As an instance of how the apparatus is used, suppose we are testing a steel surface for flatness. Any one of the optical glass flats is pressed in close contact with the surface, so that all the air possible is expelled. If the surface is perfectly flat no interference bands will be observed. But if there is a depression in the surface, at the point where the depression begins there will be a tiny wedge of air between the glass and the steel surface. A light wave coming from the box will penetrate the glass and part of it will be reflected to the eye from the *under* or inside surface of the glass. Another part of the same wave will cross the tiny air gap and be reflected to the eye from the surface of the steel. But in crossing the air gap the two parts of the wave get "out of step" so that in reaching the eye they actually collide or interfere with each other and the eye sees these interferences as dark spots, or rather fails to see anything at these points. Thus, not only can we observe that there is a depression in the steel, but we can determine just how much of a depression by counting the interference bands.

Just what takes place is illustrated in the accompanying drawing, although on a greatly exaggerated scale.

In comparing the length of two gauges, or the diameters of two plug gauges or ball bearings, the two objects are placed between two of the glasses and the observer looks down through the two glasses. In this case the under surface of the top glass acts as one reflecting surface, as before, and

(*Continued on page* 313)

Digitized by Google

Electrons and the Constitution of the Chemical Atom

By Prof. T. O'Conor Sloane

CENTURIES before the dawn of modern experimental science the ultimate constitution of matter was a subject of speculation and theory. The conception of the atom was formed, as a minute indivisible particle of matter and every substance was held to be composed of such minute and impenetrable particles. In the early days of the last century chemistry was formulated. The word atom acquired a new meaning, the conception of the molecule built up of atoms was evolved and the molecule came nearer the old time atom of the philosophers than did the new atom of the chemist. What might for instance, under the old theories be called an atom of water was now called a molecule of water; in a general way it was assumed that an atom could not exist alone, that it must be combined with one or more other atoms building up molecules. The conception of the chemical elements was formed, and the universe, or as much of it as man could get at, was found to consist of marvelously few elements. Another change has come; the atom no longer is accepted as the smallest possible division of matter, but is considered as a compound structure of varying numbers of parts, some atoms containing more parts than others, so that the atom is compound in structure and is made up of components, originally called corpuscules.

In olden times alchemists had made their living by persuading men of property and rank to back up their efforts, alleged or sincere, to convert the base metals into gold. Some of the alchemists were probably honest, but many were imposters. After the modern chemist had found that the world of matter consisted of less than a hundred elements, he began wondering whether there might not be an ultimate substance, out of which the elements were composed. If such were the case the transmutation of metals might not be impossible after all. This original of all matter, whose existence was not even hinted at by any known property of the elements, was termed protyle—the first stuff, from the Greek. The word, atom, from the same language means, indivisible; molecule, from the Latin, means little mass. The old scholastic philosophers had all sorts of views about matter. Some practically said, that it did not exist; this is about what Bishop Berkley's subjective idealism amounted to.

Priestly and Lavoisier are generally considered the founders of the modern science of chemistry by their work on oxygen and on the theory of combustion. Soon the idea was grasped, that chemistry was a quantitative science, and that the composition of compounds must be determined and stated by weight. This was an immense stride in the right direction; the use of the chemist's balance, the subjection of compounds and elements to the criterion of proportion by weight, the devising of methods for the quantitative analysis of substances, making the quantitative composition the all important thing in the study of a substance, all these lie at the foundation of modern chemistry. The theory, that matter was all made up of compounds of a few original inalterable substances was formed, the substances were called elements, and it was found, by the application of the chemist's balance, that the elements united in very simple ratios as regards the weights entering into combination with each other. It was found that water was composed of one part of hydrogen and eight parts of oxygen; hydrogen was the lightest substance known, and one part of no other element entered into combination with eight parts of oxygen, it was always a greater weight. As water was taken to be a combination of an atom of hydrogen with an atom of oxygen, its gravimetric composition, which means its composition by weight, was supposed to give the relative weights of the atoms of hydrogen and oxygen; that of hydrogen, the lightest element known, was taken as the base of the atomic weights, and was put at unity, or one, which gave the weight of the atom of oxygen as eight. From time to time new or rather unknown elements were discovered and added to the list; their atomic weights were determined on the basis of the composition of water given above, and each such discovery was a triumph of the comparatively new science.

Then the law that the molecules in the gaseous state all occupy the same volume was formulated and accepted, and this forced a modification. A single instance will suffice to show just what kind of changes were involved. The volumetric composition of water, when its constituents were in the gaseous state, and in those times they were only known as permanent gases, is one volume of oxygen to two volumes of hydrogen. Water is readily decomposed by electrolysis, many of our readers have done it as an interesting experiment, and when water is so decomposed and the gases are separately collected in two tubes, the hydrogen in one and the oxygen in the other, it will be found that the hydrogen measures twice as much as the oxygen. Therefore by the last law to form water, twice as many molecules of hydrogen would be needed as of oxygen. Molecules of elements are supposed to contain as a rule the same number each of atoms; therefore the water molecule should contain two atoms of hydrogen and one of oxygen, and its formula should be H_2 O and not H O. Yet up to the year 1870 and even later many chemists wrote the formula of water as H O. But a few years earlier it was always so written. It was about the year 1868, that Columbia College, as it was then called, announced, that the new system of chemistry should be accepted and used in its scientific courses. In the old system the symbol or formula of water was, as we have seen, H O. Sulphuric acid was expressed as H O, S O_3, calcium chloride as Ca Cl. and so on; for many compounds formulas differing from the accepted ones of the present time were used.

In these days the expressions "old system" and "new system" are never heard; fifty years ago they were in constant use. As a matter of historical interest a few of the old system formulas are given here with their translations into the new system.

	Old System	*New System*
Water	HO	H_2O
Sulphuric acid	HO, SO_3	H_2SO_4
Calcium carbonate	CaO, CO_2	$CaCO_3$
Calcium chloride	Ca Cl	$CaCl_2$
Nitric acid	HO, NO_5	HNO_3
Barium hydrate	BaO, HO	$Ba(OH)_2$

The first theorizing about atoms referred to the physical atom, which is the chemical molecule. Various attempts were made to get an approximate picture of its shape. The smoke ring, often produced by smokers, and sometimes seen in great perfection formed at the smoke stack of a locomotive, shows the motions of the eddys of air. These rings collide and rebound, but never pass through each other. They are impenetrable by one another and are elastic. They have been cited as possibly somewhat like molecules.

The chemist in former times could never get below the atom, so it was

Digitized by Google

considered the smallest possible division of matter; it was held, that two or more atoms formed a molecule and that an atom could not exist alone, so that molecules were the smallest unit of independently existing matter, and a molecule was built up of atoms.

We have seen that two parts by weight of hydrogen combine with sixteen parts of oxygen. As the atomic weight of oxygen is sixteen, this tells us that two atoms of hydrogen combine with one of oxygen. Hydrogen is assigned a valency of one, and is called a monad. As two atoms are required to saturate one atom of oxygen, the latter element is called a dyad, meaning that it has a valency of two. The atomic weight of carbon is twelve and as many as four parts by weight of hydrogen can combine with twelve parts of carbon; this is the same as saying that four atoms of hydrogen can combine with one atom of carbon. Therefore carbon is an element whose atom can combine with four atoms of the monad hydrogen, which gives it a valency of four, and it is called a tetrad. The possible valencies of atoms run from one to eight, some possess more than a single valency; they are called monads, dyads, triads, tetrads, pentads, hexads, heptads and octads, terms derived from the Greek language, and indicating in the order written successive valencies from one to eight. Later it will appear that the number eight enters into the theory of atomic constitution very specifically.

In the bond system the valency of atoms was referred to the possession by each atom of unsaturated bonds, each bond representing a valency of one. A bond was saturated by joining hands as it were with another bond. Thus the atoms of hydrogen, barium, triad nitrogen, carbon, pentad nitrogen and hexad sulphur may be written thus:

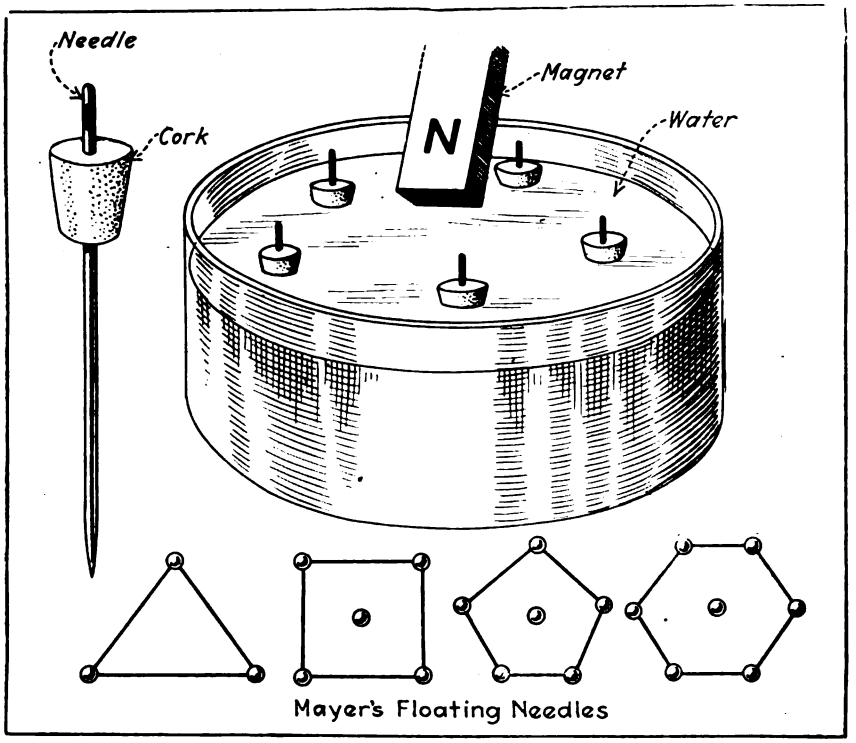
H—, Ba=, N≡, =C=, N≣, =S=

But atoms under this theory have to unite and form molecules so as to saturate their bonds. The molecules of the same elements would then be represented thus:

H—H, Ba=Ba, N≡N, C≡C, N≣N, S≣S

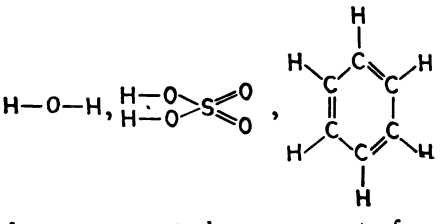
The formulas of compounds must provide for the saturation of bond by bond, and to illustrate the principle the formulas, on the bond system, of water, of sulphuric acid and of benzol follow.

Each of these formulas tells its story but there is not the least idea that they represent the shape or appearance of the molecule.



Mayer's Floating Needles

If an atom is separated by any operation from a molecule it immediately unites itself to another atom or group



of atoms so as to become a part of a molecule. There is no known limit to the number of atoms which can form a molecule, the molecules of organic substances seem to have the capacity of containing more atoms than inorganic compounds can contain.

And now while the atom and molecule remain the working units of chemistry, while the old stoichiometrical rule of three calculations are good and valid as ever, the theory in the last few years has had great developments, a sort of protyle seems to have made its appearance, the atom is considered a very large unit of matter, comparatively speaking, and the impenetrability of the atom is quite disposed of. A new unit of matter, the corpuscule, appears on the scene; it is smaller than the atom, perhaps not a hundred thousandth part of the diameter of an atom, and the atom is made up of a few of these corpuscules so distributed, that the atom is far more void than substance, and an atom resembles a solar system, with corpuscules for sun and planets. Just as a body can move between sun and planets without hitting any of them, so can a corpuscule presumably move through the void space of an atom with freedom.

For the working system of chemistry the bond method is perfectly good and valid, but the phenomena of radiation have exacted a new conception of the atom and the electron and nucleus constitution is now the accepted one, subject undoubtedly to change and modification as more work is done on the abstruse subject.

If a number of similarly electrified corpuscules were placed near each other they would tend to fly apart and separate. If some force is conceived which overcomes their mutual repulsion and holds them in greater or less propinquity, the modern idea of the constitution of the atom is reached. The present accepted theory it may be said is, that the force holding the corpuscules together is located in a central body, whose electrical charge is the opposite of that of the other corpuscules. The central body is called the nucleus, and the mass of the atom is supposed to be concentrated in it. The surrounding corpuscules are called electrons, each is charged with exactly the same charge of negative electricity, and this charge is the natural unit of electric charge. The nucleus carries a positive charge equal to the sum of the negative charges of the surrounding electrons.

If a number of common needles are strongly magnetized, and each one is thrust through a cork and floated in a basin of water, as shown in the cut, similar poles being upward, they will repel each other. They may be taken as representing negatively charged electrons or corpuscules. Then if a magnet pole of opposite sign is held above them it will draw them together and they will take a symmetrical arrangement. The magnet represents the positively charged nucleus.

(To Be Continued)

Digitized by Google

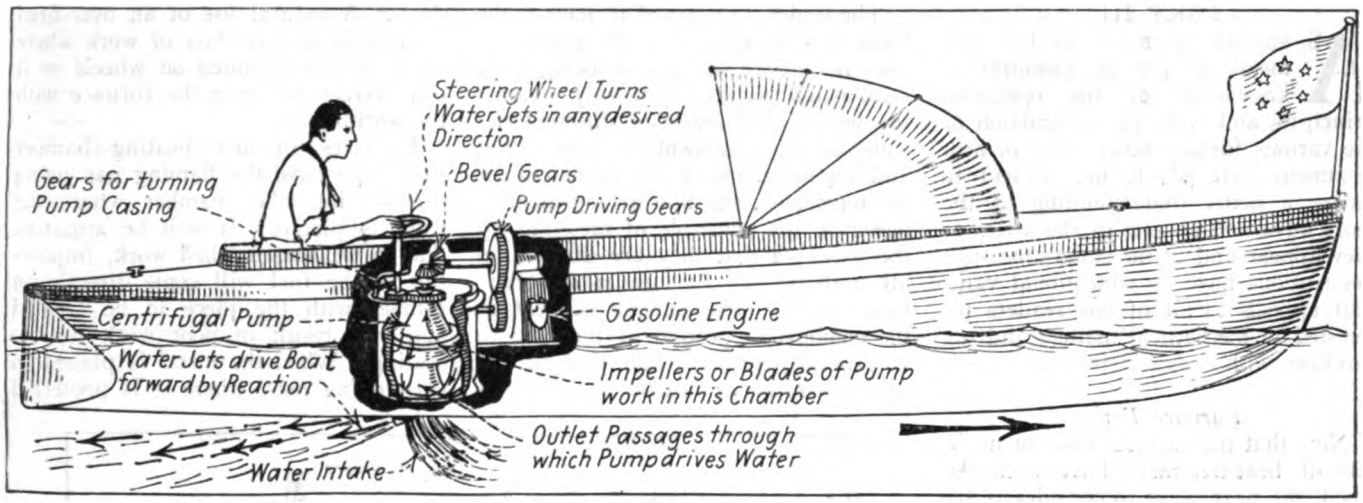
JET PROPULSION FOR MOTOR BOATS

ONE of the earliest methods for propelling boats and which was also employed in a suggestion for the first steam engine is a reaction motor in which a jet of water or steam impinges upon the air or water as the case may be, the resulting reaction serving to propel whatever the jet is fastened to in a direction opposite to that of the jet.

This scheme has been suggested from time to time for the propulsion of ships and only recently we find an inventor backed by the resources of the French Government working out a blast engine for the propulsion of airplanes by a reaction system. We illustrate herewith a new scheme which has been suggested by an English inventor for utilizing hydraulic jets for propelling small boats. While the scheme is not as simple as the conventional propeller and its efficiency may be questioned until its value has been demonstrated by actual tests, the idea is a novel one as worked and should be interesting because it is a modern variation of an idea that is as old as Science and Mechanics. The propelling unit consists of a gasoline engine which drives a powerful centrifugal pump. Inasmuch as the crank shaft of the engine has a horizontal axis and the pump shaft is on a vertical axis, it is necessary to use considerable gearing, which no doubt contributes its quota to the loss of efficiency.

In the scheme suggested by the English inventor the impeller shaft is driven by bevel gearing. The water is drawn in through a suction intake and after being whirled around at high velocity it is discharged through water nozzles placed on the pump casing somewhat back of the center of buoyancy of the hull. The reason these jets must be placed either in back or ahead of the center of buoyancy is because the jets perform a dual function. They are not only used for propelling the craft, but inasmuch as the direction of the discharge openings or nozzles may be changed by a steering wheel which revolves the pump casing to which the nozzles are attached, they also serve to steer the boat. The rudder is thus dispensed with and the inventor claims that the hull may be as easily controlled as with the usual form of rudder. It is claimed that this system is particularly valuable for use in boats intended for shallow water.

The details of the propelling mechanism are clearly shown in sketch, but no reports are available to indicate if the scheme is an efficient one. It would seem that the inventor neglected to work out his scheme as fully as he might have by overlooking the fact that a gasoline engine would operate just as well with its crank shaft vertically placed as it will with its crank shaft horizontal. If there is any merit to the device, it would seem that the use of a five or seven-cylinder radial engine horizontally placed in relation to the mechanism with a centrifugal pump attached directly to the crank shaft and having no gears to transmit power would be considerably more efficient than the scheme outlined.



English scheme for jet propulsion applied to small motor boats

LUBRICANTS FOR BICYCLES

OIL used for lubricating bicycles is commonly made of sperm oil and vaseline, mixed, 3 parts of the former to 1 part of the latter by weight.

The sticks of hard lubricant that are rubbed on bicycle chains for lubricating purposes are made by melting some tallow, stirring in graphite until it is thick enough so as to have it set solid when cold. While it is still fluid it is poured into moulds of any desired character. A mixture that does not solidify and that must be applied with a brush consists of vaseline to which enough graphite is added to stiffen it again to the desired degree.

FORMULA FOR WHITE BRASS

A GOOD white brass can be made as follows: Melt 20 lbs. of zinc and add 3 lbs. of copper in the form of thin sheet, wire or other easily dissolved material. Heat the zinc until the copper has been dissolved and then add gradually 12 lbs. of zinc, making a total of 32 lbs. To this add 63 lbs. of tin and 2 lbs. of phosphor tin. The mixture should be thoroughly stirred.

ONE-MAN HAND TRUCK

ONE of the disadvantages of the usual form of hand truck is that it often takes two men to load it, as one must steady the truck while the other assists in placing the boxes or barrels on the carrying platform. A new hand truck has been introduced to save the labor of one man and is shown in the accompanying illustration. This is



One-man hand truck

equipped with a special crate rest on the wheel guides that may be adjusted to various vertical and horizontal positions. To load a hand truck of this design, the operator seizes the case or box with an adjustable steel hook and this bolts back on the hand truck, the retaining hook insuring that the crate will rest properly on the truck.

Digitized by Google

Heat Treating Alloy Steels

A Series of Simplified Articles Detailing the Various Methods of Heat Treating Modern Alloy Steels. This Instalment Explains the Various Types of Furnaces Used in Hardening, Carburizing and Tempering

By Victor W. Pagé, M. S. A. E.

PART III

As suitable furnaces to heat the metal in are so essential, a knowledge of the operating principles and types of construction of the various furnace forms used in heat treatment will enable the student to secure a better understanding of the more advanced articles of the series as they appear and at the same time such descriptions have an educational value that appeals to all of our readers interested in mechanical matters and not familiar with furnace construction.

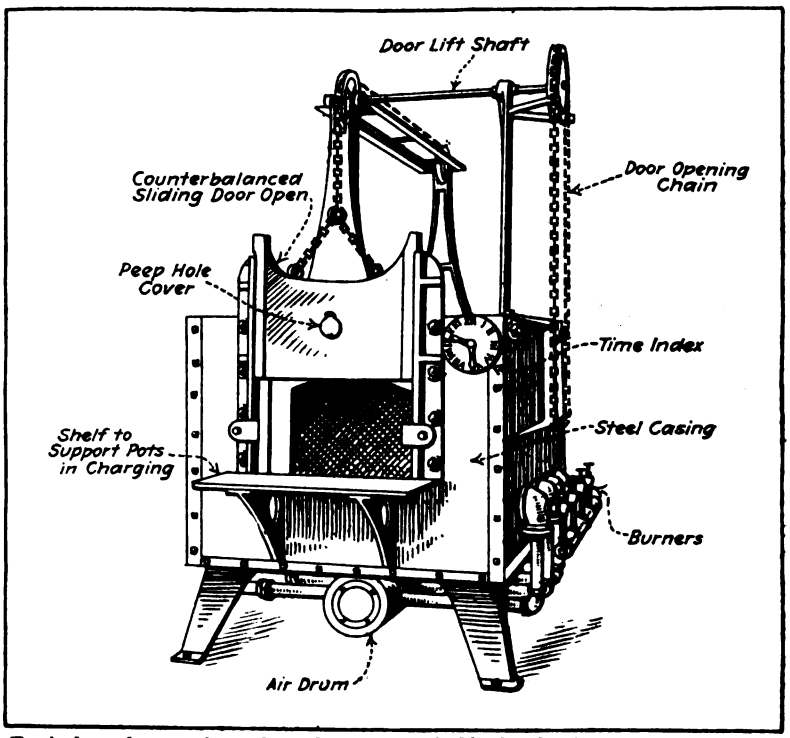
Furnace Forms

Now that the various different methods of heat-treatment have been defined, the next point to consider is the design and construction of the furnaces used in heating steel for carburizing it or heating preparatory to hardening. While a large number of designs of furnaces are offered, they may be classified in a few types. One method of classifying is by the class of fuel used in producing the heat. Some furnaces are adapted for using solid fuel, such as coal or coke, others are fitted with suitable burners to derive their heat from the combination of illuminating or other gases and air, while still others have burners adapted for liquid fuel, such as crude oil. Another group derive their heat from electricity instead of gas combustion.

Three Main Furnace Types

The general construction of a furnace and the principle it follows is independent of the type of fuel used to a certain degree, but there are three main types of furnaces employed in the heat-treatment of steel, these being classified according to the way in which the heat is applied. A furnace may be under-fired, that is the fire may be below the chamber in which the work is placed; it may be over-fired, in which the heating medium is burned above the hearth on which the work is placed, or it may be heating-chamber fired, in which case the work is placed directly in the combustion chamber. Then again, there are types of furnaces that may really be considered as heating the work indirectly because the desired temperature of the steel is produced by immersing it in baths of molten metal, or putting it in a muffle surrounded by electrically heated metal wire coils.

The under-fire type of furnace is the form that is most suitable when one does not desire the gas resulting from combustion to strike directly against the work. A number of different designs and arrangements of combustion and heating chambers are built, but for the most part, the flue arrangement is based on the principle of breaking up the gases so that they are directed to all parts of the furnace to distribute heat evenly. The amount of heat in the combustion portion of the furnace is generally greater than that in the work chamber or hearth.



Typical steel-encased gas-heated furnace suitable for hardening or carburising

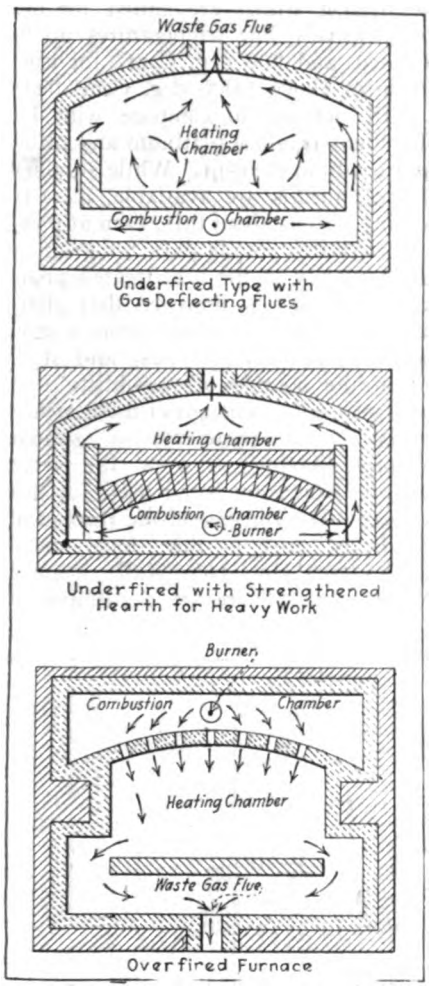
The over-fired type of furnace is that in which the combustion chamber is placed above the heating chamber and the hot gases are conveyed to the latter through a series of openings made in the arch. The burning gases are discharged from the bottom of the hearth in the over-fired furnace. This type is not nearly as effective as the under-fired furnace because a natural law is defied. The tendency of heated gas is always to rise because it is lighter than gas of lower temperature. In an over-fired furnace, the heat must be exhausted by means of some form of blower or flue arrangement that produces extra draft. A natural use of an over-fired furnace is in that class of work where the hearth is mounted on wheels so it can be removed from the furnace with the work.

Furnaces of the heating-chamber fired type have the flaming gas going directly into the chamber where the work is placed. It will be apparent that in treating finished work, impurities in the fuel will come directly in contact with the piece to be treated and may result in poor work due to scaling. When the metal is placed in carburizing pots, where it is protected from the direct action of the burning gases by packing it in carburizing material and with luted top covers, such furnaces are found to give very good results. They are also suitable for annealing pieces that are afterwards machined. It will be evident that in a heating-chamber fired furnace, work will scale much more than in the form where the steel does not come in contact with the heating medium.

A muffle type of furnace is one in which the heating chamber is completely protected from the flame or hot gases. A furnace of this type is well adapted for heating finished pieces such

Digitized by Google

as dies and tools preparatory to hardening. The niceties of furnace design and construction require considerably more space than is available in a series of this nature and any reader who is interested in building a furnace can



Diagrams outlining various systems of furnace construction

find special works on the subject that will go just as deeply into detail as he may consider necessary.

Materials Used in Furnaces

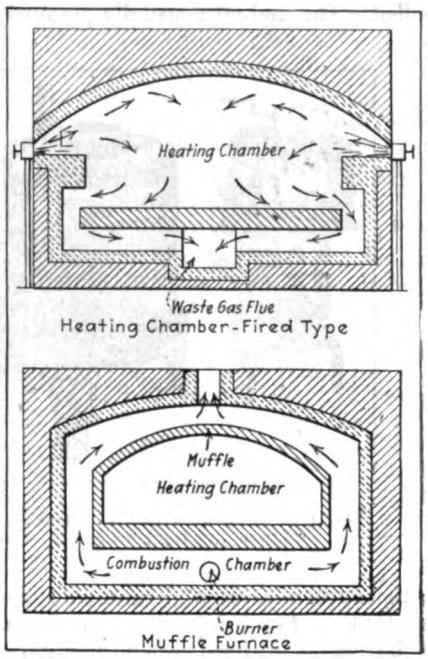
The materials employed in furnaces are heat-resisting brick for combustion chambers which are surrounded with various heat insulating materials, such as asbestos, magnesia and various types of composition, insulating bricks. The exterior of the furnace is made of ordinary building brick and if the furnaces are large or to be operated continually, the external walls are usually braced by angle or channel iron members arranged both horizontally and vertically and held together by tie-rods. The smaller, portable furnaces which may be purchased ready made from dealers in such material, usually have cast iron sides and front and are lined with heat-resisting material. In their simplest form, they are simply cast iron boxes lined with fire brick having openings for burners and flues for gas disposal.

Automatic Furnaces

When a large amount of work is to be handled, it is sometimes possible to use automatic furnaces which are equipped with special mechanism for carrying the work through them and dropping it into the bath. Special rotary hardening furnaces have been used in many manufacturing establishments for hardening screws, nuts, pins and washers and steel balls used in ball bearings that are not intended for extremely high grade work. The trouble with a rotary hardening furnace in which the work is fed through by means of a large screw-thread machined in the furnace shell or formed in the heat-resisting lining, is that the pieces passing through the furnace do not always go through at the same time or at the same speed. This results in some of the pieces being heated more than others and does not produce uniform work as some pieces will be quenched at too low a heat and others at temperatures that are too high.

Lead Pot Furnace

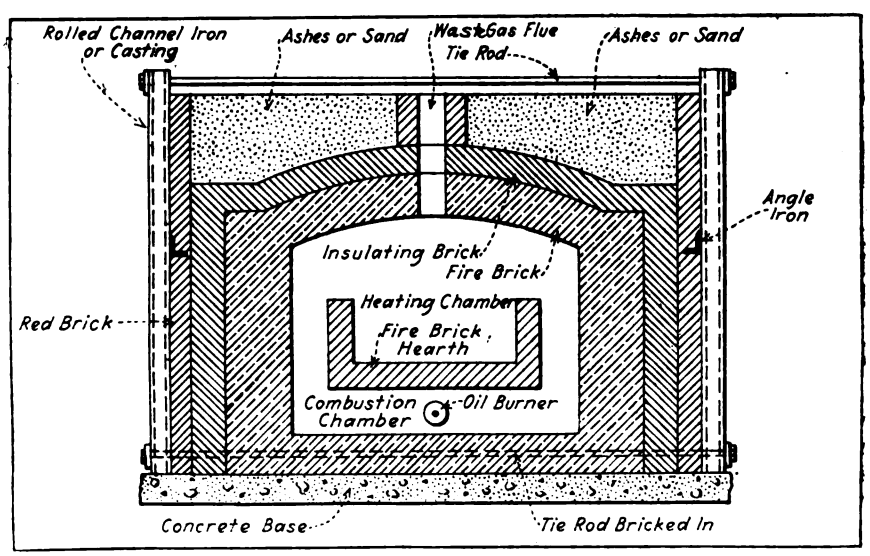
A lead pot furnace is the type in which molten metal is heated in a large metal tank or crucible which has a combustion chamber around and under it. These are often employed for heating work of which only certain portions are to be hardened. Lead pot furnaces are also used for tempering as various kinds of alloys of metal will become molten at different heats and in this way it is possible to obtain various temperatures by altering the proportions of the alloy that is to be melted as the writer has previously pointed out. A marked advantage of the lead pot furnace is that it will hold its temperature, in as much as the heat at which the molten metal is, does not fluctuate as much as in those types where the door must be frequently opened and closed to remove and insert the work. A lead pot furnace is really a muffle furnace in which the usual refractory fire brick muffle is replaced by a metal pot or special crucible. It has the same advantage that the muffle furnace has in that the gases can not come directly in contact with the work.



Diagrams showing difference between heating chamber fired and muffle furnaces

Advantages of Gas Burners

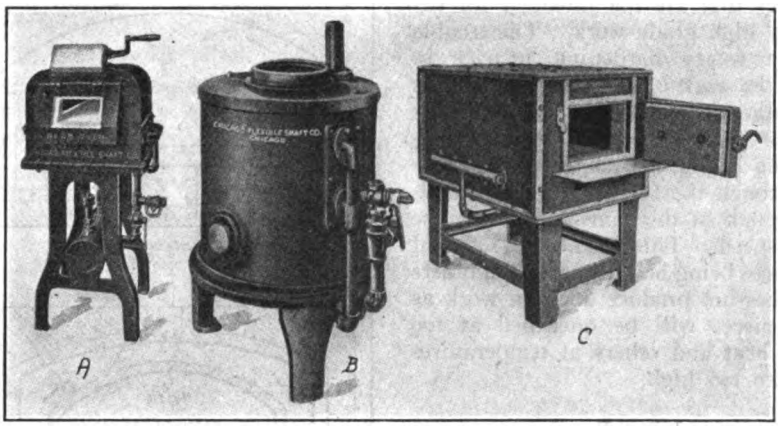
Most heat-treating furnaces now have either gas or fuel oil burners as it is much easier to regulate the flame when gas or oil vapor is burned than it is by using solid fuel and it is also possible to obtain higher temperatures. For very accurate work, such as in laboratory tests, furnaces heated by electrical resistance coils are generally used as their temperature can be controlled within very narrow limits by regulating the current flow. When crude oil is



Sectional view of underfired furnace for heat-treating steel, showing materials used in construction of different parts

Digitized by Google

used for fuel, the burner is a simple type having a regulating valve to control the amount of oil sprayed into the air stream which is supplied by some form of blower The air passes through an external tube while the liquid fuel is passed through an inner concentric tube. In some form of burners, both the air and liquid fuel may be controlled. The fuel oil is usually pumped to the burners from underground storage tanks. Practically the same form of burner is utilized when manufactured gas is used instead of liquid fuel except that the area of the gas passage must of course be larger than that of the passage of a crude oil burner.



Examples of heat treating furnaces. A—Hardening furnace. B—Lead pot furnace for tempering. C—Carburizing or case hardening muffle

Electric Resistance Furnace

Any type, style or size of combustion furnace where the temperature does not exceed 980 degrees C. (1,800 degrees F.) can be made in the ribbon wound type electric furnace. In general, where high quality product is required, the electric furnace will show a saving in cost per finished piece. Some of the more specific examples of applications in which it is highly desirable to have uniform heating characteristics and accurate temperature control of the electric furnace are: hardening and drawing furnaces for high carbon and alloy steels, drawing furnaces for high speed steel, annealing furnaces for certain alloy steels, special grades of malleable iron, cold rolled strip steel for deep stamping, etc. Annealing furnaces for copper, aluminum, brass and other nonferrous alloys can also be of the electrically heated types.

The accompanying illustration shows a horizontal semi-cylindrical furnace. The refractory brick lining is backed up with heat insulating brick and the whole is encased in a sheet steel jacket. The heating unit consists of a heavy nichrome ribbon wound on edge in such a manner that the successive convolutions form an arch which extends the full length of the heating chamber and gives a perfectly uniform distribution of heat. The ribbon is self-supporting and adjacent turns are spaced by insulators of a special refractory compound set in the furnace wall. The construction of the unit is such that it may be easily removed from the front of the furnace. The terminal studs which pass through the furnace wall are insulated from the walls by means of heavy porcelain bushings.

(To be continued)

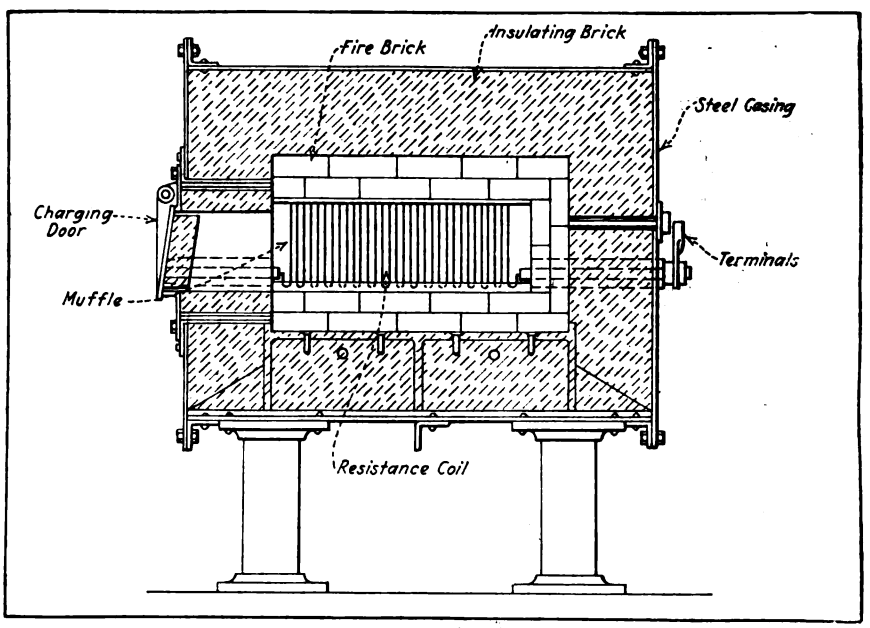


Diagram showing construction of electrically-heated resistance furnace

LOCOMOTIVES IN GREAT BRITAIN

THE number of locomotives available for traffic on the 16 principal railways in Great Britain in June, 1919, was 17,743, a decrease of 1,186 as compared with the number available in 1913; 429 Government locomotives have been loaned to the companies, and strenuous efforts are being made to reduce the number awaiting repair and to increase the rate of construction of new locomotives.

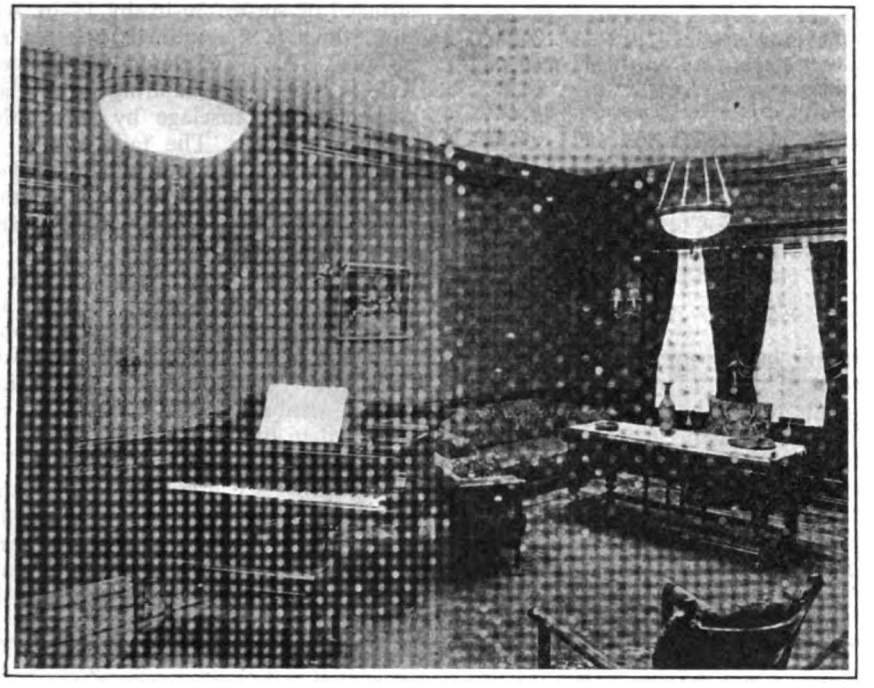
THERMO-ELECTRIC PYROMETERS

THE question of a really satisfactory base-metal couple still remains to be solved. While it is quite true there are a good many base-metal couples on the market which are suited for the comparatively low temperatures up to 800 deg. and 900 deg. Cent., for temperatures above 1,000 deg. Cent. there is still nothing to compare with Le Chatelier's original platinum and platinum rhodium element. While supplies of these metals are available, there is nothing serious about this; even at present prices this couple pays for itself in the regularity of the heat-treated products. The fact is, however, that platinum is becoming more and more scarce, the price continually rises, and it is within the bounds of possibility that there may not be enough of these metals available for pyrometry—a serious prospect, having in view the large amounts which are being used for this purpose. Dr. Burgess of the Bureau of Standards, asserts that base-metal couples are being successfully applied in America. There are a number of quite excellent pyrometers on the market described as portable pyrometers. One is well advised, however, to take as little advantage of their portability as possible; there should be an instrument for each furnace or group of furnaces. Moving these delicate instruments about the works, to say the least, does them no good, and further, the calibration varies with the surroundings and the leveling. Unless the instruments are handled carefully and by experienced men, there is always the danger of setting them down too hard and disturbing the adjustment.

Digitized by Google

DOMESTIC ILLUMINATING ENGINEERING

A LITTLE simple "illuminating engineering" applied to your door and window screens will make them serve the double purpose of protecting the interior of your home from the prying eyes of inquisitive folk, as well as from the inroads of flies and mosquitoes. One has simply to paint the screens white to make them "peep-proof". The accompanying photograph illustrates the principle. The picture was taken through an ordinary wire screen, half of which was painted white and half black. It will be noted that the black screen interferes very little with vision through it. The white screen, on the other hand, effectively conceals the room behind it.



Photograph showing relative visibility through white and black screen mesh

The explanation is simple. The screen was only a few feet in front of the camera and is "out of focus". Nearly all of the light falling on the white wires is reflected and is seen as a blur of light. The intersecting white wires form a screen of white light which interferes with light coming between the wires and destroys good vision. The black wires, on the other hand, absorb most of the light which strikes them and there is no interference with light coming between the wires. Vision is good through it. The effect is the same to the eye as to the camera. To a person standing near a screen and looking through it, the wires are "out of focus" and the white wires offer even better resistance to vision than to the searching eye of the camera.

A white screen can be depended on for this purpose only in the daytime, however, since at night the observer outside has no reflected rays to contend with, while persons inside the room will have difficulty in seeing out because of reflected light from lamps.

Vision from the inside of the house can be rendered better at all times by painting the inside of the screen black, while the outside remains white. This would seem to be the ideal screen, because even in daytime some reflected light from the interior of the room would interfere partially with vision out. The best plan in making a screen of this kind is to secure a screen which already has on it a coat of black enamel, and then to paint one side white. In doing this a small brush should be used, carrying as little paint as possible. It is well to have the paint thick. If these precautions are observed no trouble will be experienced from the paint running through the mesh and coating both sides of the wire. A little more patience is required, but the results justify it.—HARRY A. MOUNT.

Hard rubber or ebonite, which is essentially a vegetable substance, if rubbed with a woolen cloth or with a piece of fur becomes charged with negative electricity. It is due to the contact of animal and vegetable substance, but if half of the piece of ebonite is rubbed with quick lime and then the piece is rubbed with the cloth or the fur the untreated portion will be negatively electrified as before, while that portion which has been rubbed with lime will become positively electrified, and this property will last for five or six months, gradually fading away until the lime-rubbed portion becomes quite inactive to rubbing with the cloth or fur.

MEASURING HEAT VARIATION IN GAS ENGINE CYLINDERS

EXPERIMENTS described in *Engineering* show that the temperature at the inner surface of a small gas engine cylinder is about 240 degrees C; and the cyclical variation is usually less than 10 degrees C. The steady conditions of low temperature at the wall surface are maintained by the jacket-water, although the explosion of the gaseous mixture produces very great changes of temperature close to the walls of the combustion chamber.

This variation has not hitherto been measured for a complete cycle owing to the difficulties which occur in measuring the highest temperature of the explosion. In order to obtain the cyclical variation near the walls, a couple was made of an alloy of 10 per cent iridium and platinum, with a pure platinum wire, and this was secured in a metal plug so that it projected ¼ inch into the cylinder. On light loads and weak mixtures the cycle remained unbroken, but near full load the platinum wire melted.

Couples made from 10 per cent alloys of iridium and rhodium with platinum were afterward used, having an electromotive force E above 500 degrees C. given by $E = -174 + 7.6075\,T - 0.00167\,T^2$, where T is the temperature centigrade. The junctions were rolled down to five or six ten-thousandths of an inch thickness and inserted at a depth of ½ inch from the cylinder wall.

These couples were able to withstand the highest temperatures near the walls, and they were not melted except during abnormal explosions. Measurements of the cyclical variations showed a variation of E. M. F. lying between 1.56 and 7.83 millivolts with an average cold junction temperature of 30 degrees C. The temperature variation corresponding to these values ranges between 250 degrees C. and 1,700 degrees C.

HOW LOCOMOTIVES HAVE INCREASED IN POWER

THE lubrication of the main journal of the modern locomotive calls for careful consideration, both because of increased weights and exacting demands in service. A passenger type of fifteen years ago, with a tractive force of 16,000 pounds, could handle a light train between Chicago and New York in about thirty hours. Today the same service requires a locomotive of 300,000 pounds, with a tractive force of 30,000 pounds, capable of hauling the heavy all-steel train in twenty hours at all seasons and always without delays. In like manner freight locomotives have developed from a tractive force of 25,000 pounds to the Mallet articulated compounds, with tractive force of 100,000 pounds, weighing 450,000 pounds.

Digitized by Google

A Compressed Air Driven Monoplane

The Main Features of an Interesting and Simple Monoplane Using a Compressed Air Power Plant That Has Made Successful Flights

By H. C. Ellis

THERE is a growing interest on the part of model engineers in compressed air motors and model airplanes suitable for use in connection with them. The writer has recently completed a simple monoplane design that has made successful flights and that is not so complicated but what any amateur mechanic can build it without much trouble. If the enthusiast does not have shop facilities sufficiently complete to build the engine or tank, these may be secured from makers of model supplies, so the simpler work, such as wing construction and assembling the parts can be done by anyone possessing even a limited tool equipment.

While the machine illustrated is a monoplane, there is no reason why the experimenter cannot build other types of multiplanes, using the same power plant and air tank. Inasmuch as wing construction has been described in articles previously published in EVERYDAY ENGINEERING MAGAZINE detailing various rubber motor-propelled types, only the main points of construction will be considered in this article.

Details of Motor

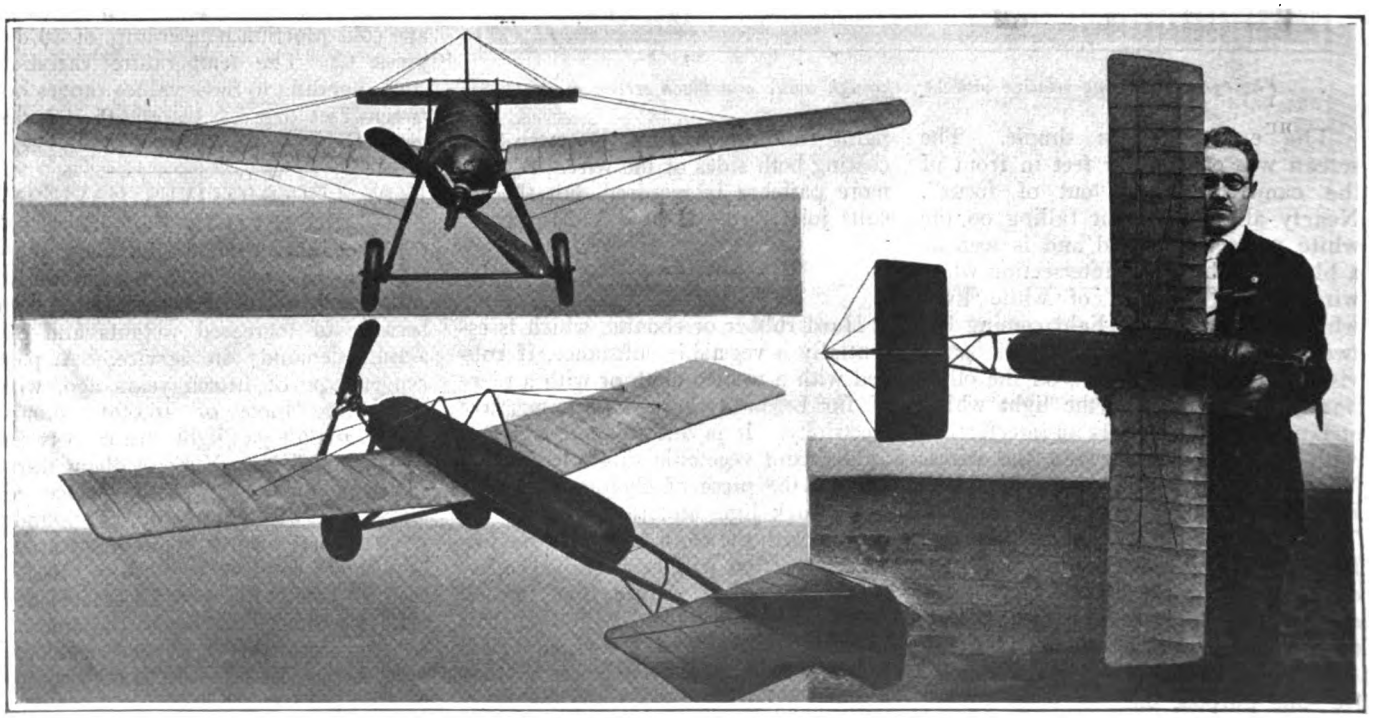
The motor is of the three-cylinder rotary type, 3/8-in. bore and 3/8-in. stroke. The cylinders are turned from a solid piece of steel and have a small flange at the bottom so they may be bolted to the crankcase. The crankcase is entirely of aluminum. Pistons are of aluminum and are lapped into the cylinders to insure a perfect fit. Connecting rods are of bronze. It is not easy for the average reader to build these motors and will cost less in the end to purchase same from a model supply house specializing on such product, though instructions detailed enough for building several types are given in this issue of EVERYDAY ENGINEERING MAGAZINE.

For some time past, our mail has indicated that there was more than the usual amount of interest in model airplanes driven by compressed air motors. The model plane and engines described on this and following pages should be of particular interest to the more advanced airplane model enthusiasts who have graduated from the rubber motor driven types of construction.—THE EDITOR.

Main Planes and Landing Gear

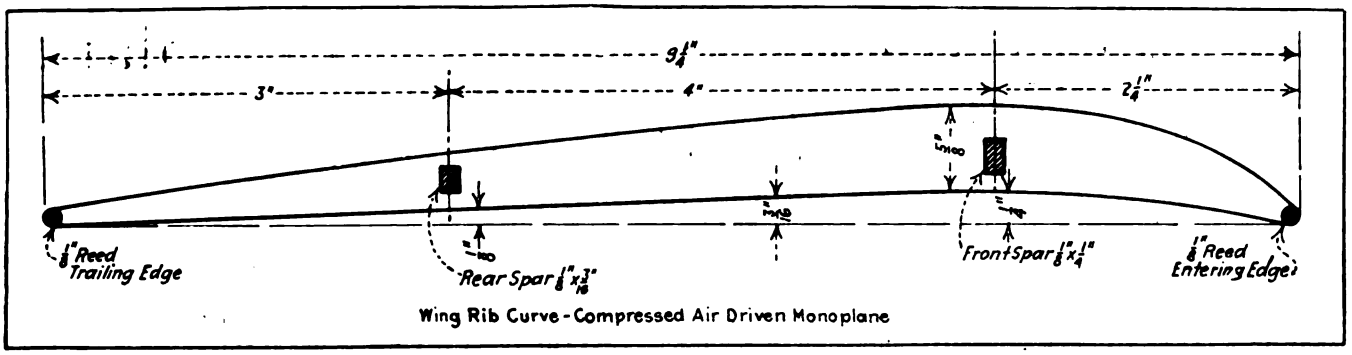
The ribs of the main planes are the solid web type. They may be made of 1/16-in. spruce or of Balsa and are assembled on the wing spars and held in place by gluing. Twelve ribs are used in each wing. The curved wing tips are made of reed. The front spar is 1/8-in. by 1/4-in. section, rear spar 1/8-in. by 3/16-in. section, spruce. The entering and trailing edges are 1/8-in. reed. Planes are covered with bamboo paper to which three coats of dope are applied. The landing gear is made of two V type strut assemblies and is constructed of spruce 3/8-in. by 1/2-in. section which is streamlined to lessen resistance. A 1/8-in. round section steel axle is used. The landing gear is attached to the fuselage by small aluminum fittings. The tail skid is of 1/8-in. reed bound and glued in place and is similar to the tail skids that were used for a time on the early Bleriot monoplanes.

The pylon for the bracing wires is also of reed, bent to shape and attached to the longeron members with a binding of fine wire. The bracing wires, which may be provided with light model turnbuckles if one desires, are attached to light aluminum fittings attached to one of the wing ribs. The flying wires are attached to the landing gear struts, the landing wires are secured to the pylon. The wing spars terminate into round aluminum or brass tubes which project about 1 1/2 ins.



Front, three-quarter rear and top views of compressed air monoplane using a three-cylinder motor. The plan view shows the large size of this machine and how everything is built around the air tank

Digitized by Google



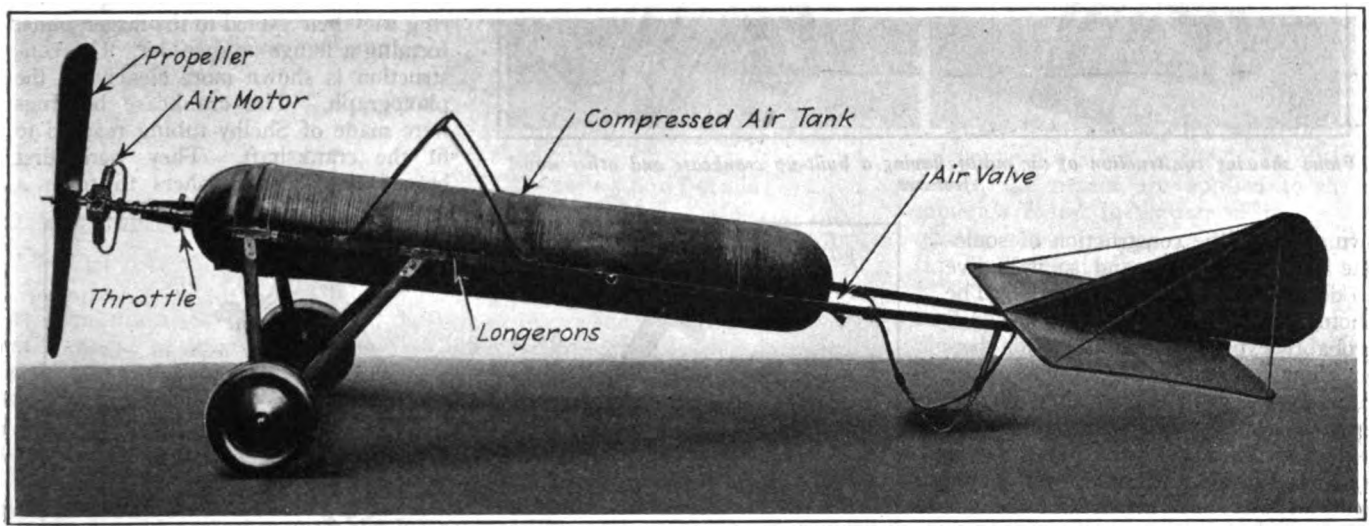
Wing Rib Curve - Compressed Air Driven Monoplane

from the wing inner ends and which are inserted into sockets of tubing brazed or soldered in the air tank at the proper points. These tubes go entirely through the tank, and are carefully soldered at their ends to minimize leakage.

Tank and Fuselage

The tank is constructed of 30 gauge sheet bronze in strips of suitable size. The bronze is wrapped around a suitable mandrel to form the tank body, lapping the edges about ½ in. Hold the material in place with small rivets and solder the seams. After soldering the metal should be trimmed off to receive the ends. Wrap the tank with light gauge steel piano wire, making the wraps about ⅛-in. apart as a reinforcement. The wires should then be soldered at several points to keep it in position. The caps or ends are spun of steel of the same gauge as the bronze and are carefully riveted and soldered to the cylinder. Light tie rods are sometimes used, being placed longitudinally through the tank to help in holding the ends. An ordinary bicycle tire valve is carefully soldered in one end and the throttle and motor shaft in the other end.

Two longerons of spruce attached to and in connection with the tank form the two side members of the fuselage which carries the motor at the front end and empennage at the rear and to which all parts are fastened. They are ¼-in by 5/16-in. at their greatest cross section, which is situated 22 inches from the nose of the model, from which point they taper to 3/16-in. by ¼-in. at the ends. The longerons are united at the rear by gluing and binding. The tank is fixed by bronze distance pieces soldered to it. The ends of these are bent to the form of the longeron and then soldered to hold them in place. The general design of the machine is clearly shown in accompanying illustrations and some idea of its size can also be obtained. The principal specifications follow:



Side view of compressed air monoplane after wings are removed to show how air tank forms the basis of the entire fuselage

COMPRESSED AIR-DRIVEN MONOPLANE

Span	56 ins.
Chord	9¼ ins.
Length over all	50 ins.
Propeller	12 ins. diam., 25 ins. pitch
Tank	4 ins. diam., length 24 ins.
Wheels	4 ins. diam.
Stabilizer	8 by 18 ins.
Pressure	150 pounds
Weight	30 ounces
Distance of flight with 150 pounds pressure	400 feet
Wing area	462.5 sq. ins.
Loading	15 sq. ins. per ounce
Dihedral	5 degrees
Incidence	4 degrees

FIRE-PROOF FABRIC ON GERMAN AIRPLANE

A PORTION of the airplanes that were surrendered to the Allies at the conclusion of the Armistice by the German Air Service have been received in this country and are distributed to the various flying fields so that the features of construction could be studied and various experiments could be carried out with different machines. During recent tests at Kelly Field, Texas, it was found that the Fokker airplane was covered with fire-proof fabric. Even when the material with which the wings were covered was exposed to the hot flames from a blow torch the fire did not spread even after holes had been burned through the fabric, which required a great deal of time. Recent experiments made in this country with fire prevention materials indicated that by the use of wing coverings of fire-resisting material of non-inflammable dope, that the accidents which have been so common in the past due to a plane catching fire in the air, would be practically eliminated.

The Aviation Committee of the Aero Club of France has now approved the regulations for the Louis Bleriot Safety Prize. The prize of 100,000 francs will be awarded to the competitor, who under certain conditions makes the lowest vertical speed in descending from a height of 500 meters and lands in a circle of 50 meters in diameter.

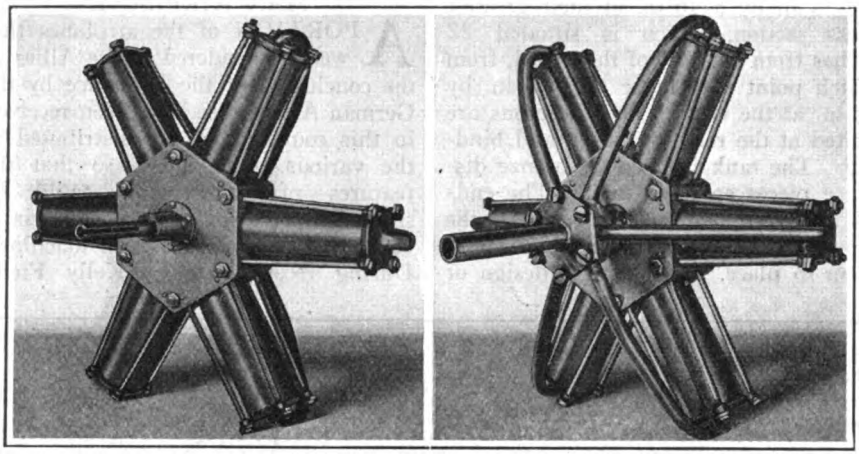
Digitized by Google

How To Make A Compressed Air Motor

Details of an Interesting and Powerful Model Airplane Power Plant Built With a Minimum of Lathe Work

By V. Davenport

I HAVE always held that a description of anything of this sort should be short and general in its nature as any real model engineer generally wants to follow out a few ideas of his own, even in the construction of someone else's apparatus, and so will give no dimensions or lengthy details. The photographs with this article will probably explain the construction better than a lengthy description. The main idea I want to bring out is that the only lathe work was the pistons and distributing valve. All the rest was hand work and easily obtainable material was used throughout the engine.



Views showing construction of air motor having a built-up crankcase and other novel features

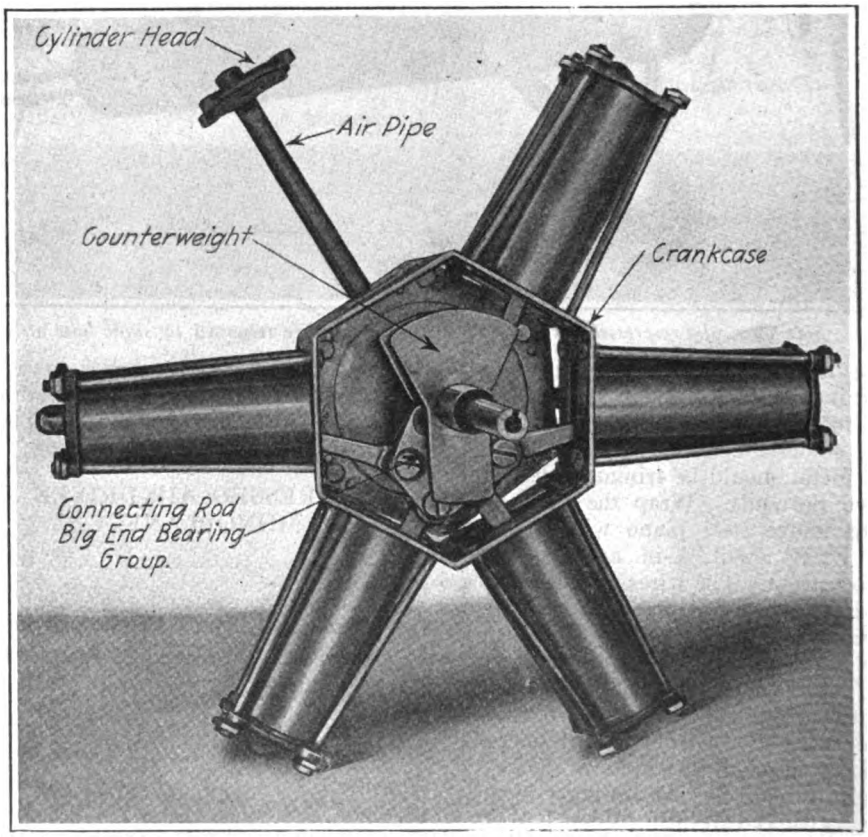
Reamed Tubing for Cylinders

The cylinders were made from Shelby seamless steel tubing. They were first cut to slightly over length, and then a wooden block with a hole the same size as the outside diameter as the tubing was made so as to hold the tubing in a vise while it was reamed. To get a good finish the tubing was reamed three times. First with a roughing reamer, then with a standard size 15/16-in. reamer. It was finished with a 15/16-in. expansion reamer, expanded to a little over its ordinary size. The outside of the cylinders were polished by inserting a bolt, about a half inch longer than the cylinders in the chuck of a hand drill and slipping the cylinders over this and letting the conical end of the chuck extend into the tubing, a nut and washer on the other end holding them in place. The hand drill was placed in a vise and strips of emery cloth used for the polishing.

Crankcase Made of Sheet Metal

The crankcase can perhaps best be described by the use of a sketch, which is given at Fig. 1. A strip of rather thin steel, 1/16-in. is thick enough, equal to the width of crankcase wanted and in length equal to the perimeter of the crankcase is taken and the groove for the cylinder and the hole for the bolts laid out and drilled before bending to shape. A true hexagon should be cut from a block of wood to insure a true crankcase, as it serves as a pattern and the case is made by bending the strip of metal around it. The ends of the strip were butted together, riveted and brazed.

The sides or end plates of the crankcase were made from sheet aluminum cut to the shape of the crankcase proper. The flanges were made by taking a piece of the same material and cutting to the inside diameter of the hexagon, then cutting out the middle of it so as to leave a ring. This ring was then riveted to the larger plate, forming a flange or shoulder. The construction is shown more clearly in the photograph. The crankcase bearings were made of Shelby tubing reamed to fit the crankshaft. They were first brazed onto thin washers to form a flange. This flange was then riveted to the crankcase. The bearings were finished the same as the cylinders.



View of crankcase interior of Davenport motor shows counterbalanced crankshaft and method of grouping connecting rod big ends

Digitized by Google

Built-up Crankshaft

On account of the construction of the connecting rods the crankshaft was made in two pieces and bolted together by means of the crankpin, similar in construction to that of a motorcycle. The crankpin itself is brazed to the propeller end of the crankshaft, making the end of the crankshaft that takes the strain one solid piece.

The connecting rod bearings and crankpin bearings were made from the rollers and roller sleeves from a motorcycle chain, and brazed to the connecting rods. Afterwards they were reamed to fit the crank and connecting rod pins. A jig was used for the brazing operation to make sure that the sleeves would be the same distance apart. The connecting rod big end assembly is very much the same as used on the Gnome aviation engine, consisting of one master rod and five auxiliary rods.

The cylinder heads were made the same as the crankcase was, except that they were made of brass. They were first drilled, the grooves cut, and then filed to shape. They can be made as separate pieces or as one piece and cut apart.

The cylinder retaining bolts were made of spokes from an aeroplane wheel, the reason being that the heads on these are straight and not at right angles, as with bicycle spokes. The crankcase sides are held by bolts running clear through. The rotary valve is of the ordinary construction. Tubing is copper and all joints are silver soldered. No doubt but the reader can considerably lighten the weight. The engine weighed 20 ounces as made and delivered a maximum of about three horsepower on two hundred pounds of air.

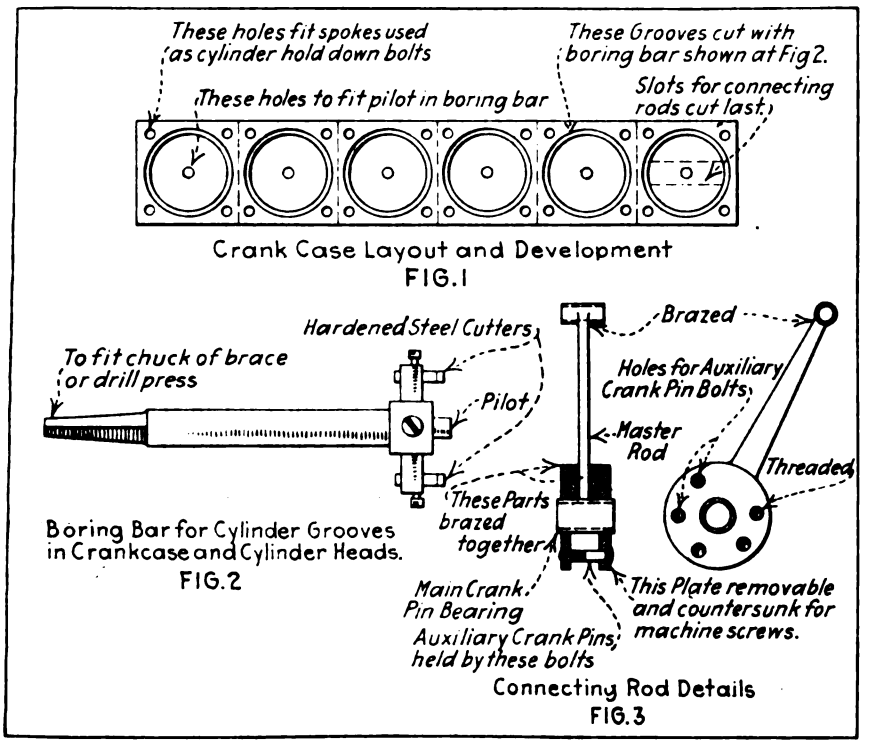


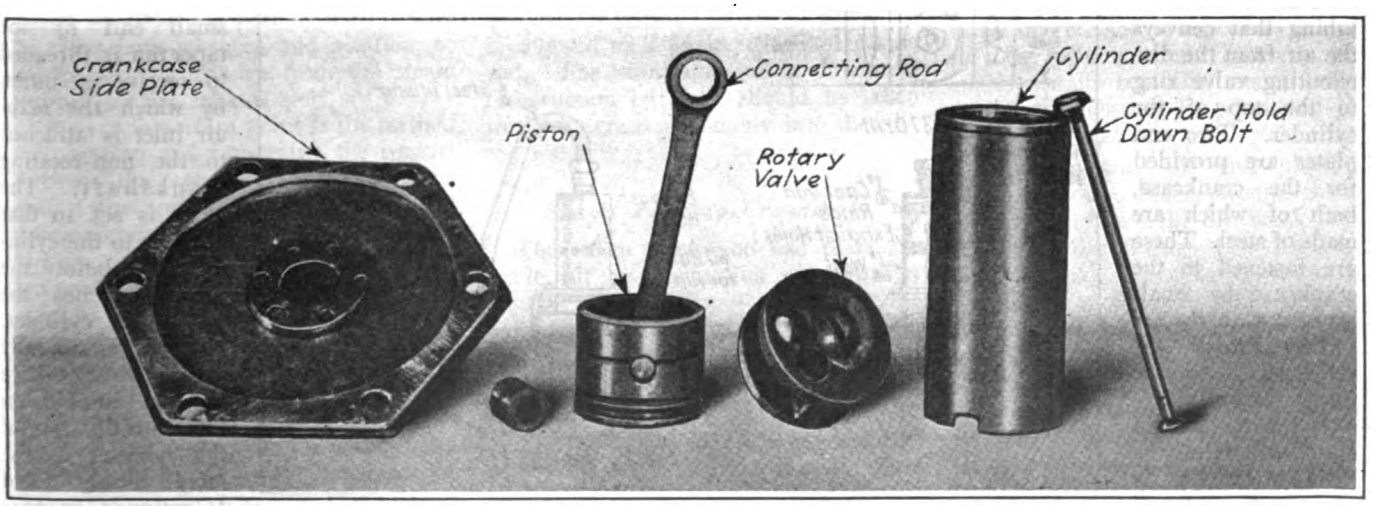
Fig. 1—Development of crankcase. Fig. 2—Special cutter for cylinder heads and crankcase. Fig. 3—Connecting rod details showing master rod

MODERN PRECISION MEASUREMENTS

(*Continued from page* 302)

the other reflecting surface is the top surface of the under glass. If there is any difference in the thickness of the objects being compared the air space between the two glasses is again wedge-shaped, although the wedge is much wider. But the result is the same and not only can a difference in thickness be detected, but the difference determined within a millionth of an inch by counting the interference lines. By using a standard of known accuracy and comparing other parts to it, measurements can be rapidly made with the apparatus. A different procedure is necessary for other measuring operations, but the basic principle of determining distance from the interference bands is used throughout.

Quartz and flint are the mineralogical names for silica or silex. In other words, the names are applied to the minerals found in nature. Flint is a quartz with a sharp, conchoidal fracture, but chemically the same. Silica is the chemical name for quartz and flint. It is oxide of silicon. Silex is the old chemical name and is not used in modern chemical treatises. The name silica has replaced it. Therefore, quartz, silex, flint and silica are the same chemically, when ground into powder. But in masses, the quartz and flint have a slightly different appearance. Quartz is the name applied to a general class of materials of different colors but of the same chemical composition. Flint is really a variety of quartz, but this is not generally known.



Group of parts of Davenport air motor. Note built-up crankcase side plate and method of using wire spoke as cylinder hold-down bolt

Digitized by Google

A Six Cylinder Air Motor

By A. Bohaboj

THE motor described is a six-cylinder form that has been used successfully on various types of model aircraft, including helicopters that have raised themselves and the weight of the motor, though they do not lift the source of compressed air. The illustrations and drawing show the details of construction clearly enough so that any experimenter of average ability and owning a small lathe should have no difficulty in building the engine.

The cylinders are machined from a solid steel bar and are ½-in. bore and stroke and are machined to the dimensions indicated. The piston is made of cast iron and also uses 1/16-in. section cast iron rings. The crankcase is made of aluminum and is machined from a hexagon of that material 1¾ ins. across the flats and finished 15/16 of an inch wide.

Of course, sufficient stock must be allowed for finishing the sides so it is well to have the aluminum piece at least one inch thick. The internal dimensions need not be held very accurately, the aluminum piece being bored out so that there will be ample room for the crank pin and connecting rods to swing around as the cylinders and crankcase revolve. The boss on top of the cylinder is machined with a 10-32 thread and a simple coupling nut fitted thereto. This serves to hold the ⅛-in. steel tubing that conveys the air from the distributing valve ring to the top of the cylinder. Two end plates are provided for the crankcase, both of which are made of steel. These are fastened to the crankcase by small screws and are turned from the solid stock to the forms shown.

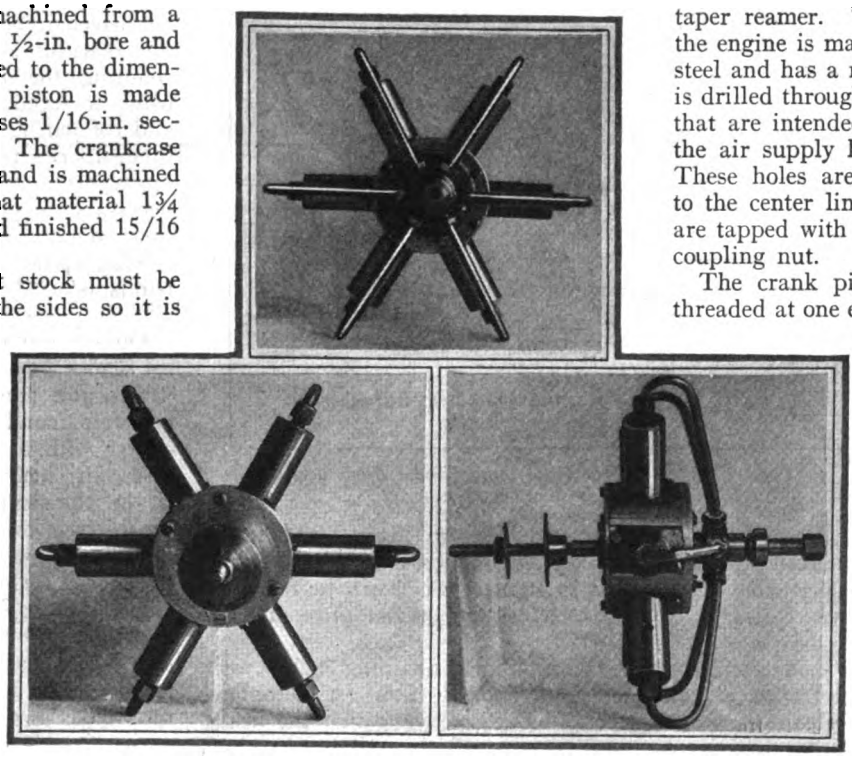
A flange is formed on the base of the cylinder which is afterwards cut off at the sides and the base is drilled with two No. 2-56 screws which hold the cylinder in place on the crankcase. A hole is drilled with a No. 37 drill through the boss on top of the cylinder for the air intake and a series of holes are drilled around the cylinder about midway of its length so that they are uncovered when the piston reaches the end of its stroke. These serve as passages for the exhaust compressed air. The connecting rods are light rectangular section members machined out of sheet brass of any desired gauge. As considerable space is allowed inside the piston interior, the rods are assembled all in a line on the crank pin and some will be off center as relates to the cylinder center line.

The construction of the crankshaft, which also serves as an air distributing valve, can be readily ascertained. A No. 6 standard taper pin is used, this being carefully fitted to the end plate which is reamed with a standard No. 6 taper reamer. The rear end plate of the engine is machined from a piece of steel and has a ring turned on it which is drilled through with a series of holes that are intended to communicate with the air supply hole in the crankshaft. These holes are drilled to correspond to the center line of the cylinders and are tapped with a 10-32 thread for the coupling nut.

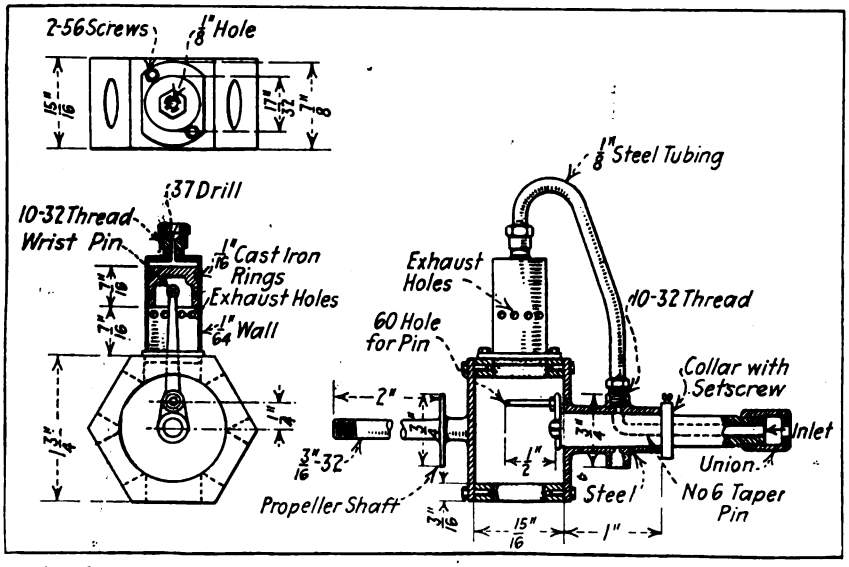
The crank pin is a piece of stock threaded at one end to fit into the crank web. It is held firmly in place by a small nut and is drilled at the end with a No. 60 hole for a pin that keeps the connecting rods from working off of the shaft. The web is made of a piece of sheet steel and has a square hole filed in it to fit a corresponding square portion that is filed at the big end of the taper pin. When this square projection is burred over, the crank web is firmly retained by the riveted metal. The small end of the taper pin is threaded to receive a union by which the main air inlet is attached to the non-rotating crankshaft. The valve is set so that air goes to the cylinders just before the piston reaches the top of the cylinder.

There is actually very little clearance between the piston top and the top of the cylinder as the more closely fitted

(*Continued on page 379*)



Front, rear and side views of the Bohaboj six-cylinder compressed air motor for model airplanes



Design drawing showing main details of Bohaboj motor. Attention is directed to the simple air distributing valve and crankshaft construction

Digitized by Google

Model Steam Engine and Boiler Construction

By W. A. Helm

PART I

SMALL OSCILLATING CYLINDER ENGINE

ALTHOUGH the following article will be of more interest to beginners than to older readers and more experienced model engineers I feel it fills an existing demand. The readers of EVERYDAY ENGINEERING increase with every issue and many of the boys who have been in the services during the war have returned to their old pastime of making models. So I feel justified in starting from the very beginning and gradually working up to the more complicated engines and locomotives. I shall begin with the oscillating type of steam engine as the simplest form. Before starting with the actual construction it will be necessary to say a few words as to the operating principles of those engines.

Steam Distribution

The steam is distributed by a port. A single port is drilled into the cylinder (see Figs. 1 and 2), the outer face of which slides over the ports in the steam block, the latter being stationary, also forms the pivot bearing for the cylinder (see Fig. 4). The setting of the ports depends on the size of the cylinder and the extent of the oscillation. The amplitude of the latter is regulated by the length of the stroke and that of the piston rod. The diagram at Fig. 3 shows how to set out the ports in a single acting oscillating engine. The width of the ports is not less than 1/6th of the cylinder bore. According to this rule, the ports for a cylinder of ⅜ in. diameter are 1/16 in. In setting out the ports on the steam block we must take care that they are sufficiently far apart to allow the port in the cylinder to clear both when in mid position, so as to prevent leakage from the steam supply to the exhaust port.

A very important point is the method of pivoting and preserving the contact between the port faces. The writer has found the spring contact the best and recommends it as the only satisfactory device. In selecting the spring it is necessary to be very careful as the tension of the latter must be sufficient to overcome the opposing steam pressure, which is tending to force the port faces apart. This force is equal to the pressure of the steam multiplied by the area of the port. On the other hand the tension of the spring must not be too great, as the resulting friction will seriously reduce the efficiency and speed of the engine.

Keeping the above facts in mind, let us now get to the actual construction of a single acting oscillating engine of ⅜ in. bore and ⅝ in. stroke. We begin with the cylinder, the dimensions and components of which you find in Figs. 1, 2 and 5. For the benefit of the readers who may prefer to build up their own cylinder in preference to purchasing the castings in the rough or half finished, full size details of the various parts are given in Fig. 5.

How Cylinder Is Made

The cylinder barrel can be made from a piece of solid drawn brass tubing with a bore of ⅜ in. inside diameter. By passing a ⅜ in. parallel reamer through the piece of tubing the bore can be trued up to the required diameter. Having done this, file the ends of the tube square until it is exactly 1 21/32 in. long. Then bell mouth the lower end so that there is no difficulty in placing the piston into position after it has been packed.

The top cap can be made out of a solid piece of brass and permanently soldered on, together with a block 3/16 in. thick drilled and tapped for the pivot pin. A 1/16 in. hole should be drilled through the interior of the cylinder, and the block should be recessed so that only the port face and the strip below the pivot pin make contact with the steam block. To show up the parts which form the bearing surfaces I have shaded the rubbing portions. The bottom cap of the cylinder may be made to fit tightly, or may be secured by a drop of solder. It should be provided with two or three vent holes. The piston shown is a long one with two grooves for packing or piston rings. It is screwed to a ⅛ in. diameter piston rod. The crankpin end is of simple construction but care should be taken to fit the crankpin snugly into the piston rod.

Simple Built-up Crankshaft

The steam block and bed plate are made out of one casting as shown in Figs. 4 and 6. Fig. 4 shows how the cylinder is secured to the steam block. The drawing speaks for itself and it is not necessary for me to describe how to finish it. The crankshaft is very simple. A piece of 3/32 in. diameter mild steel rod will be required. This should be 1⅝ in. long, after the ends have been filed square. Place this in the bearing space which has been drilled and afterward carefully smoothened with a reamer. The reamer used is a 3/32 in. expansion type. Then attach the flywheel on one side and the crankpin on the opposite side as indicated. So much for the construction of the engine proper.

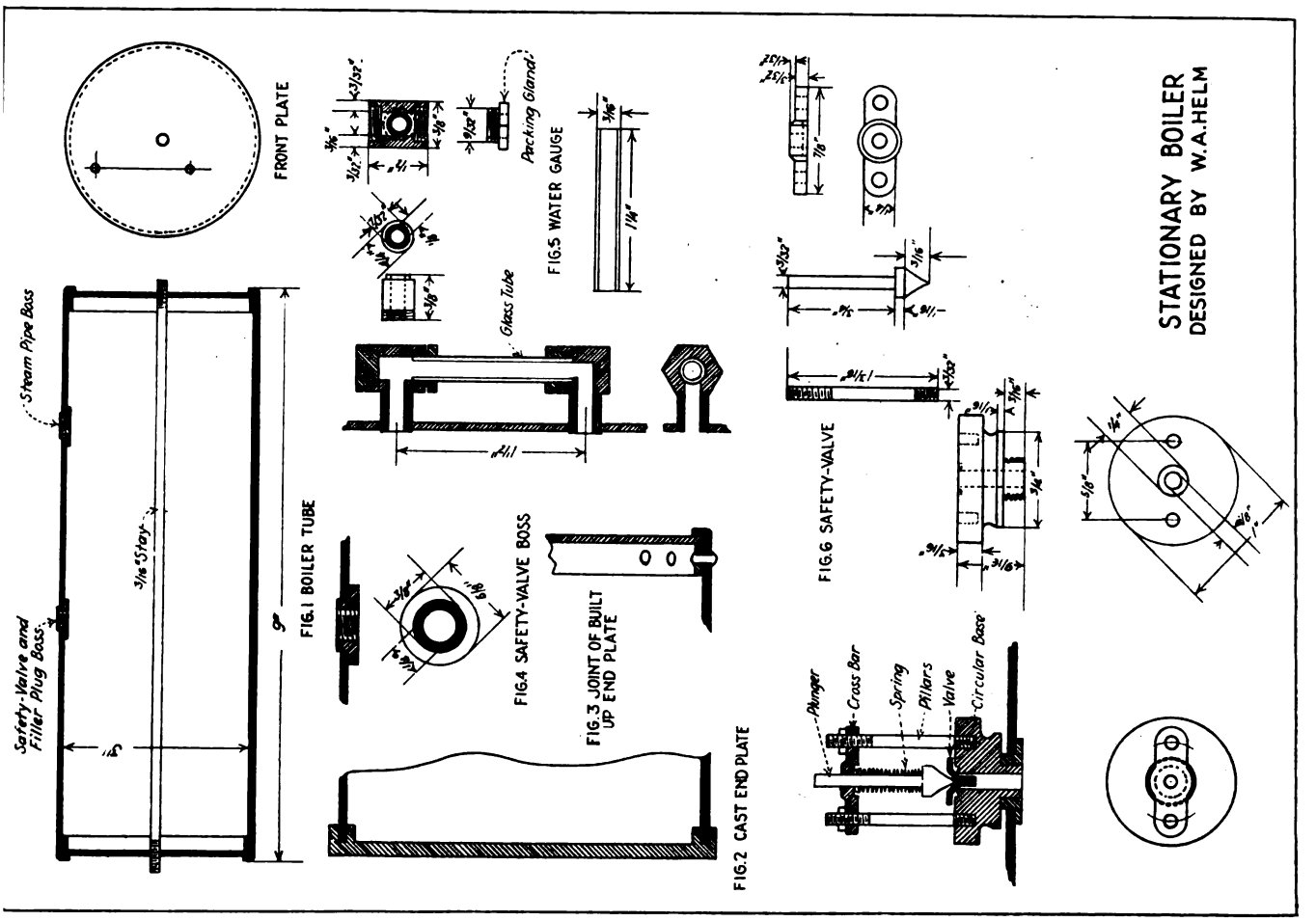
HOW TO MAKE THE BOILER

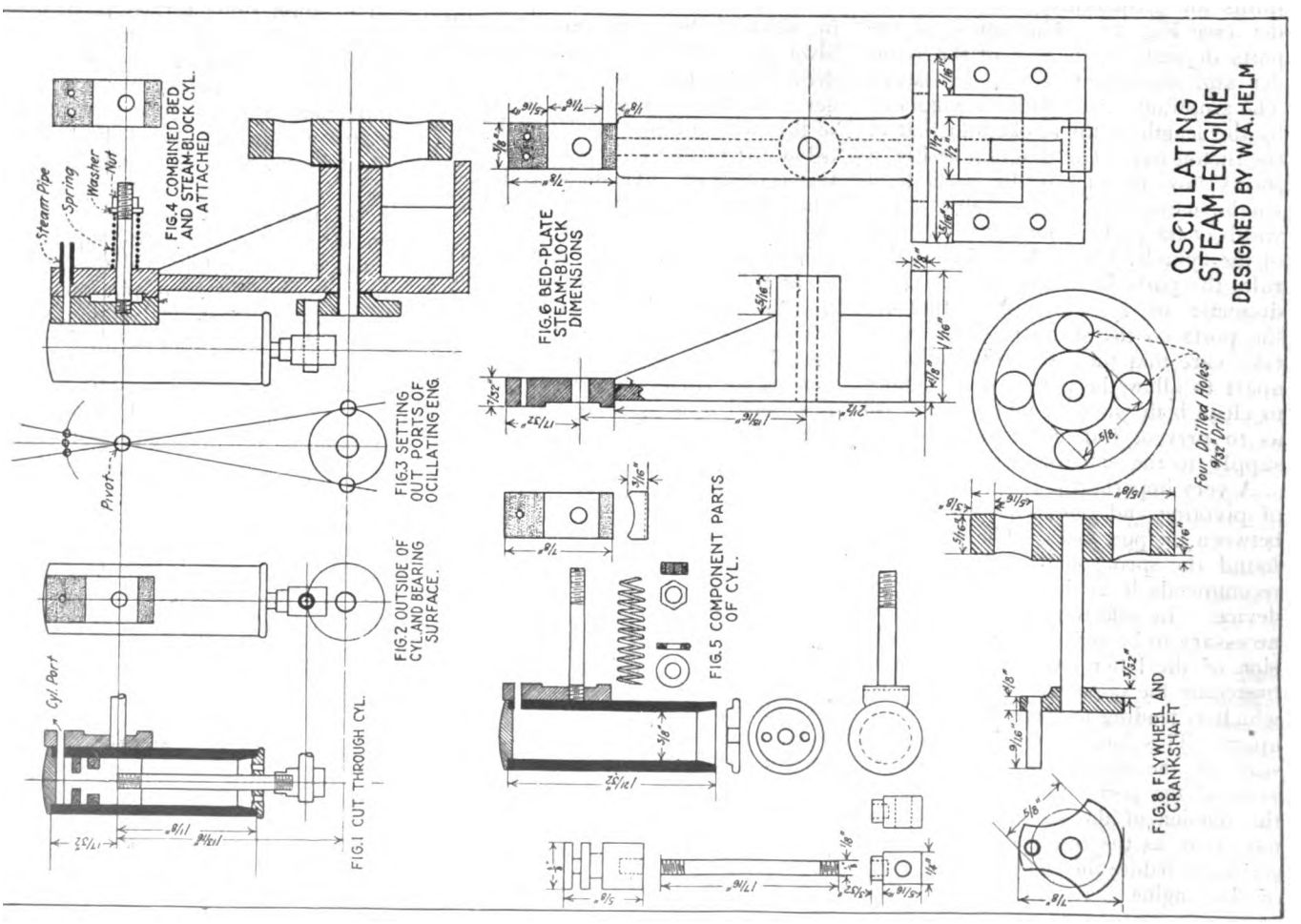
A steam engine cannot run without a boiler to provide steam, so I have decided to describe a suitable boiler for each engine. The boiler described is of the stationary type and is perhaps the most efficient to drive a small oscillating engine, as the latter is seldom worked at a greater pressure than twenty or thirty lbs. I might suggest here to the prospective builder to take great care in building the boiler, as it is also of ideal construction to keep on hand for trying new engines as built.

To make this boiler take a piece of solid drawn copper tubing 3 ins. in diameter and 9¼ ins. long (see Fig. 1 of the plate giving the boiler details), the thickness of the wall being about 3/64th in. The end plates may be made out of a casting (see Fig. 2), or out of sheet brass turned or filed circular to make a tight fit inside the tube. If the latter method is employed cut two strips of copper ¼ in. by 1/16 in. and about 9¼ ins. long and fit them accurately into the barrel of the boiler about ⅛ in. from each end, then rivet fast. Put the end plates in against those rings and flange the projecting rim of the tube, by lightly tapping with a hammer (see Fig. 3), the ends of the tube having been previously annealed. The first method of using a casting has the advantage of being by far the easiest way, and so I recommend this method as especially adapted to those who have not had any great experience in building model boilers, as the castings can be purchased at a very small cost.

Before putting the end plates in place, drill two holes through the top of the boiler to hold the brass bosses for the boiler fittings (see Fig. 4 of boiler plans). The latter shows the dimensions of the boss. The same size is employed for both the safety valve and the steam pipe. Before soldering the end plates and bosses into place it is necessary to scrape and clean the surfaces coming in contact so that the silver solder will be sure to run all around the joint. Through the front plate of the boiler drill two holes for the water gauge. Through the front

Digitized by Google





Digitized by Google

and rear plate centers, drill a 3/16 in. hole in each for stay bolts.

After having completed the work on the boiler tube and the bosses, the end plates are soldered into place. We take the fittings in hand. They consist of a safety valve, filler plug, water gauge and steam pipe, the latter being equipped with a union cock to turn off the steam. As the efficiency of a model boiler is somewhat dependent upon its fittings it is good business to pay close attention to the making of them.

We start with the safety valve. The circular base of the latter also forms the filler plug. It is turned out of a solid brass bar of 1 in. diameter to the dimensions given in Fig. 5. The cross bar is also turned out of a solid piece of brass. The pillars and plunger are turned out of a mild steel rod. The valve itself is turned out of steel, tempered and carefully ground in. Care should be taken, when turning the valve, that the point of contact between the plunger and valve is below the seating surface of the latter.

The next fitting in importance is the water gauge as indicated in Fig. 6. It is a plain gauge without cocks and can be easily turned out of a 3/8 in. diameter hexagonal brass rod. The nipple into the boiler is silver soldered into the rod. The top fitting is open and has a cap for the insertion of the glass. The maker should be very careful in lining the top and bottom fitting up to the center of the glass, before inserting the latter.

These instructions should be sufficient to keep the reader busy over to the next article, when I shall finish the description of the boiler and shall advance to the next step in model steam engine construction.

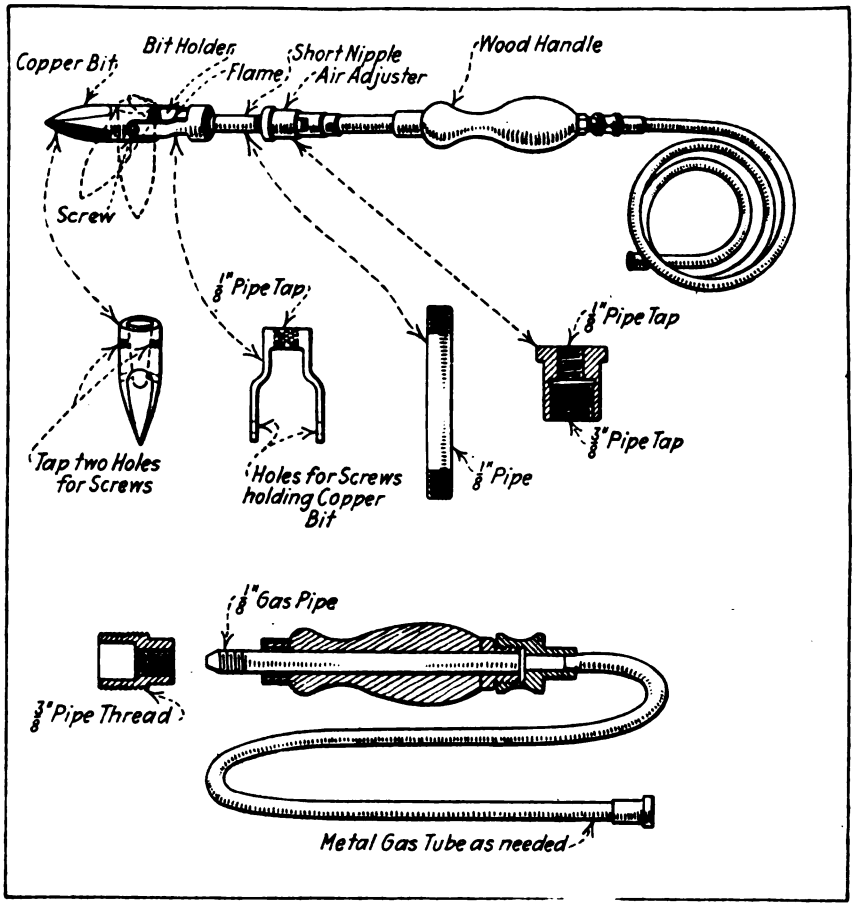
HOW NAMES ORIGINATE

MANY persons are puzzled to understand what the terms of "fourpenny," "sixpenny" and "tenpenny" mean as applied to nails. "Fourpenny" means four pounds to the thousand nails, or "sixpenny" means six pounds to the thousand nails, and so on. It is an old English term, and meant at first "ten pound" nails (the thousands being understood), but the old English clipped it to "tenpun" and from that it degenerated until "penny" was substituted for "pounds." A "monkey wrench" is not so named because it is a handy thing to monkey with, or for any kindred reason. "Monkey" is not its name at all, but "Moncky." Charles Moncky, the inventor of it, sold his patent for $2,000 and invested the money in a house in Brooklyn.

GAS HEATING SOLDERING COPPER

ONE of the deficiencies of the ordinary form of soldering iron or copper is that considerable time is taken up to heat the iron and that it cools rapidly when it is removed from the source of heat and used in soldering. Of course, this can be eliminated to some extent by using two irons, one being heated while the other is used. Electrically heated soldering coppers are marketed and have many advantages for different varieties of work such as carried on by various manufacturing firms. In some cases, the gas heated copper bit such as illustrated may be used advantageously. The soldering copper is carried by a simple forked member that screws on to the end of a piece of pipe which in turn is attached to an adjustable fitting that forms part of the Bunsen burner. In fact, this fitting has an air control for the burner. The pipe passing through the handle has its end blocked and is drilled so as to allow only the proper quantity of gas to pass through. The air adjuster carries a nipple that forms the burner and the flame issuing from its end, which is the usual hot, blue, Bunsen flame impinges against the copper and in a hole formed in its interior so that this is kept heated at all times that the burner is lighted. The adjustable bit support makes it possible to place it in various positions for different classes of work.

The construction of the device is clearly shown in a sectional view as are the various parts comprising the assembly. The gas is conveyed to the device by flexible, metal gas tubing. Even if illuminating gas is not available, hydro-carbon gas may be used if the burner design is modified somewhat so that the orifice through which the gas issues is controlled by a screw valve. In this case, if this modification is made, the flexible gas tube may be connected to a suitable container in which the gasoline is under air pressure and the device will function on the same principle as a brazing torch. Modifications of this design will readily suggest themselves to the experimental engineer.



Details of gas-heated soldering copper

BELL METAL

THE best bell metal is composed of 78 parts of copper and 22 of tin. The use of silver in the manufacture of bells is purely imaginary. The idea grew out of a practice at the casting of church-bells when pieces of silver were supposed to be mixed with the bell metal. The foundrymen had other uses for the pieces of silver and contrived means for the silver pieces to fall through the grate bars into the ashpit. Nearly all bell makers have their own methods for determining the tone of a bell from a certain size.

Digitized by Google

Switches and Cut-Outs

Overload and Underload; Electro-Magnetic, Centrifugal and Film Circuit Breakers

By Prof. T. O'Conor Sloane

CUT-OUTS and switches may be entirely hand or mechanically operated, or the action of the electromagnet or other electric device may be utilized in their operation. There are a number of constructions of switch, in which centrifugal force is the controlling factor. When one of this type is applied to a motor, the latter will not start when merely connected to the circuit; the centrifugal switch must be closed and kept so by centrifugal action. Often the starting in such a case is done by hand, the rapid turning of the motor armature closing the switch.

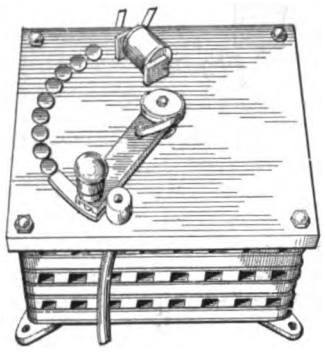


Fig. 1. Starting box

The cut-outs, which will be first described use electromagnetic action for their operation. The starting box whose appearance is familiar to all is an example of this type. It is used on direct current circuits for starting motors. If the full potential of a circuit were connected to a stationary motor with no resistance intervening, the armature would pass so strong a current in the absence of all counter-electromotive force, that it would be heated and perhaps permanently injured. Referring to the cuts, Fig. 1 and 2, it will be seen how this cause of accident or damage is avoided. The switch handle passes over a series of studs one by one. As it touches the first one, a number of resistances in series, one for each stud are interposed between the active lead and the motor. The armature begins to rotate under the effect of a reduced current. As the switch bar passes to the next stud it cuts out one resistance coil, and the armature now in motion receives more potential. This goes on as the switch is moved until all the coils are cut out, and the armature protects itself by counter electromotive force due to its own rotation. When the switch handle or bar reaches its final position, it is held there by the electromagnet, from which a spring

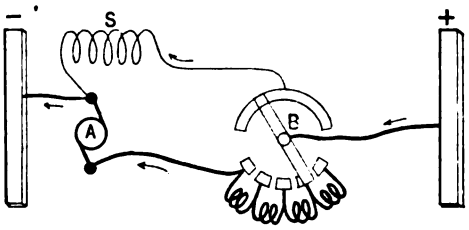


Fig. 2. Starting box connections

tends to separate it and to pull it back to its original inactive position, cutting off the current completely. Suppose that by any accident or incident the current is cut off; the electromagnet ceases to act, the switch bar flies back, and if the current is turned on at any other point, the motor circuit remains open and the motor does not start. It has to be started just as before, with the successive reduction of resistance, so as to protect the armature from burning out.

This is an example of a no-load or protective cut-out. If the motor circuit stayed closed, and the circuit was opened and closed, the closing would bring the full potential to bear on the armature and perhaps would burn it out. It is obvious, that, while this device is primarily or usually a no-load circuit breaker, the magnet and spring could be so adjusted as to make it an underload instrument, one which would open the circuit if it fell below a certain potential.

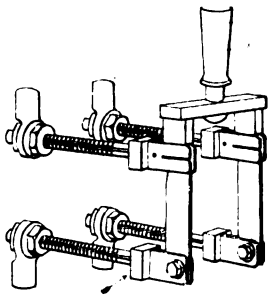


Fig. 3. Knife switch

This is also, as illustrated, an example of a flat bar switch. The knife-bar switch is the more approved construction for heavy currents, and to make the sequence complete a simple two-pole knife-switch is shown in the cut, Fig. 3. The construction is familiar to all; the only point to be made is, that, except in particular circumstances, the switch should open downwards. Then as far as gravity is concerned it tends to stay open, and to that extent there is no danger of an accidental closing. If placed in the other position, the handle might fall and close the switch when not desired. The position is a safeguard against accidental closing.

The next cut, Fig. 4, shows an underload knife-switch cut-out. When the handle, H, is pushed up the circuit is closed and current passes. At M is an electromagnet. The bell-crank lever on the handle, H, is pulled back by the operator when the switch is to be closed.

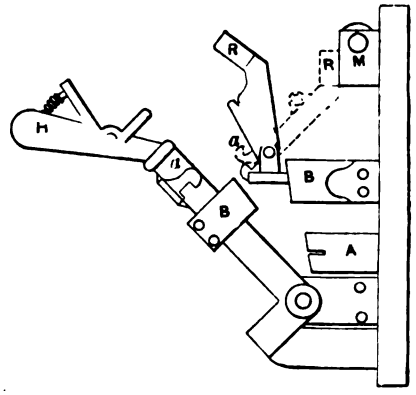


Fig. 4. Underload cut-out

As the handle is pushed up, the projecting end of this lever pushes the pivoted bar, R, into the position shown by the dotted lines. At the end, R, there is an armature, which is attracted by the magnet, M. The catch, *a*, engages in this position of R, with the corresponding catch on H, also indicated by *a*. The current is now passing. But if the current ceases or grows weak, the magnet will not have power enough to hold R, which is drawn away by a spring, omitted in the cut. The bar, R, will fly back the catch, *a,a,* will be released, the bar, H, will fall back and the current will be completely cut off and the circuit will be broken. The minimum load required to keep the circuit open is determined by the relative strength of spring and magnet.

There are double contacts in this switch. B, B, are carbon contacts and A is a metallic one. The carbon contacts are the last to open and the first to close. This protects the metal contacts from injurious sparking and arcing, although the metal contacts are the real working contacts.

Digitized by Google

The overload cut-out is designed to open a circuit when too strong a current is beginning to pass. It protects apparatus directly from burning out. One form is shown in Fig. 5. This is a knife-bar switch, with an auxilliary carbon contact above the metal one. In the position shown in full lines the carbon contacts at the top of the swinging bar are seen in contact with each other. Below them the metal contacts are in engagement. If the handle, seen

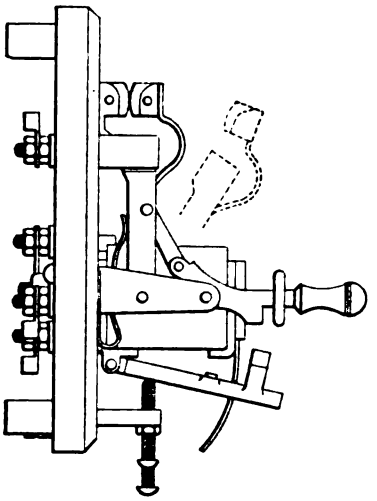


Fig. 5. Overload circuit breaker

projecting to the right, is pushed upwards the switch-bar will be thrown into the position shown in dotted lines and both carbon and metal contacts will be opened. This can be done by hand, but to introduce the feature of

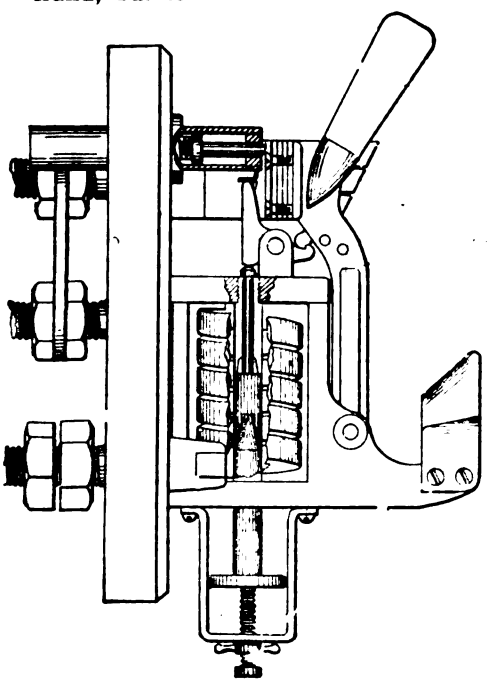
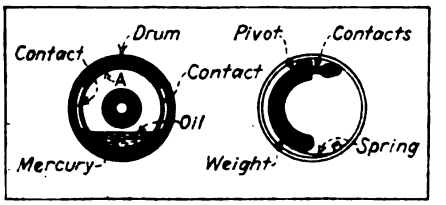


Fig. 6. I. T. E. overload cut-out

automatic overload opening, an electromagnet is placed back of the handle bar as shown, and below it is a pivoted armature If too strong a current passes, the armature will be drawn up, it will strike the handle and drive it up so as to break the contacts.

Another form is shown in Fig. 6. The pivoted handle in its vertical position as shown closes the switch against the pressure of a spring, which presses against a bar, which in its turn presses against the switch-bar at its upper end. A low resistance solenoid coil is shown, cut away in the drawing to show the plunger within it. The entire current goes through this coil. The switch-bar is held in position against the pressure of the spring, just spoken of, by a catch, just above the solenoid. When too much current starts to pass, the solenoid draws up its plunger armature, driving up the rod seen on top of the plunger, and releasing the catch. The horizontal plunger actuated by the spring just spoken of pushes the switch-bar back and the contact is broken.

There is another type of switch depending for its action on centrifugal force. Several examples are given below.



Figs. 7 and 8. Centrifugal switches

The next cut, Fig. 7, shows a switch in which mercury thrown out from the center by centrifugal force forms a sort of ring around the inner perimeter of a drum. There is a contact plate on each side of the drum and the mercury when the motor is in action makes an electrical connection between the two. The case, A, of the drum is of insulating material.

In the next cut, Fig. 8, a curved arm is pivoted at the point as shown; near the pivot are the contacts also clearly indicated. The distant end of the switch-bar is weighted and is held by a spring in such a position as to keep the contacts separated when the motor is not in action. The switch in question is carried on the end of the motor shaft or in other position where it will rotate when the motor does. It will be understood that the actuating current of the motor passes through the switch. When therefore the current is turned on, none can pass because the switch is open. But if closed for an instant by hand or otherwise the motor will start into action and the weighted end of the switch-bar will swing outwards under the effect of centrifugal force, the contact points will come together and the motor will go on indefinitely. If it is a small motor all that is necessary to stop it is to check its rotation by hand; the switch will be opened by the spring and the current will be cut off.

The film cut-out, Fig. 9, is simply a pair of contacts held apart by a piece of thin paper. It is to be used in parallel with a lamp in a series circuit. If the lamp filament should break down it would put out all the lamps on the

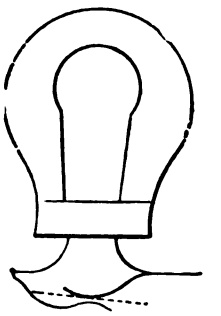


Fig. 9. Film cut-out

circuit. But if such an accident did occur there would be a sudden rise of potential, enough to make a spark, which would pierce the film and restore the connection. Of course the resistance of the lamp would be lost, but the series of lamps would be relighted instantly as the film would be perforated.

WHAT IS DRY ROT?

THE term "dry rot," the Forest Products Laboratory finds, is applied by many persons to any decay which is found in wood in a comparatively dry situation. Thus loosely used the term actually includes all decay in wood, since wood kept sufficiently wet cannot decay. In the more limited sense in which pathologists use the term, "dry rot" applies only to the work of a certain house fungus called *Merulius lachrymans*. This fungus gains its distinction from the fact that it is frequently found growing in timbers without any apparent moisture supply; in reality it does not grow without moisture and is as powerless as any other fungus to infect thoroughly dry wood. Given moist wood in which to germinate, it is able to make its way a surprisingly long distance in dry timbers, drawing the water it needs from the moist wood through a conduit system of slender, minutely-porous strands.

Wood in the typical advanced stage of dry rot is shrunken, yellow to brown in color, and filled with radial and longitudinal shrinkage cracks, roughly forming cubes. In many instances these cracks are filled with a white felty mass, the interwoven strands of the fungus. The decayed wood is so brittle and friable that it can easily be crushed into powder. The dry rot fungus is active in nearly every region of this country, in Canada, and in Europe. It is very destructive to factory and house timbers and to logs in storage. Coniferous or soft woods are more commonly infected by it than hardwoods.

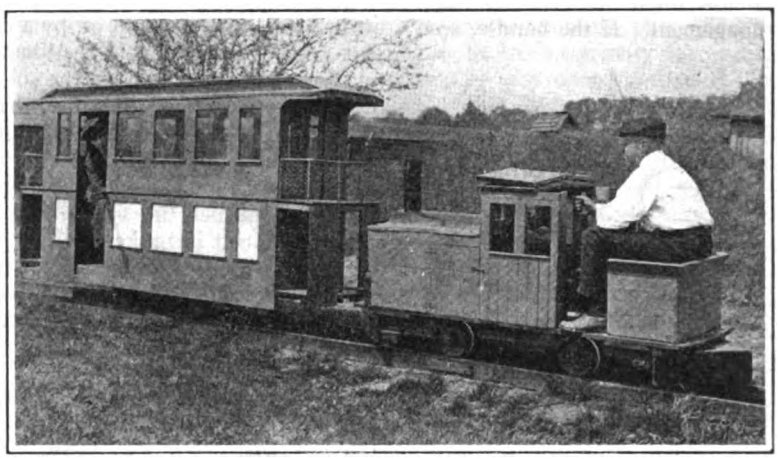
Digitized by Google

Miniature Railroad System

WHEN a man who has been active in business decides to retire and enjoy the peaceful routine of farm life, it is often necessary for him to interest himself in other things besides farm work in order to keep busy enough to satisfy his longing for action. A former New York broker, Mr. W. Cecil Gage, found that he had considerable time on his hands so he spent this spare time in building a miniature railroad, views of which are presented herewith. The materials for its construction were obtained by demolishing an unused henhouse, 250 feet long, which provided enough wood to not only build the railroad rolling stock, but also the track. Practically everything about this road is built of wood, the rails being made of 2" x 4" timbers, and even the locomotive being built largely of this material. Special passenger cars and freight cars have been built entirely of wood and the miniature railroad operates much the same as its larger prototype. The locomotive is driven by a four-horsepower gas engine which drives a counter shaft supported by regular shafting hangers, and this in turn transmits power to the traction wheels by means of a drive chain of the conventional pattern.

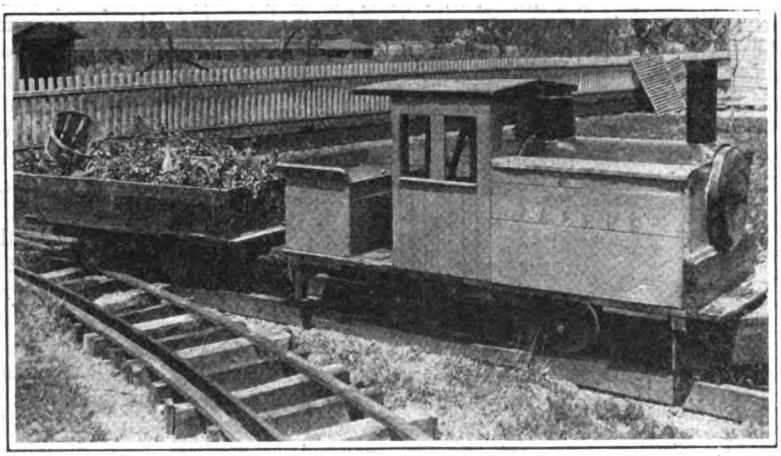
Plenty of room is provided in the engine room for the engineer, and the passenger cars will carry two people with ease and comfort. The interesting point about this railroad is that it was built entirely by a man who normally was engaged in a business that did not give him any opportunity to develop latent mechanical talent. He also claims that many men who are working in the professions and in merchandizing find in mechanical handiwork at once a hobby and a source of pleasure and recreation.

The construction of the entire system called for considerably more skill than possessed by the average man and the installation of the engine and effective utilization of its power in the compact and realistic-looking locomotive evidently required more than an elementary knowledge of mechanical principles. The false boiler top of the locomotive covers the power plant.

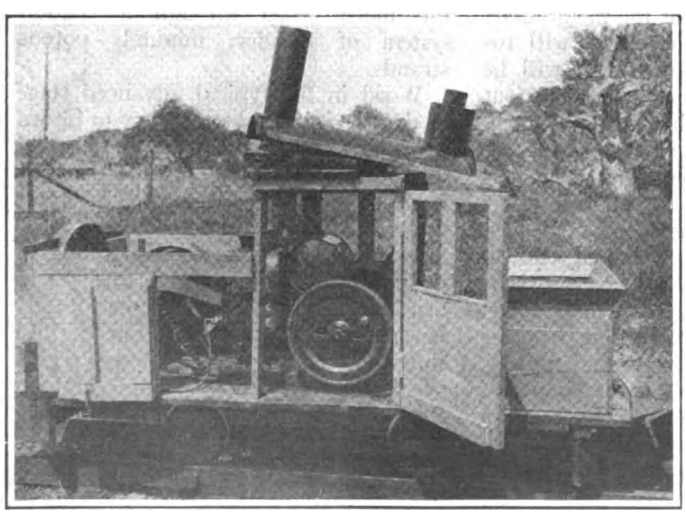


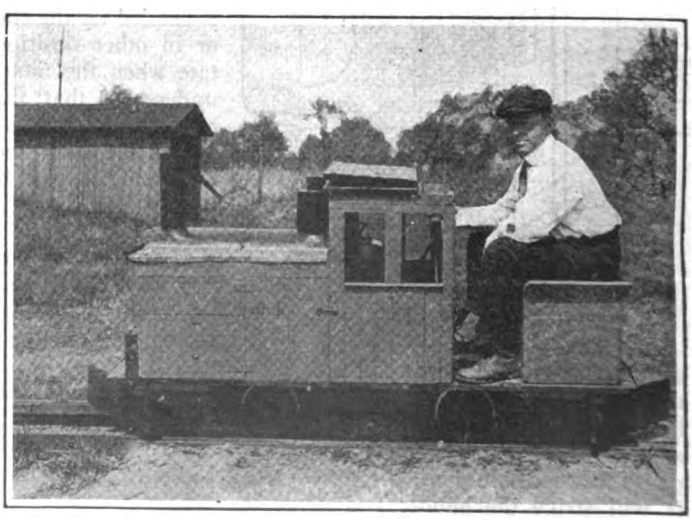
The double-deck passenger car seats two people

The view below shows the locomotive power plant which is a single horizontal cylinder hopper cooled gasoline engine driving a countershaft, this in turn driving an axle by a chain



The locomotive attached to a freight car full of produce is shown at left. The engineer, as seen below, seems to be a fair load for the tender and can reach the controls in the cab easily



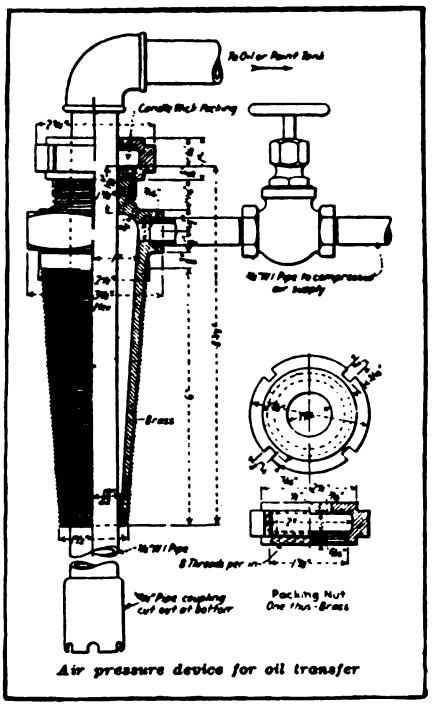


Digitized by Google

SHOP PRACTICE

AIR PRESSURE DEVICE FOR THE TRANSFER OF OIL

THE illustration shows a handy means of removing oil or other liquids from barrels or other closed containers for transmission to permanent shop tanks or elsewhere. It is essentially a home-made device of the class so numerous in railroad shops where a supply of air at suitable pressure is



Details of air pressure device for transferring oil from barrel to storage tanks

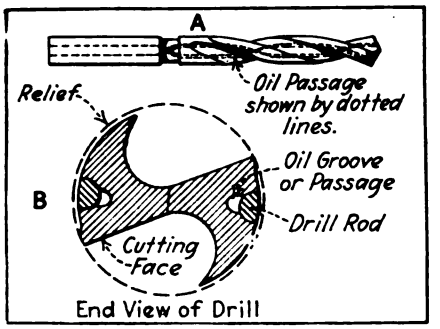
always available, and the dimensioned drawing is reproduced from the *Railway Mechanical Engineer*. It comprises a long, finely threaded taper plug, with diameters ranging from 1½ to 2½ in., which may be screwed into any ordinary bunghole, or, if more convenient, into a hole in the barrel head. The oil delivery pipe which is long enough to reach the bottom of the barrel slides in a stuffing box which makes a practically air tight joint. When a barrel is to be emptied the plug is screwed into the bunghole, a small air hose is connected to the pipe at the side and connection is also made from the delivery pipe to the point where the oil or other liquid is to be deposited. A slight opening of the air valve admits pressure above the body of liquid and it is driven up the delivery pipe with any permissible rapidity.

PROTECTING MOLTEN METAL FROM OXIDATION

A DIFFICULTY in melting alloys and some metals is the oxidation of the metal, whereby serious loss of material occurs. To meet this difficulty the Technische Blatt says it is a common practice to fill the container with a neutral gas so as to effect the fusion in a neutral atmosphere. But the usual arrangements allow the neutral gas to escape, its place being taken by air from the surrounding atmosphere. As a consequence, some oxidation still occurs. An invention, patented in Germany, remedies this effect. The container in which the metal is melted is constructed to be closed air-tight, and put in communication with a compressed air-cylinder filled with nitrogen. The gas, under a pressure of 60 to 70 atmospheres, may be led into the container through a reducing valve.

PRACTICAL OIL DRILL

A MASSACHUSETTS firm has brought out the oil drill illustrated which is intended to remedy some of the troubles which have been noted by using those forms of oil drills in which the oil conductors are soldered to the drill. The old-style drill with an inserted tube sometimes gives trouble



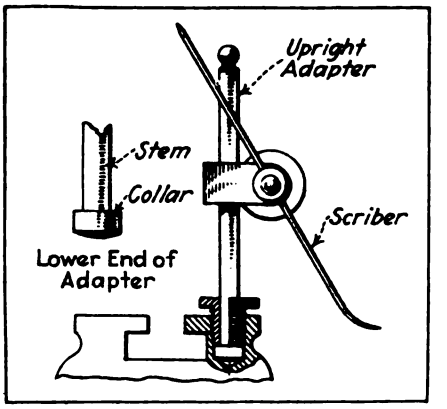
How a practical oil drill is made

through the loosening of the tube or this may bend and break. The oil conductor may also be bent and the flow interrupted. The new oil drill is made by forming an oil channel in the drill itself, by milling a groove in the body of the drill and dovetailing a piece of rod into the upper portion of this groove. When the process is complete the piece of drill rod can never come loose and for all practical purposes a solid oil drill is produced that is said to be free from trouble.

ADAPTER FOR SURFACE GAUGE

A SURFACE gauge is a handy tool around a lathe and similar machinery, but it is not always an easy matter to clamp this securely to the carriage or tool. The accompanying illustration shows an adapter that should be very useful.

The adapter is made the same size as the regular surface gauge except that a collar is turned or brazed on its lower end. This collar may be easily



Adapter for surface gauge

formed by heating the lower end of the rod to the proper temperature and by upsetting it to form an enlargement which can afterward be machined down to required size. A special hollow nut that fits in the hole drilled into the tool slide and which is placed at any convenient part is a good fit on the surface gauge standard and when it is screwed into place the collar will be held firmly against the bottom of the hole. In using a surface gauge this is removed and the clamp and pointer are moved on the adapter to any desired point.

Various modifications for this device will suggest themselves. The lower end of the adapter column may be threaded or it may be a simple piece of straight stock that will clamp by a split, tapered nut, which closes in against the rod when it is screwed down into the hole.

HARDENING SMALL CARBON STEEL TOOLS

SPECIAL care must be taken in the tempering of small tools of carbon steel. A small gas furnace, inclosed with a chamber for the heating of the tools, is desirable but a coal or coke fire properly banked is satisfactory. The fire must be burned down to a bed

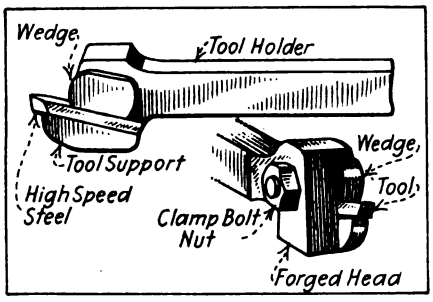
Digitized by Google

of live coals, and it is best to insert a section of tubing into the fire to protect the tools from the direct blast. The quenching heat may be determined accurately by instruments, but where these are not available, the use of a magnet is suggested. When the magnet no longer has an attraction for the steel being heated at the part in the fire, the proper point for quenching may be determined by permitting the steel to remain in the fire a few minutes longer. The point at which the magnet ceases to attract is about 1,425° F., and the best heat for tempering is 10° above that temperature.

Tools cracked and damaged in the hardening process frequently result from the failure to relieve the strain on the steel after quenching, and the moment that it has cooled sufficiently to harden. While still grasping the tool in the cooling bath, the instant that the tremor from the sudden plunge stops, the piece should be withdrawn quickly, and permitted to cool in the open air. The steel will still be too hot to hold in the hand. This is only necessary, of course, when the steel is not to be drawn to temper on the original heating.—*American Blacksmith.*

SPECIAL TOOL HOLDER

THE special tool holder shown is of English design and possesses many features which enable one to describe it as both a handy and substantial tool. As the illustration shows, it takes 3/16th in. cutters of square section; the holder shank being ½ in. x 7/16th in., and 5 inches overall. The cutter is ⅜ in. above the level of the top slide; and the drop head, fitting flush and

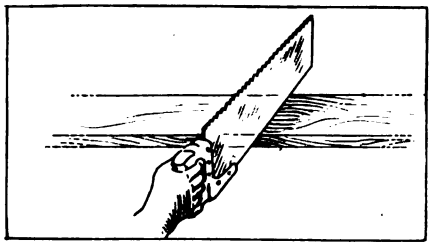


Special lathe tool holder

square to the edge of the slide rest, takes the "thrust" of the cut, preventing all vibration of the cutter. The head is also "off set," which enables a cut to be taken close up to the chuck or face-plate. A side or facing cutter can also be used in the holder. The long bearing surface of the clamp permits the cutter to be held at an angle for recessing. It is only made in one size and is being marketed, with one high-speed cutter and spanner wrench to fit the clamp nut. Extra cutters of high-speed steel ground to various shapes may be easily inserted in the holder and can be made by the workman without any trouble from the special high-speed tool bits that can be secured from dealers in machinery supplies.

USING A CROSS-CUT SAW AS A TRY-SQUARE

A USEFUL kink for the handy man is shown in the illustration, as it demonstrates how a saw can be used to draw a line perfectly square across a board. The saw is held vertical with its back resting on the board and is



Using saw as try-square

turned one way or the other until the reflection of the edge in the bright blade is exactly in a line with the edge of the board in front of the saw blade. The saw now is exactly square with the edge and a pencil or scriber can be used to mark the place for the cut. If the saw is rusted it will not work so nicely because the reflection will be dimmed.

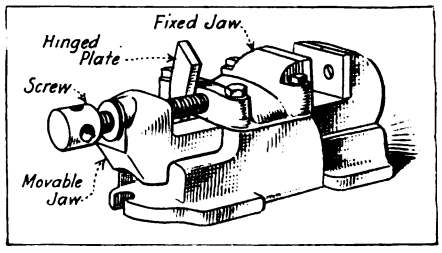
CHART FOR POWER TRANSMITTED BY LEATHER BELTS

THE accompanying chart may be used to determine the width of a single leather belt necessary to transmit any ordinary amount of power, the horsepower that will be transmitted by a single belt running at a given speed, or the speed at which a belt may run in order to transmit a given power. For example, to determine the power that will be transmitted by a single belt 7 inches wide running at a speed of 5000 ft. per minute, locate the point 7 and 5000 in the lower graduated line and then find the point midway between them. This point will be found at 44 h. p. on the upper graduated line. The dividing may be done with a rule, or a pair of dividers, or by folding a piece of paper.

Should it be necessary to transmit 44 h. p. by means of a belt traveling at a speed of 5000 ft. per minute, the width of single belt required may be found by measuring the distance between 44 h. p. and 5000 and then measuring an equal distance to the left of the 44 h. p. point. In this case it will be found that a 7-in. belt is sufficient. In a similar way the belt speed can be determined where the belt width and horsepower are known. This chart is based on the well known rule of thumb: A single leather belt, 1 in. wide, running at a speed of 800 feet per minute will transmit one horsepower.—*Machinery.*

QUICK SETTING MACHINE VISE

THE vise we illustrate is an English one. The movable jaw of the vise is the inner one, the reverse of the usual practice. The vise-screw end enters the hole in the movable jaw. A plate is riveted to the back of the jaw which, when dropped, covers the hole. To force the movable jaw forward, this plate must be dropped. To open the vise, all that is necessary is to turn the screw back a quarter of a turn. The plate is then swung upwards, exposing the hole and the jaw can be pushed back by hand. When the work is replaced between the jaws, the movable jaw is pushed forward until it is in



Quick setting machine vise

contact with the work. The plate is dropped down and a quarter turn of the screw locks the work fast. It is evident that, where a number of pieces of the same size are to be worked in the vise, there will be a great saving of time in its use.

It is often an object to have a source of illumination truly reproducing daylight for comparing colors and perhaps for other purposes. Considerable attention has been excited by the Sherningham daylight reflector, which is simply a reflector covered with little squares of different colored papers, which are so selected as to give a true daylight effect.

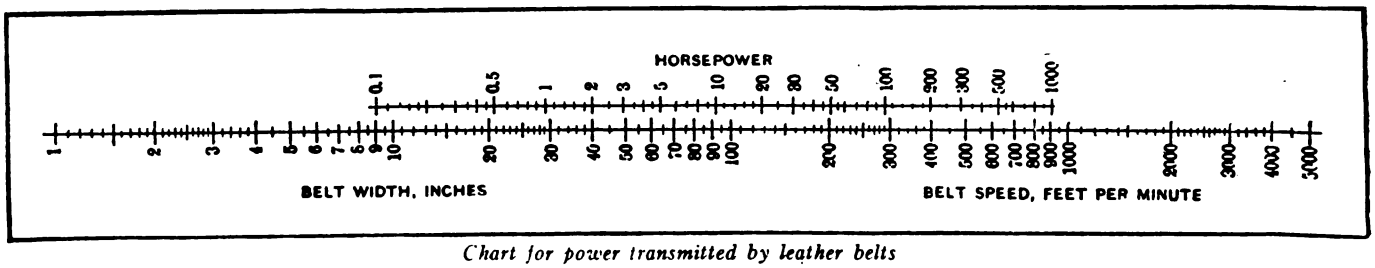


Chart for power transmitted by leather belts

Digitized by Google

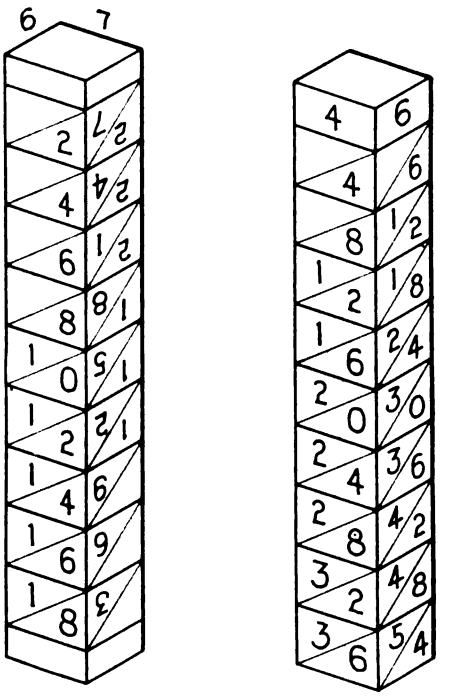
Napier's Rods and their Use

By Prof. T. O'Conor Sloane

JOHN NAPIER of Merchiston, Scotland, born 1550, died 1617, is distinguished for all time as the inventor of logarithms. This is a capital claim to distinction for it is hard to say how trigonometry calculations could be performed in any reasonable time and without the aid of absolutely unwieldy tables, were it not for the conciseness of logarithmic methods. For years the discovery of a method of determining the longitude at sea was an unsolved problem, and was in the class with perpetual motion and the squaring of the circle. The mechanical solution came from the production of the chronometer. But to use the chronometer a calculation in spherical trigonometry has to be made for every observation. Two or more such observations are taken in a normal day at sea; the navigator has to solve a spherical triangle morning and afternoon and often at other times, in the evening when twilight enables him to see the stars and to distinguish the horizon. In the routine of navigating a ship Napier's great invention, logarithms, are in constant use to bring the ship across the ocean and into port.

We illustrate one of his inventions, on which he set great store, although now it is nearly forgotten, Napier's Rods or Bones. They are designed to facilitate multiplication. They are strips of bone, ivory, wood or even heavy cardboard. They may be from a quarter to half an inch wide, and about ten times as long as wide. Each one takes care of one of the multiplications of the multiplication table; two times up to twice nine, three times up to three times nine and so for the rest. As shown in the cut, each rod is divided into squares, and a diagonal line is drawn from corner to corner of each square, from the upper right-hand to the lower left-hand corner. At the top of each rod is placed the number by which the nine units are multiplied on that particular rod. Then in the upper divided square and below the diagonal line is placed the unit multiplied.

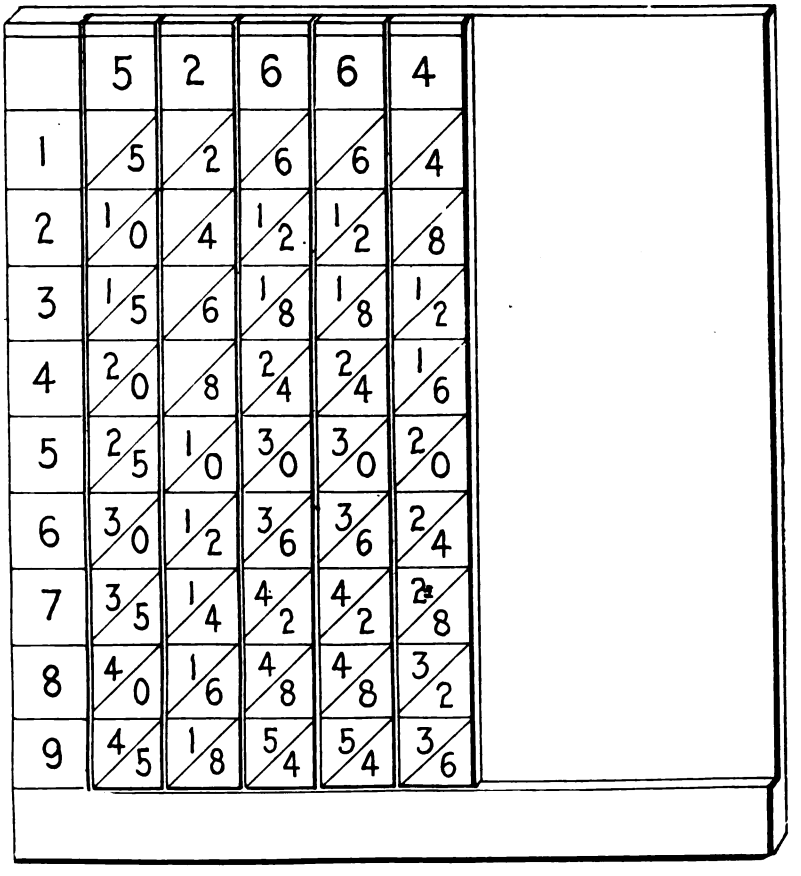
This is taken as "one times" the number at the head of the rod. In the next lower square is placed "two times" the same number and then "three times" and so down the rod in the successive squares. When numbers are reached which contains tens, such as 24, 36 and the others of two digits, the unit figure is placed below the diagonal and the tens figure above it. As many of such rods as needed are to be made, in general terms the more the better. Then there must be a master rod, which contains in its nine squares, the upper one being empty, the nine digits in their regular order. A very convenient accessory is a board or tablet of wood or heavy pasteboard. A strip of the thickness of the rods is glued along its bottom, and another one at right angles to this at the left side and on the strip at the side is glued the master strip, with the bottom of its lowest square exactly even with the top of the bottom strip.



How square rods were numbered

To use the rods such are selected as are headed by the numbers of the multiplicand. They are put on the board as shown in the cut in proper order. Suppose they are to be multiplied by 7. The horizontal row of squares on a line with the seven square of the master rod contains the products of the digits of the multiplicand by 7. Suppose the number to be multiplied, the multiplicand is 37564. For the right hand figure of the product put down the unit figure of the square of the rod headed by 4, which square is opposite the number 7 of the master rod. This figure is 8. For the next figure add the tens figure of the same square, which figure is 2, placed above the diagonal as explained, to the unit figure of the square on the immediate left, which figure is 2, the unit figure of 42. This square is on the next rod, the one headed by 6. Adding these figures gives 4, the second figure of the product, which is 4. In this way we follow along the horizontal row, adding tens of the right-hand squares to units of the left-hand adjoining squares. 4 added to 5 gives 9, the next figure of the product. Sometimes there is one to carry. Thus in the particular multiplication we are supposed to be doing, after the addition of 4 to 5 comes the

(*Continued on page* 360)



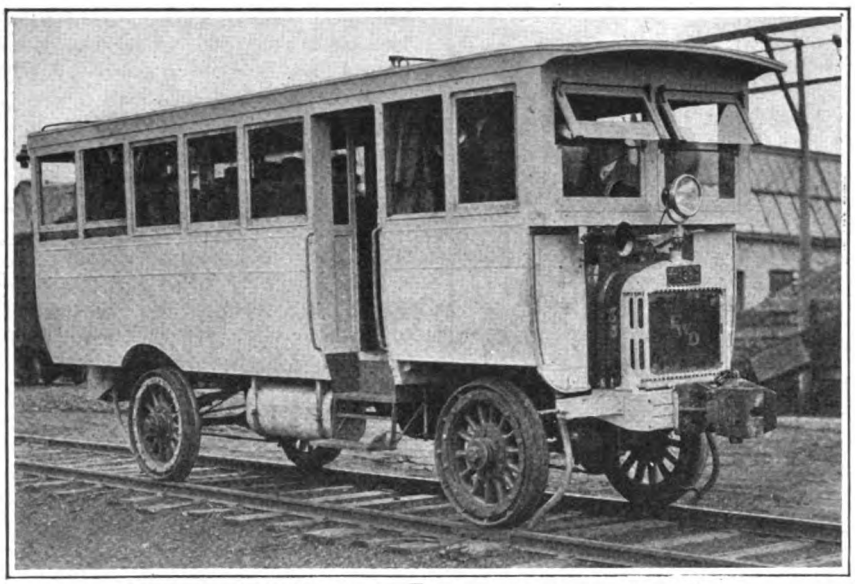
Arrangement of Napier's rods on a supporting frame for doing multiplication

Digitized by Google

EVERYDAY MOTORIST

MOTOR TRUCK FOR RAILS

THE increasing interest of railroad heads in the use of motor trucks to facilitate freight and passenger transportation on short hauls is evidenced in the recent addition of motor



Motor truck fitted with flanged wheels for short railroad lines

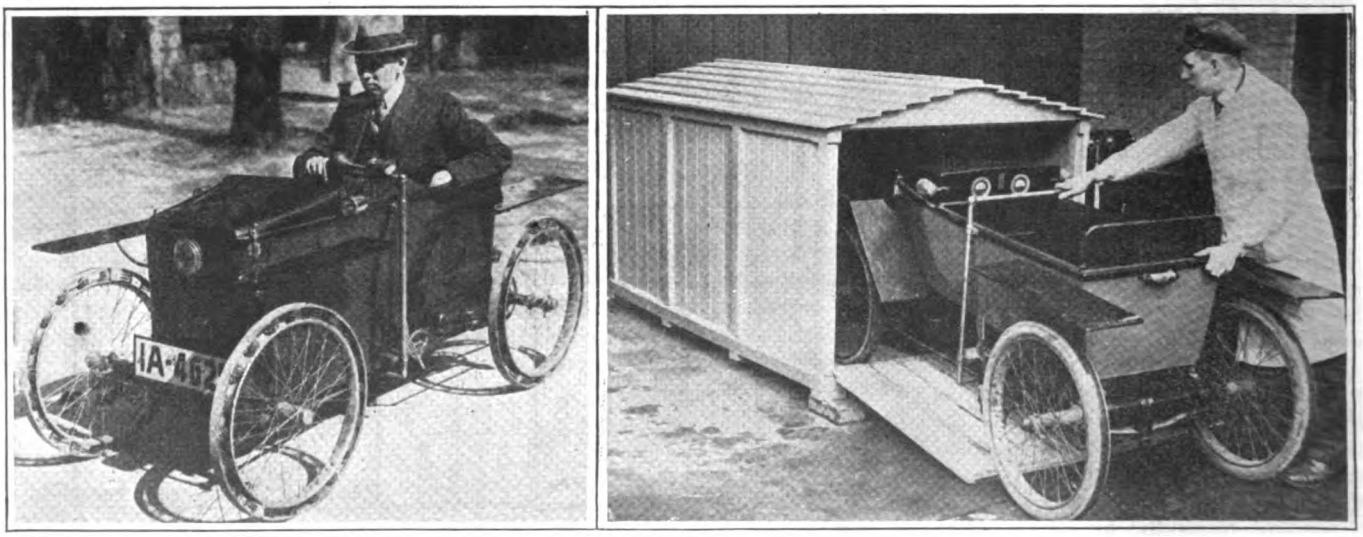
lines by several roads. Prominent among these is the Palatine, Lake Zurich and Wauconda Railroad, which is using a 3-ton truck, equipped with flanged wheels and passenger body on its 16-mile track from Wauconda to Palatine, Illinois. The truck, which has a capacity to care for 30 passengers, also hauls a trailer loaded with freight and baggage weighing 5 tons. When not pulling a trailer the round trip of 32 miles is made on 6 gallons of gasoline. At one point on its route the truck climbs a seven per cent grade with full load. It is operated continuously from morning until night.

Whether or not the railroads, with their return to private ownership will universally adopt the motor truck as an aid to their freight and passenger hauls is a question that is at present uppermost in the minds of truck manufacturers. It is the opinion of some that with a resumption of the old time competition the railroads will add motor trucks to their transportation system in an effort to get all possible business, rather than see it go into outside hands. The motor truck of the type illustrated would seem to be specially well adapted to short lines that cannot be operated profitably with steam or electric power.

NEW GERMAN ELECTRIC AUTOMOBILE

ONE of the late developments in Germany is the small automobile which is illustrated herewith and which has been developed to meet a need for urban transportation that exists on the part of a large portion of the public which cannot afford to pay the very high prices now asked for automobiles of conventional construction. This car is credited to Rudolph Slaby, son of the well-known Professor and wireless telegraph expert of Germany. The machinery in the car is extremely simple, as is the case with all electric vehicles. A person with little or no instruction can operate it because the current is supplied from batteries and is regulated by a simple controller and transmitted to the electric driving motor by simple wiring. It is claimed that the batteries supply current for four hours operation without recharging. The maximum speed of the car is 17½ miles per hour and the vehicle is so small that a garage not much larger than a dog house will accommodate it.

Because of the absence of the usual intricate propelling and speed changing machinery of the ordinary light car,



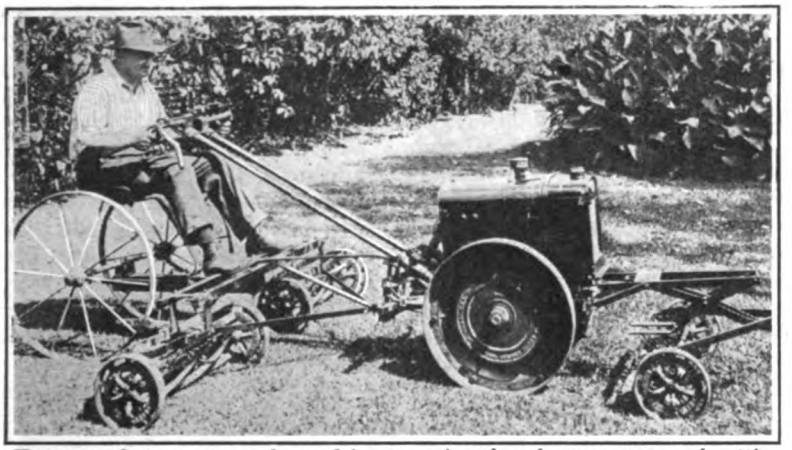
The illustration at the left shows a small electric automobile of German design suited for one person. Attention is directed to the steel spring and leather tire substitute for the usual pneumatic form shown at the left. The small size of the garage needed is clearly shown at the right

Digitized by Google

there is ample room for an adult in the small vehicle body. Steering is by a simple tiller carried at one side of the driver's seat, a method that was used in this country for many years in connection with electric vehicle control, and that is still found on a few types.

MOWING LAWNS BY POWER

MUCH of the mechanical progress in industry has been due to the limited capacity of the human being for work and also the fact that the average person does not enjoy exhausting himself in doing work that can just as well be done by machinery. This has resulted in the development of various interesting forms of labor-saving machinery in our shops and factories. It is only in recent years that machinery has been applied generally to outdoor work, especially in doing relatively light work. The accompanying illustration shows a new garden tractor which is used for many odd jobs about the small farm and can be employed for cultivating and other garden work. The addition of the lawn mower mechanism to the garden tractor makes it suitable for mowing lawns with much less physical exertion on the part of the operator than the usual method and also makes it possible to do considerably more work in a given time than can be done with either hand operated or horse-drawn lawn mowers.

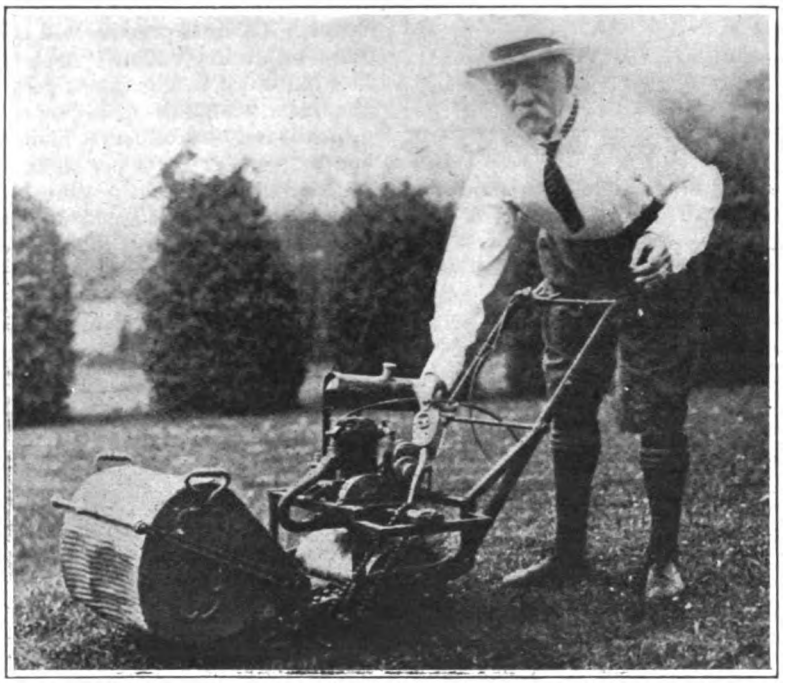


How a garden tractor can be used for operating three lawn mowers and cutting a wide swath

The other power mower shown is the invention of Admiral Sir Percy Scott, a well-known British seaman, and is very simple in design and construction. Power is furnished in this case by a small air-cooled engine, similar in construction to the types used on motorcycles. In deference to the vogue of the "Motor Scooter" which is being widely used in England, the new machine has been called "The Lawn Mower Scooter." While conventional types of power driven lawn mowers may be obtained in this country at low cost, those of our readers who are interested in making their own mechanical appliances can get ideas of value from the two types of power lawn mowers illustrated.

STEEL DISK WHEELS POPULAR

THERE is a growing tendency on the part of motorists to favor the pressed steel disk wheel and increasing numbers of fine cars are being equipped with traction and support members of this type. The wheel used for passenger cars is a single disk type, being dished for strength. In most designs the thickness of the metal is greater at the center than at the rim, thus proportioning the section to the strain coming upon it. A cast-steel master hub is fastened to the axle, and the steel disk is attached to this by four easily removable nuts which screw on studs in the permanent hub flange. The disk wheel is as easily removed as any other type and is stronger and more easily washed than the conventional wood or wire spoked forms.



Admiral Sir Percy Scott, a retired British seaman, has invented a simple lawn mower and roller propelled by a motorcycle engine

---

During warm weather, be sure to watch the lubrication and cooling systems. Keep fan belt tight, radiator filled with water and be sure to use the proper grade of oil.

PRODUCER GAS FOR MOTOR VEHICLES

A BRITISH committee in a report on the use of gas as an automotive fuel enumerates three possible systems of making gas from plant carried on the vehicle itself, and, in the case of one of these, drawings are given of the arrangements. Such plants, it is stated, can be made to work automatically, after the necessary attention of lighting up. Their fuel cost, with coke at $9 a ton or anthracite at $11 a ton, is equivalent to gasoline at 8.6 cents per U. S. gallon. One hundredweight of coke or anthracite will, on the average, do the same work on the road as 5 or 6 gallons of gasoline, and the weight of generator and accessories for a 30-b. hp. engine is about 220 lbs.

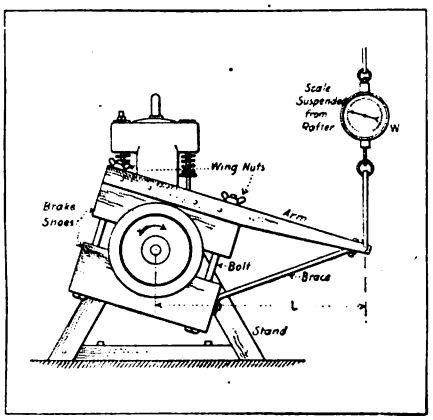
The risk of escape of unburned carbon monoxide gas from a suction gas producer on a motor vehicle is not such as to call for special precautions, except when the vehicle is at rest within a closed structure with the fire still burning in the producer. The water feed to a portable suction gas producer can be so adjusted as to increase the calorific value of the issuing gases by as much as 50 per cent on a consumption of water, falling as low as 25 per cent by weight of the simultaneous combustion of coke or anthracite. In an ordinary motor vehicle engine, unaltered structurally as regards the compression space, the power-yield, on the basis of 100 for gasoline, may on the average be taken as 91 for town gas of 450 B.t.u. gross per cubic foot, 97 for suction-producer gas (partly hydrogenated with water gas) of 210 B.t.u. and 82 for suction-producer gas of 140 B.t.u. heating value.

Digitized by Google

How to Test Engines for Horsepower

By Adrian Van Muffling, M.S.A.E.

IT is often desirable, or even necessary, to know exactly how many horsepower a certain motor develops, as in the case of automobile or marine motors that have been "fixed up" with a view to increase the power output for some reason or other. The usual (and easiest) way is to send the motor to some established testing station or to a concern which is known to have the necessary outfit for the purpose. This method is very expensive. Unless the power is unusually large, however, such tests can be quite accurately performed by anyone who is able to rig up a suitable stand, and who commands the most elementary notions of mechanics. The



Simple Prony brake

purpose of this article is to show how such tests can be performed with comparative ease and little expense.

As nearly everyone knows, a horsepower is defined as being equivalent to 33,000 foot pounds per minute—that is to say, the work done in lifting a 33,000 pound weight one foot (or 33 pounds 1000 feet, or 330 pounds 100 feet, etc.) *in one minute.* The problem of finding the horsepower of a given unit then resolves itself to this: Find out how many pounds it will lift and how many feet per minute. Multiplying the two values together will give us the number of foot pounds (Ft. Lbs.). Dividing the result by 33,000 will give us the H.P. There are three ways of finding the foot pounds developed.

Prony Brake Test Simple

The first is the familiar "Prony brake test." The motor is firmly mounted upon a stand, which should preferably be bolted on to the floor, or at least be heavily weighted to avoid tipping over. If the motor is provided with a moderate size flywheel this may conveniently be used, but if it is very large, a pulley should be fitted for the brake shoes to press against.

The shoes are made of hard wood, cut out on a band saw so as to encircle at least 9/10 of the circumference of the flywheel. Two long bolts are then mounted so as to pass through the shoes and permit tightening up of the brake while the motor is running so as to apply the load gradually as the speed is increased. Wing nuts are excellent for this purpose.

One of the shoes has attached to it a strong arm of wood or metal, so placed that it will not bend, and which is about four feet long. The line between the shaft center and the point at which the scale is attached must always be horizontal, or nearly so, and is made to exert a pressure upon a pair of scales either of the platform type or an ordinary spring balance suspended from a rafter. A revolution counter of any suitable form completes the outfit.

The method of performing the actual test is as follows: The motor is first started and allowed to "warm up" at moderate speed, with the shoes completely released. When everything is ready pressure is gradually applied upon the brake by tightening the wing nuts while the throttle is gradually opened. (A little practice will be necessary to avoid "racing" or a sudden slowing down.) This must go on until the motor has attained its proper speed, which is most conveniently found by using the counter for a period of 10 seconds at the time, 150 revolutions being equivalent to 900 R.P.M., 166 to 1000 R.P.M., 200 to 1200 R.P.M., and so on. It is best to take short readings to avoid overheating the brake. When the motor is running at its rated speed (say 1200 R.P.M.) with throttle wide open, the actual test is made by measuring the number of pounds registered at the scale. Having this, we are through, and can proceed to calculate the H.P. of our motor.

What we must look for first is the actual distance that the end of the arm *wound* have traveled *if it had been left free to swing.* If the end was four feet from the center of the flywheel, the circumference would obviously have been $2 \times 4 \times 3.14 = 25.12$ feet.

In one minute it would have covered 1200 times that distance or

$$25.12 \times 1200 = 30{,}144 \text{ ft.}$$

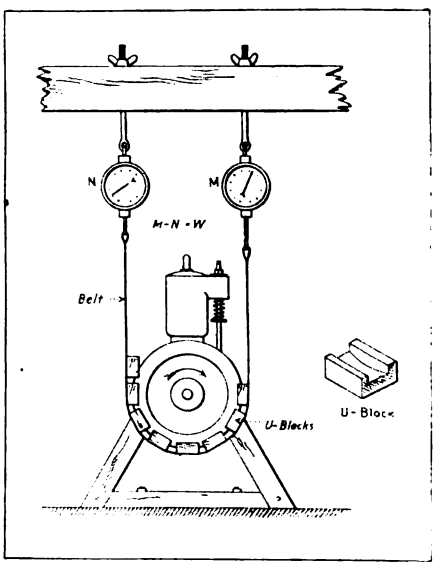
This is the distance through which the registered pull acted during one minute. Let us say for example that the scale was found to indicate 46. pounds. Then the number of foot pounds is given by $30144 \times 46 = 1{,}386{,}624$ foot pounds, which divided by $33{,}000 = 42.02$ horsepower.

It will generally be found more convenient to write all the factors involved in a formula as follows:

$$\text{H.P.} = \frac{2 \times L \times 3.14 \times W \times \text{R.P.M.}}{33{,}000}$$

in which L is the length of the arm *in feet* and W the weight shown by the scale.

During this test it will be found that the brake will heat up quite considerably. As this heat means a waste of power in the form of friction, it is evident that the test by this method is not entirely accurate. It should be noted, however, that as the power thus wasted is generated by the motor, and is not shown on the scale, the result will indicate a horsepower somewhat lower than the one actually developed. The error is thus on the safe side. To avoid undue heating the brake shoes are sometimes lined with asbestos cloth or brake lining. If the arm has a tendency to



Modified Prony brake

"chatter," that is, vibrates too much to permit an accurate reading, *a few drops* of kerosene will generally obviate the trouble.

Modified Prony Brake

The second testing method is a modification of the prony brake, and is sometimes more convenient, especially when the flywheel is large. It requires two pairs of scales and a long leather belt which passes around the flywheel, and is attached by each end to the scale. These are suspended from a roof rafter so as to allow the tension to be adjusted by means of wing nuts as before. Before the test is made the latter are drawn up until the tension of both legs of the belt is equal, say 50 pounds. The motor is started according to the procedure outlined above. It is obvious that the friction along the belt will increase the pull on one side while relaxing it on the

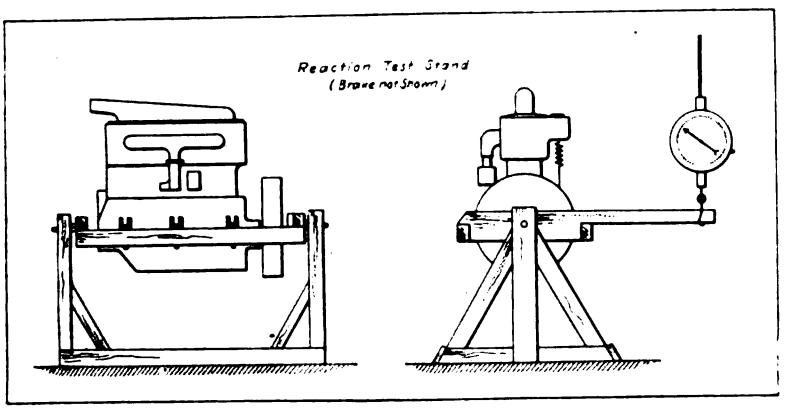
Digitized by Google

other. The total force is then indicated by the *difference* between the pulls on the two scales. This will be W in the formula, which can be applied just as before, excepting of course that the radius of the pulley now represents the arm, and consequently the value of L = Diameter of the pulley.

It may be found that the belt shows a tendency to slip off during the test. This can be obviated by interposing a number of small wooden blocks cut to a shallow U shape between the pulley and the belt, and screwed or riveted to the latter, the pulley being made to run in the channel of the U formed by the blocks.

be. But as the strength and dimensions of the club should be calculated, and as its use involves considerable danger (they have been known to fly apart and kill some innocent bystander), it is perhaps best to use a brake similar in construction to that described above, but now, of course, firmly bolted to the stand.

The test is performed in exactly the same manner as in the case of the prony brake, and the same formula can be applied, L being the length of the arm measure from the center of suspension of the cradle. If the arm is placed on the side of the cradle, which tends to go *downward*, the best way to measure the torque will be to suspend a known weight from its end, which can be increased or decreased until the arm remains perfectly horizontal, with the motor running at the required speed and under load. When many tests are to be made on different motors a simple calculation will enable one to calibrate the length of the arm so that the horsepower can be read off directly by the number of pounds necessary to balance the cradle.



Reaction method of testing horsepower

Torque Reaction Test

A better method by far, which requires a somewhat higher initial outlay but gives much more accurate results on account of eliminating all friction losses is known as the rocking cradle, or "torque reaction" test. It is based upon the fact that the reaction or "torque" of a motor is exactly equal to the motive force, and hence we get the same result whether we measure the turning force of the flywheel or the force which tend to rotate the motor around the shaft in the opposite direction. In order to be able to do this we must mount the motor in a cradle (of strong wood or iron), which is suspended into a framework so that it will rock along a line corresponding to the crankshaft of the motor. It will take a little ingenuity to suspend the motor in just that way, and it is most easily done by large ball bearings, which can freely pass over the crankshaft at both ends. When this cannot be done the suspension should be just below the crankshaft and as close to that as possible. This cradle is equipped with an arm attached to a pair of scales as before, with which the torque can be measured.

Next, the motor must be provided with a resistance, which may consist of a strong wooden club made up of laminations glued together and very carefully balanced and attached to the crankshaft as an aerial propeller would

EXTRUDED METAL

METAL wire and rod made by the extrusion process is coming more and more into common use, so that a little information about what the process is should be welcome. Wire and rod have been made for many years by the drawing process, in which the metal is pulled through dies, gradually reducing its diameter or shape. Volume of production by this process was limited, first by the fact that attempts to reduce the diameter of the wire too much at one draught resulted in pulling the metal apart; and second, by the fact that the frequent annealings necessary to soften the wire consumed time.

By the extrusion process, the metal is pushed through the die while quite hot. Thus are overcome at once the two limiting conditions mentioned in wire drawing; the wire cannot break because you don't pull on it, and it does not get hard because it retains its softening temperature during the extruding.

For lead extrusion the necessary outfit consists of a multiple plunger pump, a hydraulic accumulator for storing water under high pressure, and a hydraulic press with attachments. Briefly, these attachments consist of a heavy steel cylinder with a die-holding arrangement mounted on one end, the other end being adapted as to inside diameter, so as to form a close fit to the plunger or ram of the hydraulic press. In extruding lead wire a large piece of lead is put into this cylinder and the press started. Lead wire will flow continuously from the hole in the die until the ram reaches the end of its stroke. Naturally, some lead is left at the bottom of the cylinder, but the ram is withdrawn, another piece of lead put into the cylinder, and the ram started in again. Here is the interesting thing. During these two strokes of the ram there occurs no break in the lead wire; it is impossible to tell where the metal in the first piece of lead stops and that in the second piece begins.

In producing lead pipe a long arbor is used, the point of which enters the die in such a way as to make the orifice through which the lead must flow ring-shaped, or to be exact, shaped like a cross-section of the pipe.

Recognizing the possibilities of such a process, it was not long before experiments were tried, with the end in view of making brass rod, and wire by the extrusion process. Difficulties at once arose. It was found that to get any results at all the metal must be quite hot during the extruding; it was found that hydraulic machinery of great power was necessary; it was found that the dies suitable for lead extrusion would not stand up under the heat. However, these difficulties have been overcome and there are now a number of firms who sell extruded brass rod. One of the good features of this process is the practicability of extruding the brass through odd-shaped dies, to give a certain cross-section, very expensive to get by ordinary methods.

In discussing this process, it is interesting to note how interdependent all processes are on something else. Without the gas engine we would not have the automobile or the aeroplane; without the railroads we could not have big cities; without the powerful hydraulic press we could not extrude brass.—*Scoville Bulletin.*

The growth of trees has been registered by encircling the tree with an expansible ring, whose expansion operates an index, which records the movements on a revolving cylinder, thus making a graphic chart. The movement is multiplied by suitable gearing so relatively slight changes are magnified and made evident.

Digitized by Google

Largest American Airplane

Some Interesting Details of a Large Three-Motored Design for Commercial Work

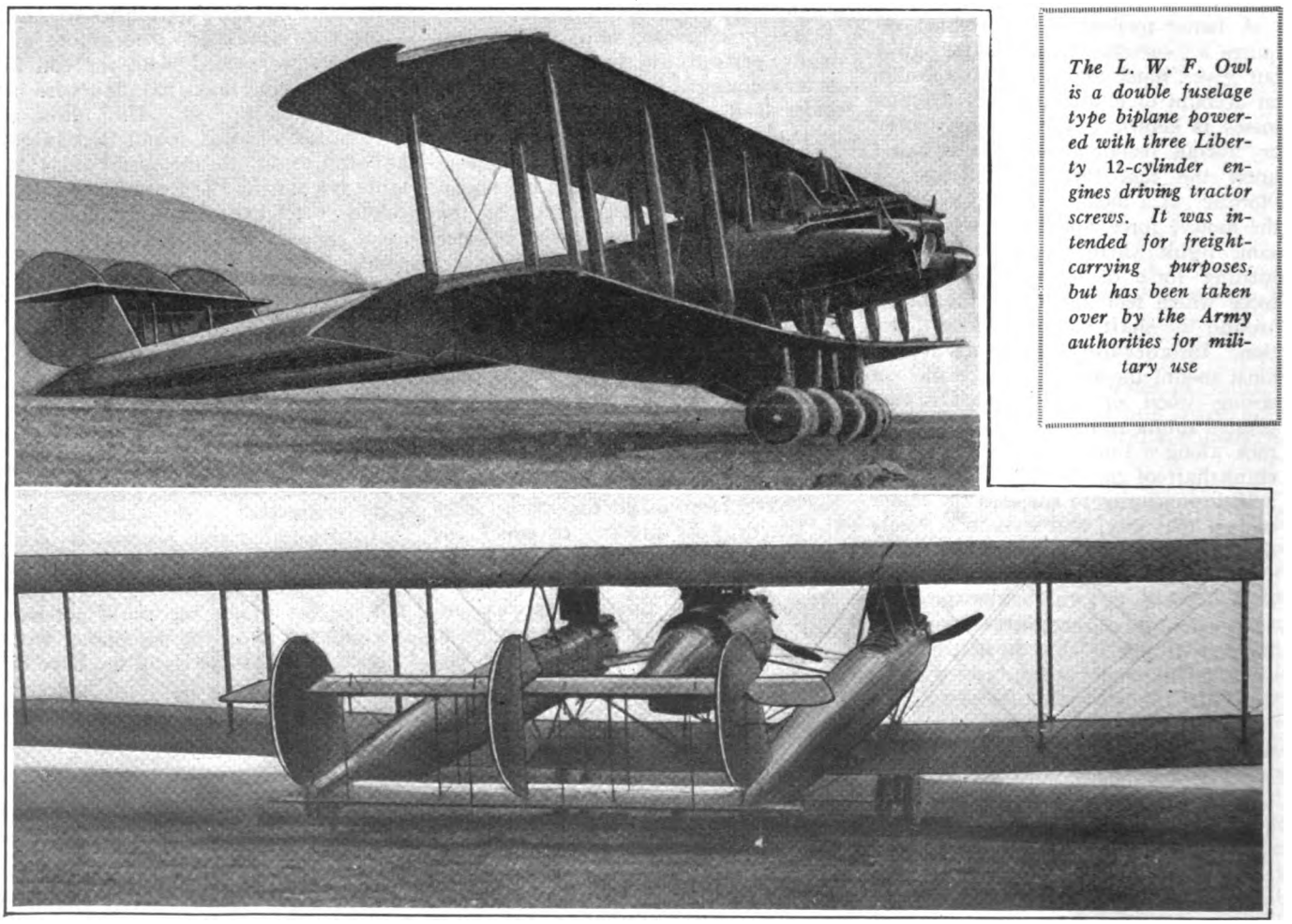
THE L. W. F. Owl is announced by its makers as being the largest freighter in America and one of the largest yet built. It was originally designed for the aerial mail service. It has a wing spread of 105 ft., being of biplane construction and an overall length of nearly 54 ft. The design is of the twin fuselage and center nacelle type. Three 400 hp. Liberty engines are used for power, one being mounted in each of the noses of the fuselages and nacelle. The machine loaded was designed to weigh ten tons and has a mail carrying capacity of 3000 lbs. on long distance flights or double that amount on shorter trips.

The crew and controls are located in the central nacelle while the two fuselages, constructed of laminated wood, carrying part of the fuel supply and the freight. Four persons comprise the crew, these being two pilots, a radio operator and a mechanic. At the maximum speed of 110 m.p.h., it is able to remain in the air for 10 hrs. or sixteen hours at a lower speed. Climbing ability with full load is claimed if only two of its engines are operative and it is designed to land at a speed of 56 m.p.h., which is reasonable.

Among the distinctive features of the machine are the monocoque fuselage and nacelle, the intercommunicating phones, the fuel and the fire extinguisher systems. The wing construction is of the usual truss type and consists of three upper and three lower panels of 11 ft. chord and equal spans with a gap of 11 ft. Each wing is equipped with balanced interchangeable ailerons. Ribs are built up first and then slipped over the beams, which are built up of four pieces, forming a hollow box section. The top and bottom of the box spar are of spruce and the sides of birch. The internal wire bracing is double, of No. 8 solid piano wire and 3/16-in. hard cable. All external wire fittings are applied directly to the beams and project through the covering.

The fuselages and nacelle are supported between the upper and lower planes on tubular struts thoroughly streamlined. Each engine drives a tractor propeller. The main load and crew are carried in the nacelle while each fuselage carries its complete motor plant and has a small auxiliary compartment for extra cargo. Each power plant is complete within its respective fuselage or nacelle and consists of a 12-cylinder Liberty engine equipped with Splitdorf ignition, electric starters and compression release. The radiators are above the motors, directly in the blast of the propeller and equipped with individual shutter controls.

The tail is of the biplane type, attached to the rear end of the two fuselages. It consists of two double cambered horizontal stabilizer planes superimposed, with elevators attached and a fin on the top of each fuselage followed by a balanced rudder. A third balanced rudder is installed midway between the two. The landing gear is of the six-wheel, two-axle type, with the outer two wheels side by side directly under the center of each fuselage and the other two wheels spaced equally between. The landing gear which is extremely well built is so placed that when landing the center of gravity falls sufficiently far back of the wheels to prevent any tendency to nose over. The great weight of the machine calls for shock absorbers of very large capacity, these being carried in streamline housings.



The L. W. F. Owl is a double fuselage type biplane powered with three Liberty 12-cylinder engines driving tractor screws. It was intended for freight-carrying purposes, but has been taken over by the Army authorities for military use

Digitized by Google

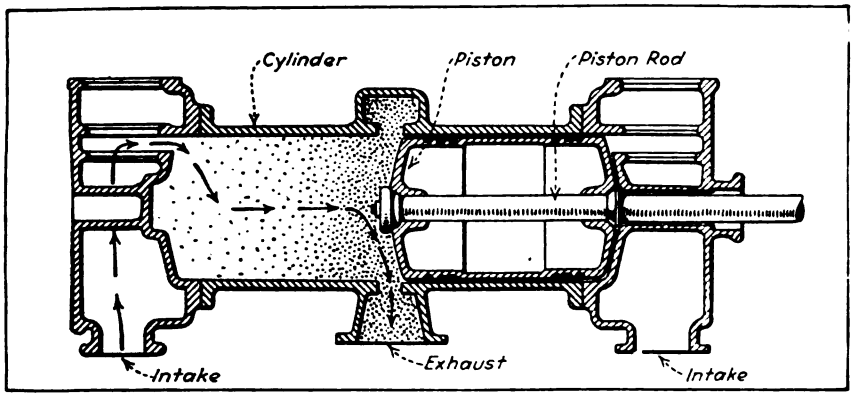
THE UNIFLOW STEAM ENGINE

THIS type of engine was described in a recent paper by Mr. Henry Billing, before the Manchester Association of Engineers, in England. It is a single cylinder engine, the steam actuating which, when it does move, moves in the same direction and in its expansion back of the piston may be taken as moving also in the same direction. The piston of this engine in total length is about 10 per cent less than the length of stroke and the cylinder itself is a little over double the stroke in length. Each end of the cylinder is provided with an inlet valve, which must be of rapid opening and closing action. Around the center of the cylinder, with its walls forming an external ring, is a steam conduit communicating with the exhaust. This conduit communicates with the interior of the cylinder by steam ports.

As the piston travels back and forth it uncovers these ports at the end of each stroke and they remain open for about one-tenth of the stroke. This feature is clear from the diagram of the cylinder and piston. There the arrow shows the course of the steam on the left end passing out into the exhaust. Referring still to the cut it will be seen that as the piston begins its return stroke the ports will be closed and no more steam can escape from that side of the piston. The piston now completes its stroke. The inlet valve on the left side stays closed while that on the right closes before the completion of the piston stroke, not only to give expansion but to close the steam inlet before the central ports are opened. As the piston completes its stroke it uncovers the central exhaust ports this time on its right end and the greater part of the steam which has actuated it rushes out through the exhaust.

In each stroke a certain amount of steam remains in the idle end of the cylinder and this is compressed by the piston forced against it. The action of the exhaust port is quite comparable to that of the auxiliary outlet port sometimes used in internal combustion engines of the four-cycle type.

The Uniflow engine condenses less steam inside the cylinder than does a compound engine, because the temperature of the walls of the cylinder is kept hot. The exhaust ports are open only a fraction of the time given in a compound engine, and it is precisely this loss by internal condensation which has been a source of bad economy in steam engine practice. The engine has more or less definite limitations. Thorough condensation is needed so there must be plenty of condensing water and the direction of rotation must be continuous. The author of the paper says that for reversing engines, such as those used on steam windlasses, other types of engines are usually to be preferred. He states that he is at work on a very large engine, one of 60 inches diameter of cylinder and of six feet stroke.



Construction of Uniflow steam engine cylinder

GAS MASKS IN PULP AND PAPER MILLS

GAS masks of a nose-breathing type with canisters containing special chemicals are used in the digester house of the Forest Products Laboratory to give protection against sulphur dioxide. These masks enable the operator to make repairs under conditions otherwise unbearable and soon pay for themselves in time saved. Masks of this type are reported by the Bureau of Mines to hold up against a 5 per cent concentration of sulphur dioxide for about 15 minutes. When it is realized that 5 parts of sulphur dioxide to one million parts of air can readily be detected, and that at a concentration of 150 parts of sulphur dioxide to one million parts of air the air becomes unbreathable, some idea can be gained of the life of a canister even under adverse mill conditions. In addition to their use in the sulphite mill, these masks are of great assistance in the bleach room, where they are worn continuously during the mixing of the breach liquor. Aside from monetary considerations, the increased comfort and safety of the workmen is sufficient argument in favor of the addition of gas masks to the regular mill equipment of up-to-date plants.

PICKLING AND CLEANING CASTINGS

IRON castings that require machining must have the scale and sand removed. The common practice for doing this is to subject the castings to what is known as a "Pickling Bath." Iron castings are usually pickled with sulphuric acid and hydrofluoric acid, the former being commonly used. The pickling solution is usually made up of 1 part sulphuric acid to 10 parts of water. When the scale is loose the castings should be washed in hot water and if the castings are small it is well to immerse them in a soda solution for a short time, to thoroughly neutralize any acid. Hydrofluoric acid is usually sold in three grades. The first contains 30%, the second 48%, and the third 52% acid, the balance of the solution being water. The 30% solution is what is usually employed for pickling castings and 1 gallon should be mixed with 20 to 25 gallons of water. Hydrofluoric acid does not act upon iron appreciably but it does dissolve black oxide of iron and sand and dissolves them. The castings pickled in sulphuric acid solution have a dull or black surface. Those pickled in hydrofluoric acid have a whiter and silvery appearance. The castings pickled with hydrofluoric acid have a much smoother surface and for that reason whenever parts are to be polished or nickel plated, the hydrofluoric acid is used. The hydrofluoric acid bath is always used cold but must be kept up above the freezing point. The workman should always use rubber gloves when handling hydrofluoric acid, and if any is dropped or splashed on the skin, it should be washed off promptly with water and diluted ammonia.

Brass castings may be cleaned by mixing 3 parts of sulphuric acid and 2 parts of nitric acid by weight and add to 1 quart of the mixture about a handful of common table salt. While this mixture is frequently used without being diluted with water, it must be handled with care, as it will attack the human skin. This pickling solution must be kept in an earthen-ware crock. Hydrofluoric acid must be kept in a lead carboy but diluted acid may be kept in wooden tubs or vats. Hydrofluoric acid must not be kept in glass bottles, because it will eat glass, but in rubber bottles.

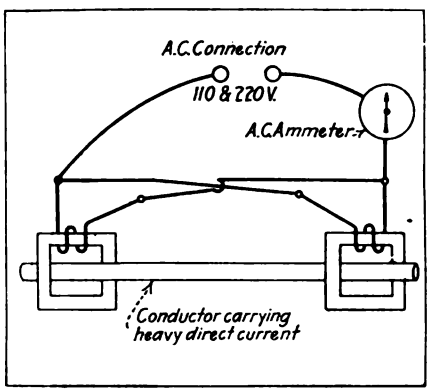
The peeling of lacquer is usually caused by the imperfect cleaning of the metal surface before lacquering, although it may be caused by the use of a lacquer not adapted for the purpose. Lacquers containing "gums," in addition to the regular pyroxylin base, hold more tenaciously, although not as tough as a straight pyroxylin lacquer.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

METERING DIRECT CURRENT

An interesting system of metering heavy direct current involves the use of soft iron cores surrounding the electric conductor. Each core is a ring or rectangle and they are operated in pairs; on each one of the cores wire coils are wound which connect to an alternating current ammeter. An alternating current is passed through these



Metering heavy direct current

coils and through the ammeter. If no current is passing in the main electric conductor, the coils choke back practically all the alternating current. If current is passed through the main line, which threads the coils, the cores become magnetized, passing lines of force, and the choking effect of the cores and coils on the subsidiary alternating current is decreased. Therefore, as more and more current passes through the main line more current in exact proportion thereto is recorded or registered by the ammeter on the alternating current line. The alternating current is very small, of course, compared to the main current so that a small instrument can be used to measure a current of great intensity.

HAVANA CENTRAL STATION TO DOUBLE POWER-PLANT CAPACITY

ON account of a rapid growth of load and the possibility of a still further growth in the next few years, the Havana (Cuba) Electric Railway Light & Power Company has just ordered two 25,000 kw. Westinghouse steam turbine-generators to double the plant rating. At present there are, in this plant, three 12,500 kw. generators supplying a combined railway and power load. In the original installation, space had been provided for only one additional unit, but now that the load has become so great it was thought necessary to increase the capacity still more. Consequently the two 25,000 kw. units were ordered, one to be installed in the space available, and the other to replace one of the 12,500 kw. units. By this means it is unnecessary to extend the power plant buildings. However, the 12,500 kw. unit is in perfect operating condition and will probably be utilized elsewhere.

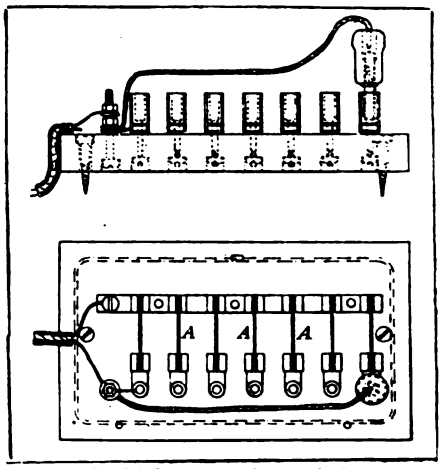
The first unit will be installed and will be in operation in 1921 and the second one will be on the line in 1922. The units are to be designed to operate at 185 lbs. pressure, 150 deg. superheat and 28 in. vacuum. In addition, arrangements have been made to operate this equipment at higher pressure and superheats if desired at a later time. To go with these turbine-generators, Westinghouse-Le Blanc 56,000 sq. ft. surface condensers and Le Blanc air and circulating water pumps have also been ordered. Each condenser will have two circulating pumps and divided water boxes so that one-half of the condenser may be cleaned while the other half is in operation. This station, which is the largest in Cuba, is modern in every respect and has an operating economy which is comparable with some of the best plants in the United States. The average fuel consumption is less than 2 lbs. of coal per kw. hr. notwithstanding that the plant has a low load factor. This economy is due to the excellent operation and maintenance afforded by the management and operating engineers of the plant.

WATER POWER IN ITALY

ITALY'S lack of coal is often cited as a handicap to the industries of the country, but, in view of the water-power available for producing electricity, coal may largely be dispensed with. The Fiat motor works, which are said to be the largest in Europe, employ no coal whatsoever for driving machinery, being supplied with electricity generated by water-power in the Alps. Even the steel works and forges are operated entirely by electricity. The hydro-electric generating plant is situated on the Cenischia River, and by large extensions to the plant, and by increasing the size of the natural lake on the top of Mont Cenis, it is estimated that a current of 200,000,000 kilowatts will shortly be available.

MULTIPLE CONNECTION SWITCH

THE switch illustrated in our cut is designed to prevent more than a certain amount of current being taken from a connection. A series of plugs are provided, each of which has its fuse, which blows out with an excess of current. The set of plugs and fuses are to be enclosed in a locked box. The



Multiple connection switch

person using the system can only take as much current as the particular fuse appertaining to the plug will pass without blowing. Should more current be required, the proper person must be notified, who will unlock the box and effect the desired connection. The inventor considers it adapted especially to such service as that of a hotel room.

AN 11,000-VOLT SUBMARINE CABLE

FROM the Teknish Ukeblad, we learn that a Swedish firm has supplied two high-tension cables for the Skars power station near Kristiansund, in Norway. Each cable is nearly two miles long and weighs 52 tons. It has a sectional area of copper wire of 350 square millimeters in three separate conductors. These are insulated with impregnated paper and compressed to form a cylindrical cable, wound with impregnated paper and surrounded with a 3/32-in. thick lead tube. This is further strengthened with impregnated jute, galvanized steel wire, and a final coat of impregnated jute. The diameter of the finished cable is 2½ inches. This cable was tested in the factory with a pressure of 40,000 volts, and when placed in position it will again be tested to a pressure of 25,000 volts.

Digitized by Google

VACUUM REGULATION OF X-RAY TUBES

A VACUUM tube subjected to constant or long prolonged discharges, as in X-ray practise, acquires a higher vacuum with time; it is said to become "hard"; this increases its penetrative power but reduces its actinic power, it does not work well in photographing objects, and is inferior from the standpoint of radiography. Now good radiographic power is what is demanded in modern X-ray work, so means have to be provided to add gas to a hard tube when it becomes unsatisfactory in photographic power and quality.

In Fig. 1 is shown the Bauer valve, by which the operator can admit gas. The bent tube seen in the interior of the larger tube contains mercury; in the small outlet tube attached to its left-hand limb at the center is a plug of porous substance, which may be carbon. Air can make its way through it but mercury cannot. To admit air so as to diminish the vacuum, air is pumped in by hand through the jet or nipple seen at the top of the larger tube; this depresses the mercury in the left-hand limb of the manometer tube, for this is what the inner tube really is; the porous plug is exposed and air slowly enters into the X-ray tube, which is connected to the lateral nipple of the large tube. When enough has entered the pressure is released and the mercury rises and once more covers the plug and the air is cut off.

In Fig. 2 is shown an automatic valve for doing the same thing and on the same lines. In it the mercury in the manometer tube is acted on by pressure of the gas or air in the bulb, A. At E is the porous plug; if the air in the bulb is heated the mercury sinks from C to D or thereabouts, the plug is exposed and the air slowly enters through the nipple, B, into the X-ray tube. If the heat in A is reduced the mercury rises and shuts off the plug so that no more can enter. Fig. 3 shows the connections in the case of a Coolidge tube. The valve is in parallel with the tube; as the tube grows hard its resistance increases, more current goes through the bulb, A, and the gas is heated. As the tube gets softer its resistance diminishes, less current goes through A and the gas in the bulb cools, the mercury rises again and shuts off the plug. This valve is the subject of a recent British patent.

On the west coast of Norway, a region familiar to North Cape tourists, efforts are being made to introduce wireless telephone lines. Norway has long depended on its telephone system for this region, where there is no railway communication whatever, and where much of her population is distributed.

Domestic electric heaters for boiling water and similar functions have had their efficiency examined. The radiant hot plate heater is about 40% efficient and the enclosed hot plate system is slightly inferior to this, but for high efficiency the self-contained kettle with its own resistance coil shows double the efficiency or more of the best of the others. As high as 95% efficiency has been credited to it.

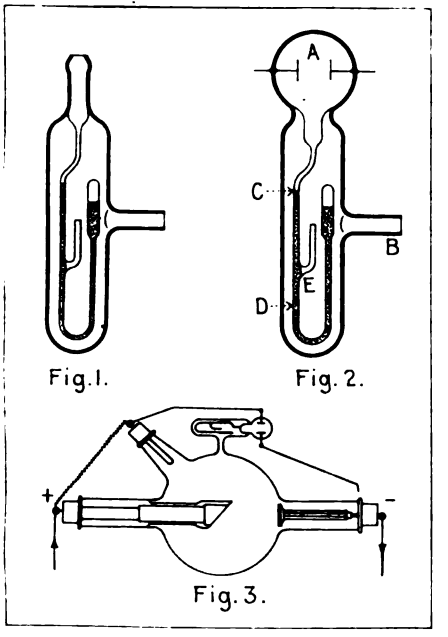


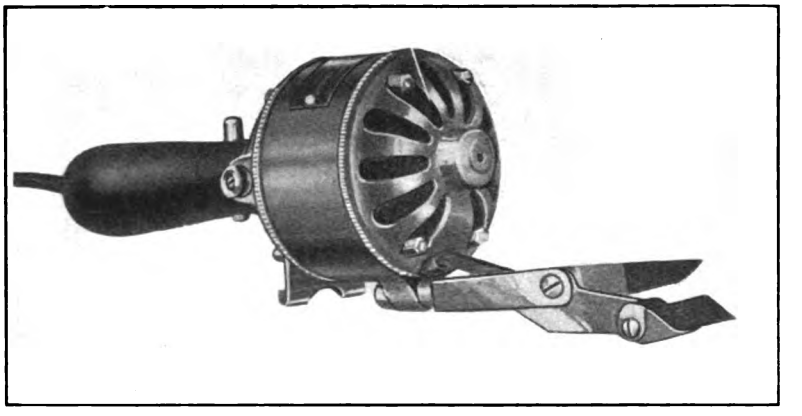
Fig. 1. Fig. 2.

Fig. 3.

Vacuum regulation of X-Ray tubes

ELECTRIC SHEARS

ELECTRIC shears are on the market driven by a motor which rotates at the rate of 9,000 revolutions per minute. One of the blades is stationary and the other vibrates at 9,000 oscillations to the minute. Its amplitude of motion is only one-sixteenth of an inch, which is a great element of safety for the operator. It will cut the finest or the coarsest fabric, and on account of the small amplitude of motion, it cannot cut the operator's hand or finger. Cloth to be cut must be pushed down toward the hinge of the shears.



New Sperry electric shears

A NEW ELECTRIC VEHICLE

SOME time ago Dr. Charles P. Steinmetz, whose name is so well known, announced the consummation of his many years of study and experimentation in electric vehicles in the form of a light-weight electric truck. The new vehicle is distinguished from the conventional types by the method of motor control, which gives compound characteristics to the motor by a storage cell floating on the field circuit. The result of this control is claimed to be speed maintenance, quick starting, power saving in the field at large currents and the feature of regeneration both on down grades and on stopping. The field and armature of the motor revolve in opposite directions, each driving one of the car wheels. In this way motor weight is saved, the differential is eliminated and the truck is as a result simpler and more compact.

In England one of the London Companies has put upon the market a portable electric rivet heater. It works on the principle of the electric welder with its transformer. The rivets to be heated are placed between spring-adjusted jaws completing a secondary circuit. Two minor features are that the heat is produced primarily in the central axis of the rivets and the point of the rivet which is the part to be expanded receives the greatest heat because the resistance is greatest there and because the greater mass of metal in the head keeps that from getting so hot. The effect of this is to put the heat where it belongs at the end of the rivet, to keep the head cool and to prevent scaling of the surface. A ¾ in. rivet can be heated in 20 seconds or less to higher temperature than is desirable. In normal operation a 23 kilowatt machine will appreciate such rivets up to riveting heat in 10 seconds and a British thermal unit will heat 19 such rivets. At English rates this figures out 10c a hundred rivets. The primary circuit is broken when the rivet is removed from the jaws.

Digitized by Google

Special Appliances for Expediting Automobile Repair Processes

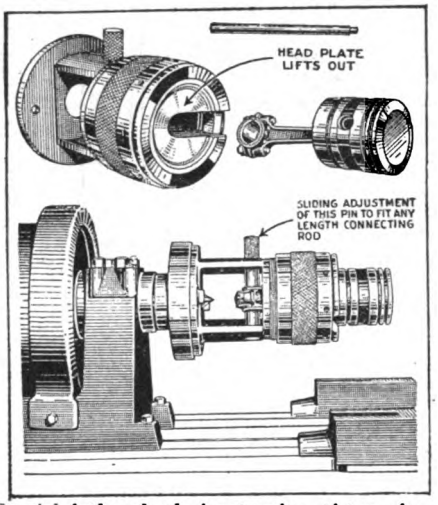
A Description of Some of the Tools and Devices Developed to Aid the Automobile Repairman by Reducing Time and Labor Required to Do Work Efficiently

By Victor W. Pagé, M. S. A. E.

THE production of enormous quantities of popular priced automobiles has created a new industry and that is the production of special tools, jigs and fixtures for making repair work easier on such makes of cars as are sold in quantities. In the early days the repairman was forced to make his own special fixtures because none were obtainable on the market and it was not often a profitable thing to do because it was seldom that enough automobiles of one make would be received for repairs to warrant the expenditure of money and labor. Now conditions are changed and so many cars of certain popular makes such as the Ford and the Overland are used in even small communities that almost any service station is justified in stocking certain fixtures.

Even the smallest shop should include valve head and valve seat reamers, valve grinding tools, bushing extractors, gear pullers and other devices of that kind. Shops of greater pretensions can now obtain engine supporting stands, special cylinder boring tools, rebabbitting jigs, piston chucks and vises, connecting rods, aligning and rebabbitting fixtures and numerous others that reduce labor and repair costs and yet that can be procured at much lower cost than they could make the devices in their own shops because they are the product of manufacturers specializing on such tools and appliances.

The Ekern motor stand illustrated herewith is one of the handiest devices



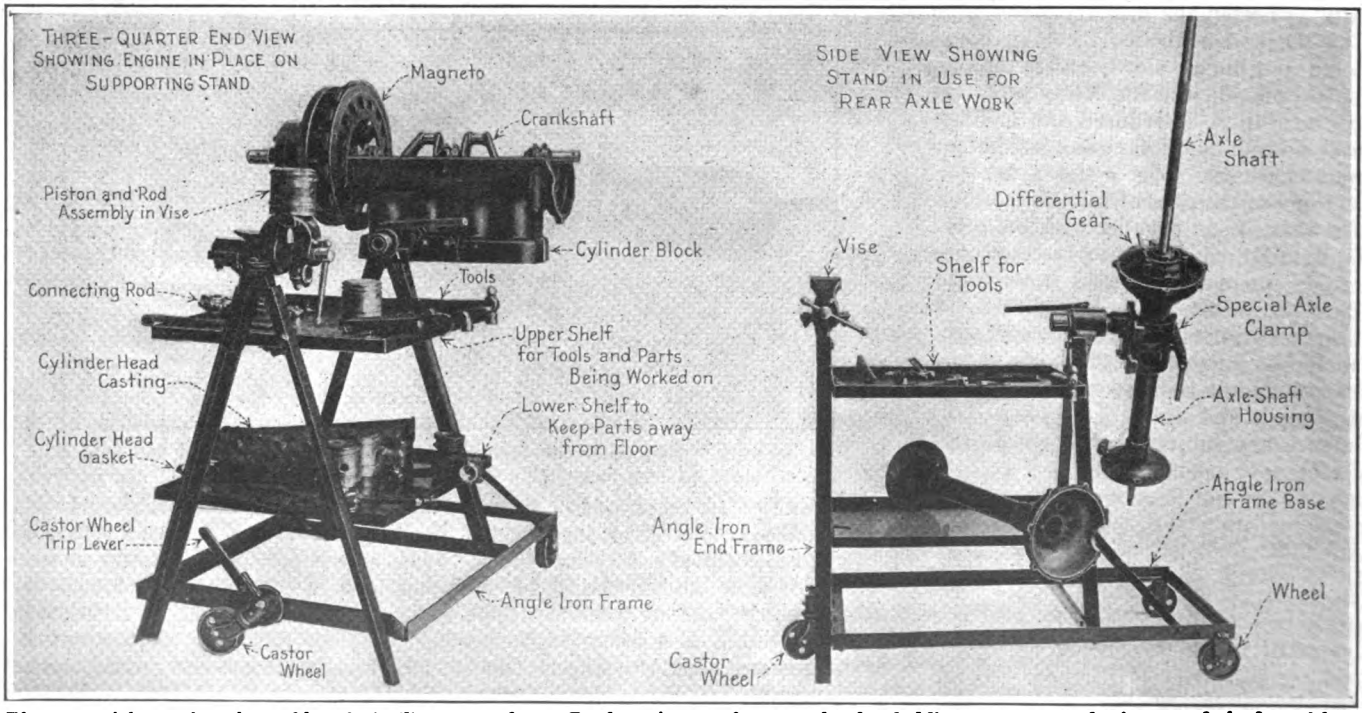
Special lathe chuck for turning piston ring grooves

of its kind for use in shops and garages doing Ford car work. The Ford motor, when taken from a car, can be fastened to the stand by the two cap screws which screw into the side of the motor where the water inlet connection is fastened. The stand is so constructed that the part screwed to the motor will revolve in the clamp on the stand and can be locked by tightening the lock-screw, which will hold the motor in any position or angle desired to suit workman. It is provided with two large trays 22"x24" for convenience, where the workman can place his tools, motor and axle parts. The stand is mounted on three 4-inch diameter wheels. The rear castor wheel is so constructed that by pulling the plunger lock the castor will swing up off of the floor and the stand will then rest firmly on its legs. By kicking the castor lever down the stand will go back on its wheels and lock automatically.

The work bench is also equipped with a machinist's vise, which has a 3-inch jaw with a 4-inch opening which will handle any work required in overhauling a Ford motor or axle, also other kinds of work that will suggest itself to the repairman. The work bench and engine stand is 36 inches high and takes 27x42 inches floor space, it weighs but 120 pounds and can be moved from one part of the shop to the other or used on the road as part of the equipment of an emergency repair car.

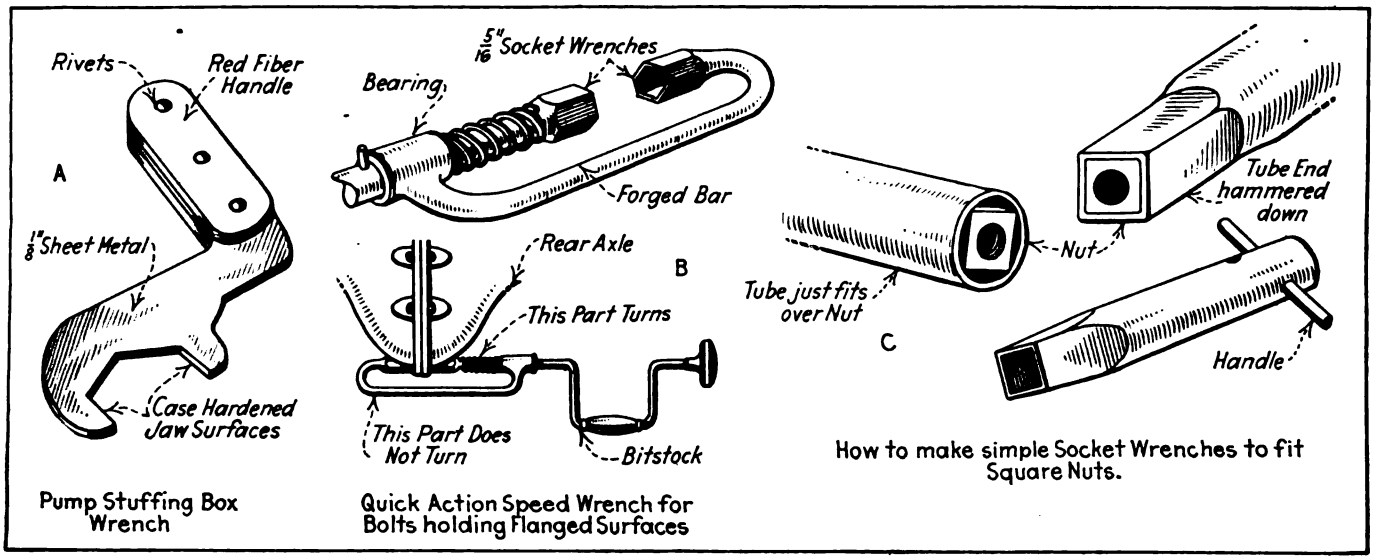
Useful Spanner Wrenches

There are various points in an auto-



Ekern special stand and workbench facilitates work on Ford engines and rear axles by holding parts securely in any desired position

Digitized by Google

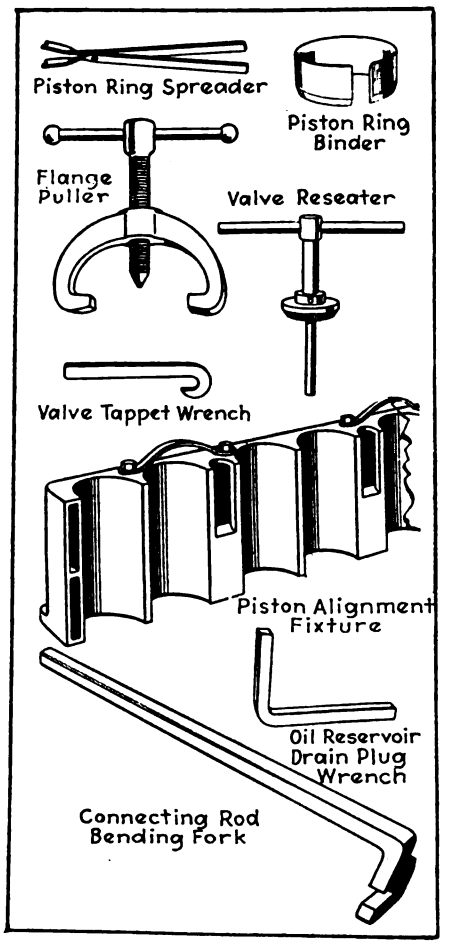


Special wrenches that are easily made by the automobile repairman make it possible to remove stubborn bolts and nuts with ease

mobile or gasoline engine that cannot be reached handily with the usual form of adjustable spanner wrenches. One of these points is the packing nut on the water pump which is generally hard to reach and which is so large as to require a special wrench. The simple wrench shown at A in the accompanying illustration may be made by any one handy with tools by cutting a piece of 1/8th inch thick sheet steel to the desired shape, then carefully fitting the jaws so that they will be the exact size of the nut on the stuffing box, by filing. After the wrench is completed the jaws should be case hardened. The handle is made by riveting two pieces of fiber to the bent portion or off-set of the wrench.

When a number of nuts are to be removed from a point where the bolt heads must be held from turning, as those holding the lower portion of the engine crank case to the upper part of it or keeping a differential housing together the speed wrench shown at D is a very useful fitting that can be made by any repair-man and will save its small cost on a single job. It will readily assemble or disassemble, any flanged parts held together by a series of bolts because it holds the head of the bolt from turning while the nut is unscrewed or replaced. A socket wrench is brazed or welded to the shank of a cheap bit stock or a simple bar of steel may be bent to perform the same functions, and a handle placed on the end as a hand grip. The wrench that holds the bolt head from turning is welded to the end of a forged bar shaped something like a hack saw frame and having a bearing at the end opposite the head of the wrench to receive the extension from the bit stock. A spring is used between the head of the movable socket wrench and the bearing on the forged bar carrying the fixed socket wrench.

This may be made as strong as desired and is intended to hold the wrench firmly in place on the nut. A stop-pin may be placed in the bit stock if desired to keep the movable wrench from backing out too far. When it is desired to move the wrench from one bolt to another the spring is compressed by pulling back on the bit stock and the wrench may be readily withdrawn and moved to a new bolt. If the movable socket is made long enough it will hold several nuts forming a magazine that need not be emptied each time a nut is removed from its bolt. The general construction is clearly shown and the design can be duplicated by one possessing even a modicum of mechanical skill.



Special tools for Hudson cars may be modified for work on other makes

To fabricate a socket wrench is not difficult as the simple socket wrenches to fit square or hexagon nuts may be readily made as shown in the accompanying illustration. With that method it is necessary to secure a piece of seamless pipe or tubing of a size just large enough to go over the nut. For example, if a ¾ inch square nut is to be removed, the wrench must be made from tubing having at least ¾ inch inside diameter. The end of the tube, when heated to a red heat is placed over the nut and then hammered down on each facet, so that the tube end is hammered down and shaped to fit the nut at the same time. If a deeper wrench is desired, a piece of hexagon or square rod of the proper size may be used as a mandrel to form the required length of socket. Seamless steel tubing is the best material to use and after the wrench is made it may be well to case harden the formed end. The tube is cut to any desired length, six inches being the average for ordinary work and a ¼ inch or 5/16 inch hole is drilled ½ inch from the top end of the pipe through which a short piece of iron or steel rod of the proper size may be inserted as a handle.

In the case of a hexagon wrench three holes are usually drilled through the end to correspond with the facets of the nut, one being placed below the other in the handle end of the tube. For a square wrench, it is only necessary to drill two holes, these being at right angles to each other as indicated.

How Automobile Factories Help

It is remarkable how the various automobile factories now co-operate with the repair-man in giving service to the owners of their cars. Some of the special tools furnished by the Hudson Motor Car Co. and described in a

Digitized by Google

special pamphlet are intended primarily for work on the Super-Six but there is no reason why modifications of these tools should not prove valuable to repairers of other makes of cars. These tools are shown in accompanying illustrations and a brief recapitulation of their use follows:

Piston-Ring Spreader

This is a convenient tool used to install or take out piston rings and its use will prevent chance of breaking the ring or burring the edges. It may be used on any car.

Piston-Ring Binder

This device is used for compressing rings into the cylinder. It is placed about the piston and rings and the piston is pushed into the cylinder. The binder remains with its lower edge on the top edge of the cylinder, and, of course, drops off when the piston is completely inserted.

Spicer Universal Companion-Flange Puller

This puller facilitates the removal of companion flanges on any Spicer universal, which flange is forced onto the gearset mainshaft and rear-axle pinion shaft to insure a perfect fit.

Valve-Tappet Adjusting Wrench

The wrench is designed to hook the tappet from the back. The design of the wrench gives more strength than is found in the conventional type. It is particularly applicable to the Hudson because of the lack of clearance between the valve tappet and the tappet-guide clamp.

Valve-Reseating Tool

The tool illustrated is easy to operate and is valuable in truing up the valve seats after the motor has seen considerable service.

Piston Alignment Fixture

This device consists of a standard cylinder block cut in half. To use, it is bolted to the crank case and gives an efficient means of lining up the pistons in reassembling a motor.

Connecting-Rod Bending Fork

This may be used in conjunction with the piston alignment fixture for lining up pistons. The slot is slipped over the arm of the connecting-rod and the leverage is sufficient to bend the rod any desired amount.

Oil Reservoir Drain Plug Wrench

This wrench is made of ordinary stock of cold-rolled square steel and is used to remove oil reservoir drain plugs.

Valve Lifter

This lifter is forged out of machine steel. It is equipped with a slip ring so that, if necessary, the valve spring may be held in a compressed position. It may be used in practically any motor with valves on its side.

Cylinder-Plate and Generator-Screw Driver

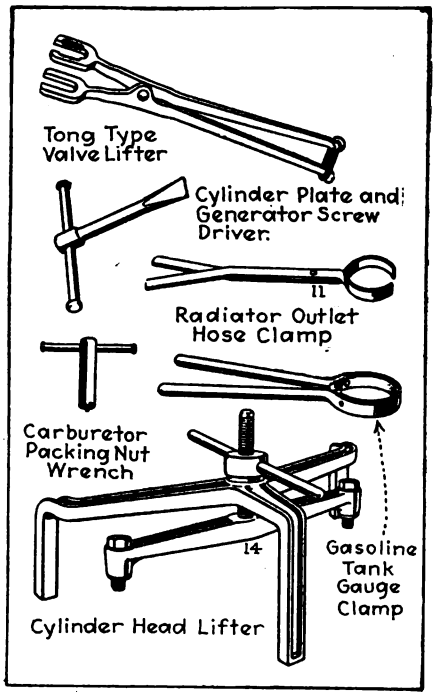
A powerful driver has many uses in any repair shop. The one illustrated is designed particularly for use on valve covers and generator-field coils, but may be put to a number of other uses where good leverage is required.

Radiator Outlet Hose Clamp

This simple tool greatly assists in getting the hose line started back onto the water pump when installing a demountable radiator.

Carbureter Packing Nut Wrench

Gasoline mileage is often reduced because of leakage around the feed regulator of a carbureter. Tightening the gland forces the packing closer around the adjusting sleeve and prevents leaks. This wrench is made for that purpose.



Tools that make hard jobs easier

Gasoline-Tank Gauge Clamp Wrench

Tank gasoline gauges are often held in position by a knurled cap which is tightened securely in place at the factory. Such a tool as the one illustrated is required to remove it.

Cylinder-Head Lifter

In removing a cylinder head it is often the case that some of the studs bind. Necessary variation of manufacturing limits create this condition. The removal of the head may be greatly facilitated by the use of lifter such as the one illustrated.

Piston Chuck

After an internal combustion engine has run for a period of six months to a year, depending upon the amount of use it has received, the piston rings will wear the ring grooves in the piston, so that it is necessary to true the ring grooves, eliminate the shoulders formed at their base and to fit new piston rings to secure maximum engine power and to keep the engine from pumping oil. The ordinary method of doing this by taking the piston off of the connecting rod and chucking it in a lathe, is of course, a practical method but one that requires considerable time, as the piston must be removed from the rods before they are placed in the chuck and afterwards re-assembled when the job is completed.

The new piston chuck illustrated makes it necessary to remove the wrist pin and connecting rod from the piston, as it may be chucked in the special fitting with these parts in place. Another advantage is that trouble from cracking the piston, as some times occurs when the ordinary form of lathe chuck is used, is prevented. The construction of this device and the method of using it can be readily ascertained by referring to the clear illustration herewith.

The desirability of having repair work done only in shops where time-saving fixtures are used must be apparent, as the experienced motorist realizes that he is not paying for wasted time when special tools are employed on his work. It may take a certain class of repairman several hours to drive a gear from a shaft, often with serious consequences to both members. The real mechanic uses a special gear puller that accomplishes the work in one-quarter the time and without danger of damaging the parts.

The manufacture of brass in Germany was first introduced in 1550 by Erasmus Ebener, an artist of Nurnberg, who prepared it by fusing copper with the so-called tutia formacem, or furnace cadmia. First made in England in 1781 by James Emerson according to one authority, but according to another it is stated that Queen Elizabeth granted a patent to William Humphrey to search and mine for calamine for making all sorts of battery wares, cast works and wire of latten, in 1565.

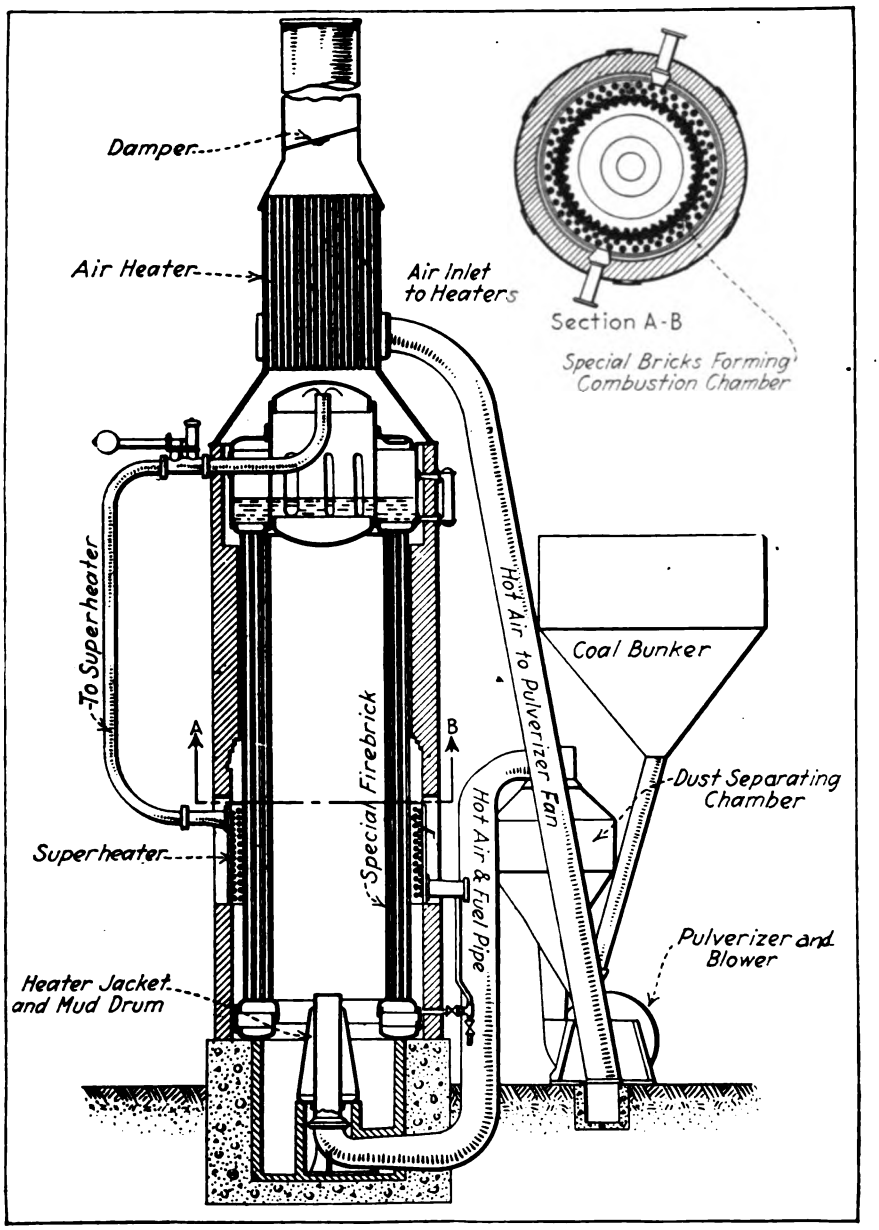
Babbitt metal is named for Isaac Babbitt, who was the first to use a soft metal alloy in bearings. He patented the use of soft metals in bearings in 1839, and claimed no particular mixture, but recommended one of 50 parts of tin, 5 parts of antimony, and 1 part of copper. This mixture is somewhat softer than is now used.

Digitized by Google

Burning Pulverized Fuel

ONE of the claims made for the Diesel engine was that it would be run by dust, the dust being finely pulverized fuel. Within the last few years dust explosions in flour mills have occurred. The fine dust and flour produced in the mills mixing with the air would form an explosive mixture, and if ignited by any chance would blow the building to pieces. Pulverization of materials in technology has greatly developed in recent times. It is done on an enormous scale in the Portland cement industry and the engineer no longer regards the reduction of an ore or other substances to a fine product as difficult. The flotation process used for concentrating ores involving the use of a mixture of oil and water, and the purely mechanical flotation process for purifying coal involve the previous pulverization of the ores or coal respectively. Many experiments have been made in the utilizing of the pulverized coal and the results have been gradually getting better and better and now it seems as if a good measure of success has been attained. The great point is to have the coal reduced to a dust and to have it dry. The illustration shows its use in an upright boiler.

The coal from the bunker descends to a combined pulverizer and blower. This reduces most of the coal to dust and the draft of air rises from it into a dust separating chamber. In this chamber all the coal over a certain size is caught and falls back into the pulverizer to be again ground up. The dust goes on with the blast and enters the bottom of the furnace, where as it issues from the nozzle it may be considered as virtually a Bunsen burner flame. The flames pass up between the water-tubes first, through an economizer where much of the residual heat is imparted to the steam in the steam chamber at the top of the boiler, and the hot exhaust goes on its way to the stack, passing through a tubular air heater immediately below the stack. This hot air is what supplies the combined pulverizer and blower with air.



Boiler and accessories for burning pulverized fuel

At the bottom of the boiler there is a superheater and on the left of the boiler the steam pipe will be seen leading into the superheater at its top. The superheated steam leaves the superheater at its base on the right of the boiler as shown in the cut. When we remember the enormous heaps of culm, which hitherto were supposed to be valueless but can be cheaply pulverized and purified so as to give an excellent fuel in dust form, the importance of this development will be recognized by all. It is not only in boiler practice that such fuel has been used, but in metallurgical furnaces its use has been quite successful and it marks an important step in advanced engineering.

OUTLINE DRAWINGS ON GLASS SLIDES

THE stereopticon is now so largely used at technical and popular lectures that a simple method of making line drawing slides to exhibit various forms of mechanism and present tubular matter may be of interest. All that are needed are some ground glass squares of the required size, these being ground on one side only; a drawing is made with a hard lead pencil on the ground surface and when the outline is finished properly, a coat of varnish is spread over the ground surface, which at once converts it into a clear glass with a fixed drawing upon it.

CADMIUM-LEAD SOLDER

Laboratory tests, together with manufacturing experience, point to a composition of 80 per cent lead, 10 per cent tin and 10 per cent cadmium as being practical for many of the purposes for which solder is required. This solder has been tried in the manufacture of tin cans, on roofing materials and for electrical joints with encouraging results in all cases. A test has also been made of it in the manufacture of automobile radiators with most satisfactory results.

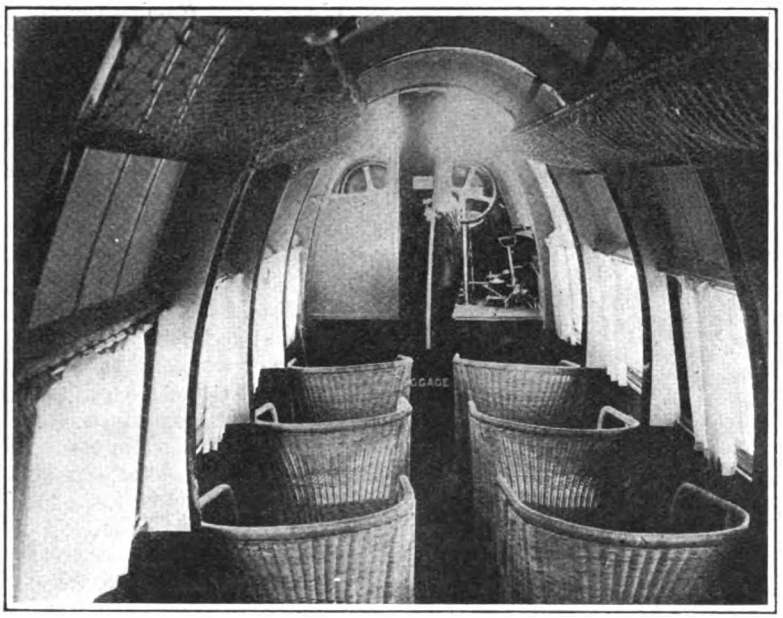
The tensile strength of the cadmium solder is about the same as that of 40-60 solder, but the ductility is approximately twice that of the ordinary solders. The point of complete liquation is only slightly less than that of solders of the ordinary composition, while the range of solidification is considerably greater. Because of the predominance of lead in the cadmium solder, the price of it is relatively low.—*Metallurgical and Chemical Engineering.*

Digitized by Google

AVIATION BRIEFS

LONDON AND PARIS AERIAL PASSENGER SERVICE

THE progress of commercial aviation is more evident in Europe than it is in America because the Europeans were more familiar with work done by aircraft in the late war than we are here and there is greater interest in aviation on the part of the public.



Luxuriously appointed interior of Vickers-Vimy airplane cabin

People who were used to seeing enemy aircraft over their cities as was the case in London and Paris, really recognize the fact that this method of transportation is a practical one and that it enables one to cover long distances in much less time than any other known means. A well-known concern of London has recently instituted a new Aerial Passenger Service between London and Paris by purchasing a number of large Vickers-Vimy airplanes as illustrated, to start the service with. These planes provide accommodations for eleven passengers in a palatial and comfortable cabin and also have a carrying space capable of carrying a half ton of baggage or other express matter. The details of the airplane are clearly shown and the interior of the cabin and the way it is fitted up can be readily ascertained from the clear photographs.

THE "MOSQUITO" AND "SPORT" FARMAN AIRPLANES

IN a recent issue we mentioned briefly the small Farman monoplane called the "Mosquito." We have received further advices and are now able to complete the specification of the little plane and are also giving the particulars of the other French sport machine built by H. & M. Farman and designated the "Sport Farman."

Specifications of the "Mosquito":

Span, 5 meters (15.4 feet).

Speed, 110 kilometers (68.3 miles).

Useful load, 130 kilograms (286.1 lbs.)

Weight (machine empty), 240 kilograms (528.5 lbs.).

Engine, 30 h.p., A. B. C.

The sport Farman is a biplane and is said to be one of the most practical and handiest small planes ever built for the man who wants to fly safely, economically and regularly.

The specifications are:

Span, 7 meters (21.9 feet).

Length, 6 meters (18.2 feet).

Maximum speed, 130-140 kilometers an hour (80-87 miles).

Motor, Rhone 40 h.p.

Useful load, 200 kilograms (440 lbs.).

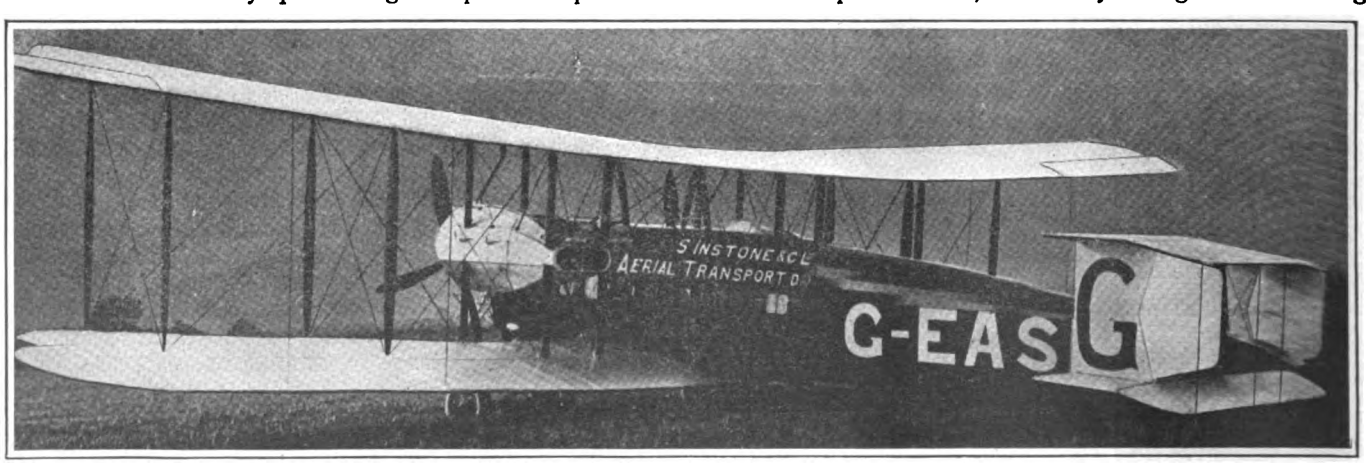
Weight (empty), 400 kilograms (881 lbs.).

Landing speed, 60 kilometers (37 miles).

Chord, 1.5 meter (4.8 feet).

Total area, 20 square meters (215 sq. ft.)

It can be seen from the illustrations herewith that it is the product of engineers and practical flyers who have flown, studied aerodynamics, and built airplanes ever since the early days of aviation. The "Sport Farman" is as practical in its field and serviceable as any motor-cycle or car. The little biplane is primarily a "bus" that will fly not only in the hands of a few experts but of anyone who can fly and land an ordinary training plane. It will, however, do many things the training

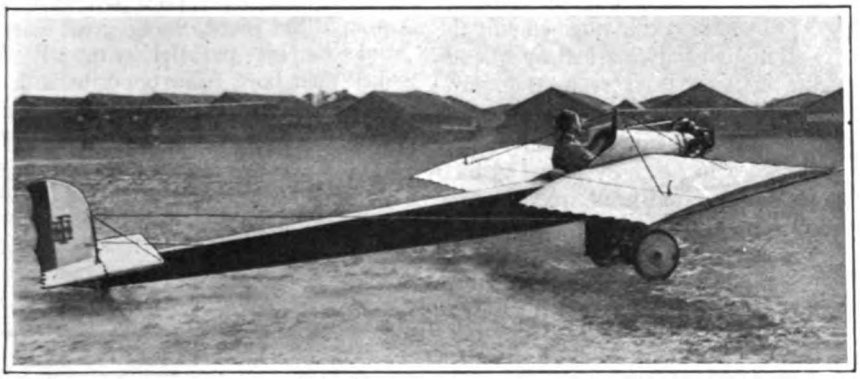


Type of airplane used in London and Paris aerial passenger service. This is a Vickers-Vimy model

Digitized by Google

planes cannot do; for instance, it will land in and get out of fields impossible for any airplane that lands at speeds of over 60 kilometers per hour (37 miles). It burns much less gas than the average plane; as the actual cost of gasoline to fly a kilometer is 13 centimes, or about 2 3/5 cents. It does not require a large crew of trained and high-salaried mechanics. The owner of a "Sport Farman" can line it up, operate it, and keep it in commission himself. The price of this machine is 13,000 francs or about $2,600 at normal exchange.



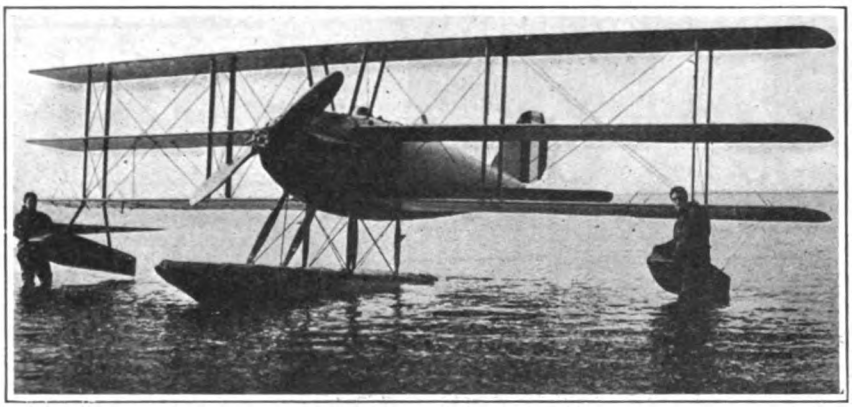


Two popular Farman airplanes. The "Sport" model is shown in upper view and the "Mosquito" below it

Many people have been awaiting the small airplane of low horsepower, which shall be economical to operate and maintain. These enthusiasts have found the call of the air irresistible; they will fly this year and henceforth, just as in past seasons they played polo or tennis or rode to hounds or owned motor-boats and racing cars. And it is a most encouraging sign for the future of Aviation!—*E. H. Lémonon, Paris.*

FAST HYDRO-AEROPLANE

THE accompanying illustration is that of the Curtiss Wasp, which was recently piloted by Roland Rohlfs and which established a new world's record for seaplanes in recent Navy trials held at Rockaway, Long Island, by travelling at the rate of 138 miles per hour in its test flights. The machine is the usual triplane construction with the exception of the substitution of a float for the wheel landing gear and the provision of out-board wing supporting floats, but it is the same in general construction as the Curtiss Wasp, which established altitude records until these were broken by Major Schroeder of the Army Air Service. The former record of a seaplane was 126 miles per hour, so it will be apparent that this triplane design is not only very efficient but that it gives promise of great speed because of the clean-cut fuselage which is stream-lined to the point where it offers a minimum of resistance.



Record-breaking hydro-aeroplane of Curtiss design owned by U. S. Navy

During the period September 2, 1919, to May 15, 1920, the Handley-Page Continental Service (in conjunction with Cie. Messageries Aériennes) carried 1,413 passengers, 79,317 lbs. of freight and traveled 104,297 miles.

COMMERCIAL TRANSPORT IN CHINA

AN air mail service has just been inaugurated between Peking and Tientsin with Handley-Page biplanes and in the initial flight mails and passengers were carried, one of the latter being Mr. B. F. Alston, the British Minister to China. The Macao Aerial Transport Co. is shortly starting a flying-boat service between Hong-Kong, Macao and Canton, and via Swatow, Amoy and Foochow to Shanghai. Curtiss H-16 type flying-boats fitted with two 330 h.p. naval type low-compression Liberty engines will be used. Beyond the fact that permission has to be obtained from the Rebel Government in Canton the service seems to be in a fair way towards success. The Hong-Kong Government seems to be typically conservative in its views, and in one case it took three weeks to get permission for one machine to fly at Hong-Kong, and then it had to be towed outside the three-mile limit.

The little Henri Potez biplane, type VIII, which was exhibited at the last Paris Aero Show and which was remarkable for the 50-h.p. Potez air-cooled engines, set with the crankshaft at right angles to the line of flight and a four-wheeled undercarriage, has been flown at Le Bourget, France, by M. Douchet. Seven flights were made, the results of which gave every satisfaction, the machine, on landing, pulling up after a run of about ten meters.

At the formal meeting of the Pan-American Aeronautical Congress at Atlantic City on May 20th, a statement made by Mr. Burleson, the U. S. Postmaster-General, was read. It was claimed that the air mail service had proved itself economical both as regards cost and time. In the first year of its working 193,000 lbs. of letters were carried, while in the year which ended on May 20, 538,734 lbs. were carried.

As a protest against lack of Government interest in domestic airplane production the Curtiss interests have closed their Buffalo plant.

Digitized by Google

MANUAL ARTS AND CRAFTS

PROJECTS FOR THE SCHOOL, HOME OR SHOP

COMBINATION HALL TREE

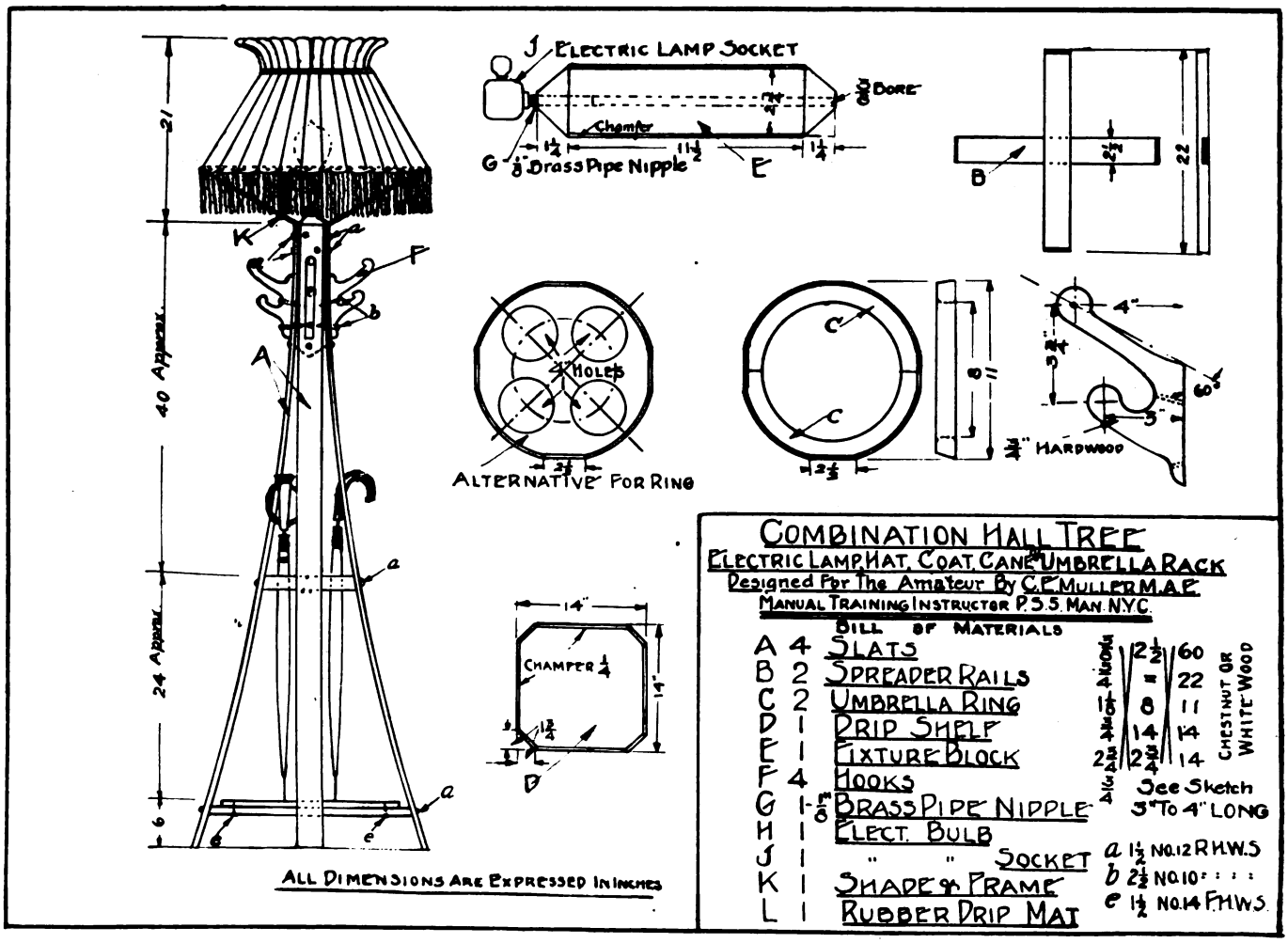
PROJECT No. 5 is a very easily made and convenient Hall Tree, a combination of hat and coat rack, umbrella and cane stand and electric lamp. It exemplifies the simplest form of construction of slats and blocking. Omitting the lamp and umbrella features, it is very useful as a costumer. It can be modified to suit most any material and has been built by the ungraded class in our elementary department. This form of construction we also use in smaller models, that will be submitted in subsequent issues. It is very popular with the graduating classes in the elementary schools. Sewing basket stands, smoking sets and tabourets are made of this construction.

It is customary to proceed in the order as arranged in the bill of materials, however, this and the dimensions may be varied to suit one's convenience. The slats A are selected for figure or grains, they should be 2 to 3 inches wide, by approximately six feet in length. Chestnut, cypress, redwood, white wood and most of the hard woods make excellent material for these projects. Their width is ¼ to ½ inch less than the block E.

The spreader rails B should be of the same material but may be anything as they are very little in evidence. They should be the same width as the slats. They may be omitted if a smaller project is made by substituting a drop pan shelf D of sufficient dimensions. They may be half lapped as shown at B or one member may act as a cleat across the grain of the shelf D, butt joining the component pieces to the cleat. The ends are beveled to suit the slats. This is easily marked by spreading the slats to their respective positions and holding the spreaders in position to scribe the line where they meet. It is fastened in place by four 1½ inch No. 12 blued round-head wood screws.

The umbrella ring C may be made in two semi-circular pieces, and then glued, as shown, or may be made as shown in the alternative piece. The holes in this last-mentioned part must be 2 inches or larger and may be bored with an expansive bit. For appearance sake they are made with a fret-turning or keyhole saw, larger than necessary. It is secured in position just the same as C.

The fixture block E may be any convenient material with the corners slightly chamferred, the ends are cut pyramid shape, but left at least ½ inch square on top and bottom to allow for the ⅜-inch hole that is bored with an auger bit. Carefully locate the center on each end, bore one-half way through the piece, using great care to hold the bit parallel with all four faces then bore from opposite end. It is not absolutely essential that the holes meet accurately, but it is excellent practice and it will insure that the fixture will set plumb if the ⅛-inch pipe nipple that is driven in the hole is true. The extension wire is threaded through this hole and nipple, then fastened to the socket. Anyone selling these fix-



COMBINATION HALL TREE

ELECTRIC LAMP HAT, COAT, CANE & UMBRELLA RACK

Designed For The Amateur By C. F. MULLER M.A.E.

MANUAL TRAINING INSTRUCTOR P.S.5. MAN. N.Y.C.

BILL OF MATERIALS

A	4	SLATS	4	2½	60	CHESTNUT OR WHITE WOOD
B	2	SPREADER RAILS	4	=	22	
C	2	UMBRELLA RING	1⅛	8	11	
D	1	DRIP SHELF	¾	14	14	
E	1	FIXTURE BLOCK	2¾	2¾	14	
F	4	HOOKS	4	See Sketch		
G	1	⅛ BRASS PIPE NIPPLE		3" TO 4" LONG		
H	1	ELECT. BULB				
J	1	" " SOCKET				
K	1	SHADE & FRAME				
L	1	RUBBER DRIP MAT				

a 1½ NO.12 R.H.W.S
b 2½ NO.10 " " "
c 1½ NO.14 F.H.W.S

Digitized by Google

tures should be able to give the proper instructions for this installation. The wire frame K is made of any convenient flat 1/16 x ½ or 3/16-inch round wire, the ends are clamped between the block E and the slats.

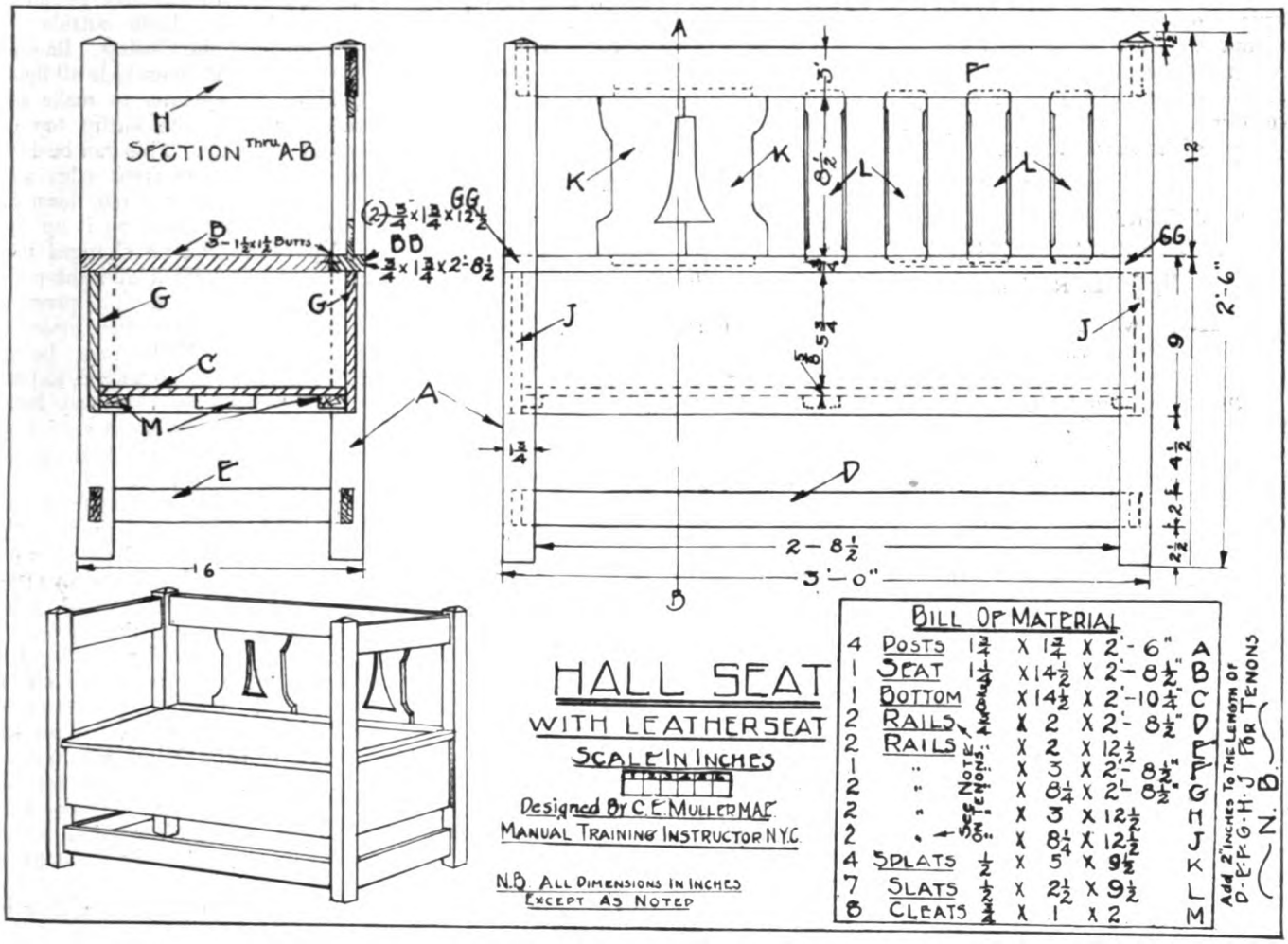
Assemble A to E, fasten each slat with three 1½-inch No. 12 blued, round-head wood screws then spring out the slats to fasten D in position, slide C into place. This location is determined by the natural bend of the material. The graceful curve of the slats must be maintained by adjusting the position of C until it does not distort this curve.

The clothes hooks may be purchased in great variety. Brass hooks with porcelain tips may be purchased at 15 cents each. They are decorated with considerable engraving and contrast very strikingly with a dark-stained wood. The hooks may be made of ash, oak, maple or even white wood if the grain is parallel to the pins; that is, the straight cut would be 60 degrees to the fibers. They are fastened by two 2½-inch No. 10 blued, round-head wood screws, as indicated at B. Stain and varnish as per directions for projects in the May and June issues of EVERYDAY ENGINEERING MAGAZINE.

MISSION STYLE HALL SEAT

PROJECT No. 6 is a mission style settee designed for the front hall or porch. The rails may be mortised or dowelled with ⅜-inch dowel pins to the posts. If mortised add 2 inches to the lengths of D, E, F, G, H and J. If mortises are used allow ¼ inch to ⅜ inch for each shoulder in the width and ⅛ inch on each side for the thickness, thus a tenon for a ¾ x 3-inch rail would be ½ x 2¼ inches to 2½ inches wide by 1 inch long. If dowels are used their centers would be ½ inch —1½ inches and 2½ inches from the edge of a 3-inch rail. A 2-inch rail would only have two ⅜-inch dowels whose centers would be ⅜ inch from each edge in width. In the rails marked G four dowels in each end would suffice for two tenons 2 inches wide, 1 inch from the edge would be sufficient. The rails marked D and E may be omitted if desired, the rails G and J would suffice.

The slats K or L are housed into the rails ½ inch deep at each end their full thickness. The slats K may be made in two pieces, which will avoid the necessity of fret sawing, the design may be varied to suit one's fancy. A method described in the previous issue of a series of holes and saw cuts may be used. If the slats outlined at L are used, stop chamfers will add to the effect. Stop chamfers may also be used on all corners and if carefully done always repay for the extra amount of work. Learn to gauge these chamfers with a pencil held in the hand using the nail of the second finger as a guide. Always slide the finger away from the body, this will avoid running slivers into the finger tips. The secret of stop chamfering is to have them uniform, small rather than large (approx. 45 degrees), and allow sufficient margin at the ends, remembering you can always take more off, if desired, but all your regrets will never add to that which is taken off if too much wood is removed.



The posts A are laid out to the figures as shown in the front view. The mortises are cut to dimensions given in the paragraph on tenons. The mortises when made by hand are always cut first, the tenons always pared to fit the mortises. All parts should be assembled and fitted together temporarily to be sure that everything is correct before glueing.

Assemble and glue the K or L slats to the back rails F and B B, then add the rear posts to these rails, inserting G and D. Be sure to square the posts with the rails. Let this remain in the clamps until the glue sets from three

Digitized by Google

to twelve hours according to the glue used and the weather conditions. Now proceed with the front, glue G and D rails to the front posts. After the glue is set the front section is glued to the rear section.

The bottom is then fitted in and 8 cleat blocks are glued in the corners as indicated at M. The blocks may also be fastened in with flat head wood screws, especially if the furniture is to be used in damp climates. The seat is then hinged with three 1½" x 1½" brass butts as indicated in the perspective. A leather seat may be added to this following the suggestions for the mission chair in the June edition. Sofa pillows could be substituted for the leather seat and would add a cosy and artistic touch. This seat is hinged to permit the interior to be used as a receptacle for rubbers, etc. It should be stained and varnished or painted to correspond with the general color scheme of its surroundings.

PHOTOGRAPH PROJECTOR MADE FROM A CAMERA

By L. B. Robbins

THOSE who take Kodak pictures must have a camera to do it with and that same camera, if of the focusing type, can be used to project the prints to greatly enlarged proportions upon a white screen, exactly as a magic lantern operates. The construction of such a projector is simple and inexpensive and will afford hours of amusement for the builder and friends after vacation is over and the negatives all printed. Mounted or unmounted prints can be used as well as postcards or magazine clippings and small objects.

No definite dimensions are given because of the many sizes of cameras that are used. But by referring to the sketches, some idea of the proportions of the projector can be gained and one built accordingly to fit your own camera. Allowance is made in this device for altering the distances between picture and light and light and lens so that focusing can be regulated to suit the various sized pictures used. The box must be considerably larger than the camera and all joints well closed to prevent escape of light and the entire inside painted a dull black. This can be accomplished by mixing lampblack, turpentine and dryer to a thin consistency.

We will suppose that the box has been chosen or built and you are ready to fit it up to accommodate the camera. It is arranged so the top will be wider than the height as the majority of views are taken the horizontal way of the film.

First, cut a hole in the front of the box somewhat larger than the camera lens through which the image can be projected. Cut it circular and in the center of the end. Now measure the length of the camera from the end of the drop to the back and mark a distance about 1 in. longer than that from the lens hole in the box. This is the location of the first of a series of wooden uprights nailed to each side of the box, inside, and exactly opposite each other so to form runs 1 in. wide. Three or four cleats each side will give sufficient number of runs for focusing the camera from the light. Be sure the cleats are nailed in perpendicular and in true relation with each other so that the runs are even and will hold the camera partition vertical and at right angles to the sides of the box. Make them of ½ in. thick wood 1 in. wide.

The camera partition is made of a single piece of soft wood just a trifle thinner than the distance between the cleats just mentioned and the same outside dimensions as the inside of the box. This must be made so it will fit closely in the runs and keep any light from being admitted to the front section of the box. Remove the back of the camera and measure the opening over which the film passes and cut an opening the same size in the center of the camera partition. Then nail a strip of wood the thickness of the camera body beneath the opening to set the camera on and one upright each side of the opening which will just accommodate the camera between them horizontally. To each of the uprights fasten two spring buttons of brass. These will serve to hold the camera in position close to the partition and can be released at will. A gasket of felt between the back of the camera and the edge of the opening will help to exclude light at this joint.

Next comes the lamp base, made to slide between the last upright cleat and the back of the box. This is made of a single piece of board somewhat narrower than the aforementioned space and nearly as long as the inside width of the box. A horizontal cleat nailed to each side of the box will act as a guide to hold the base in position. Place a light spiral spring near each end of the base, between it and the end of box and a large screw-eye down through the center of the base which will engage with the bottom of the box when screwed down far enough. The springs will always tend to keep the base against the upright cleats but it can be pressed back if desired and held in position by means of the screw-eye sticking into the bottom of box.

Mount a 60-watt electric bulb near each end of the base around which are placed curved tin reflectors as shown. Care must be taken to arrange the reflectors so that no light is allowed to shine directly from the bulbs into the opening in the camera partition. Care should be taken to direct all rays possible to the back of the box, which can only be done by experiment. When the proper position of the reflectors is reached, fasten them to the base with tacks through several little lugs cut in the bottom edge. Wire the bulbs in parallel and connect to a regulation lamp cord which passes out through a small hole in the back of the box.

Now cut a rectangular hole in the back of the box slightly larger than the camera partition opening and place small overlapping battens completely around it on the inside. Fit in a snug fitting door hinged along the bottom. Small runs of tin, to accommodate the prints and pictures are tacked vertically to the inside of this door as shown in detail. Place a knob outside the door for opening and closing. Be sure and make a snug fit to exclude all light.

To allow the operator to make adjustments, arrange the entire top of the box to swing up. This can be done by hinging it at the front edge and hooking it at the rear when down in position. Then by swinging it up, the camera partition can be changed into different runs as needed and the position of the lights altered. The perspective sketch shows how the projector looks when assembled. As before stated, it is normally arranged to project pictures with the long way horizontal. To project one taken vertically, simply place it in position and tip the projector over on its side.

The distance for prints from the holder to the opening in camera partition is from 3 to 5 ins., depending on their size. This can be altered by moving the partition back or forward in the runs and the distance of the lights can be changed at the same time. Then the focusing of the image upon the screen is done with the rack and pinion regulating the lens of camera. Once set for one size of print it will not have to be changed. To operate, first set the print in the slides, shut the door and turn on lights. Then focus as directed. If the lights shine directly upon print it will be seen in all detail upon the screen greatly enlarged. When door is opened to change prints much of the heat generated by the lights will escape. Set prints in holder upside down.

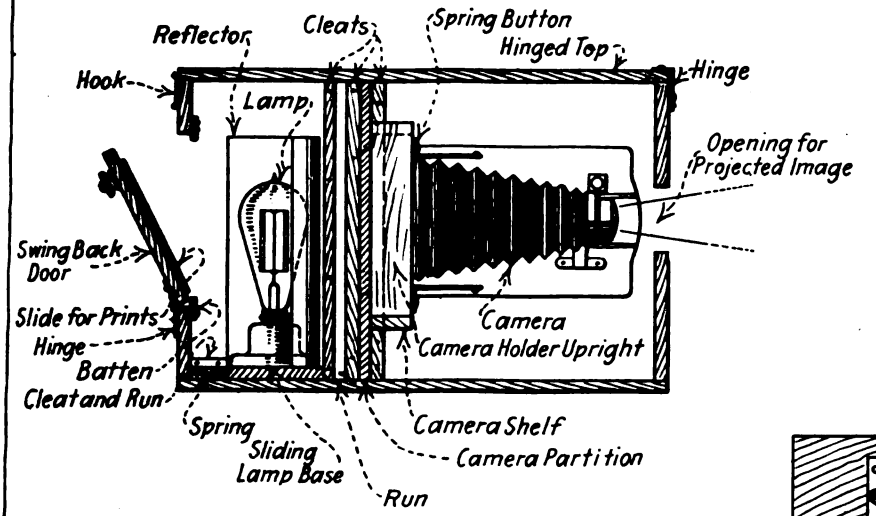
TREATING CONCRETE

EXPERIMENTS continue with various methods for treating the surfaces of concrete floors, principally with a view to preventing excessive dusting. Chemical hardeners appear to be the most efficient. Such compounds as magnesium fluosilicate, sodium silicate, and zinc sulfate, give fairly satisfactory results. Aluminum sulfate treatment has given a floor which, after nine months, still remains in satisfactory condition.

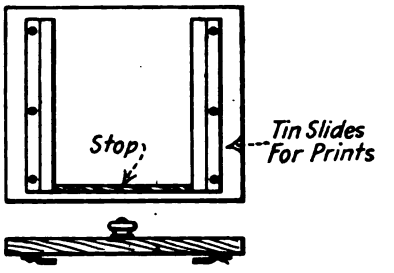
Digitized by Google

PHOTOGRAPH PROJECTOR MADE FROM CAMERA

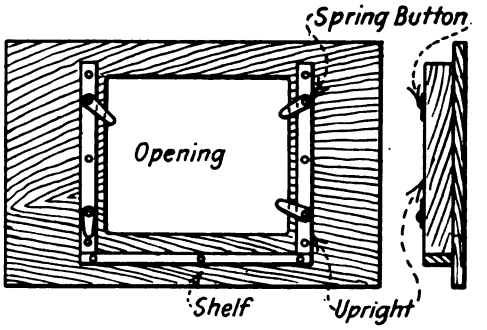
L.B. Robbins



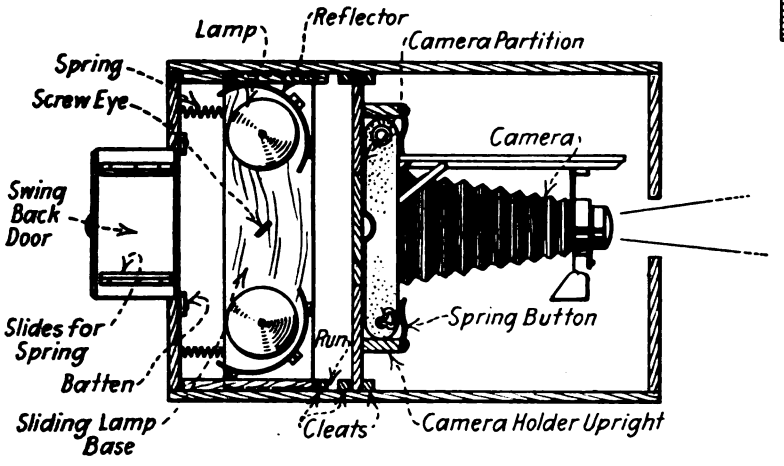
Side Section



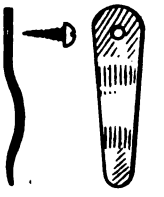
Detail of Swing Back Door



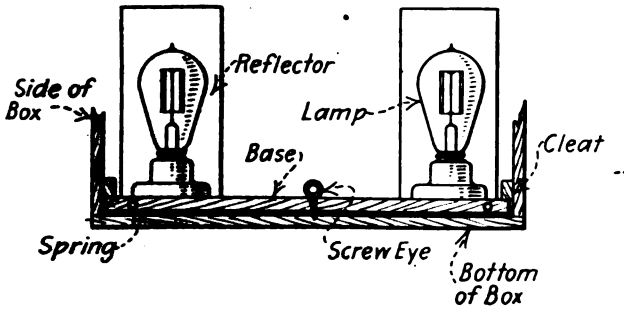
Detail of Camera Partition



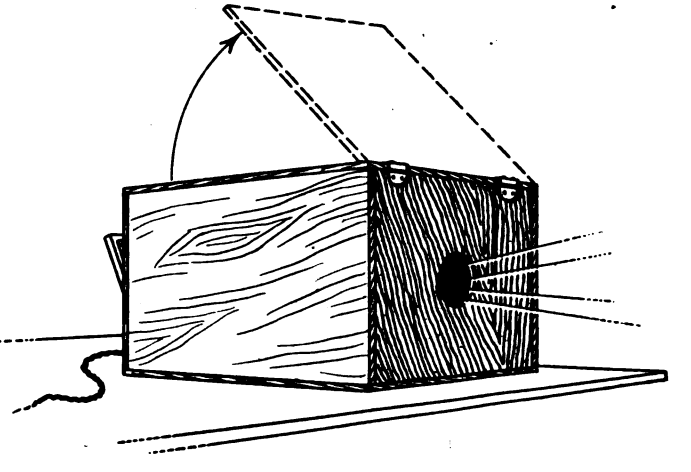
Top Section



Detail of Spring Button



Detail of Sliding Base



General Perspective

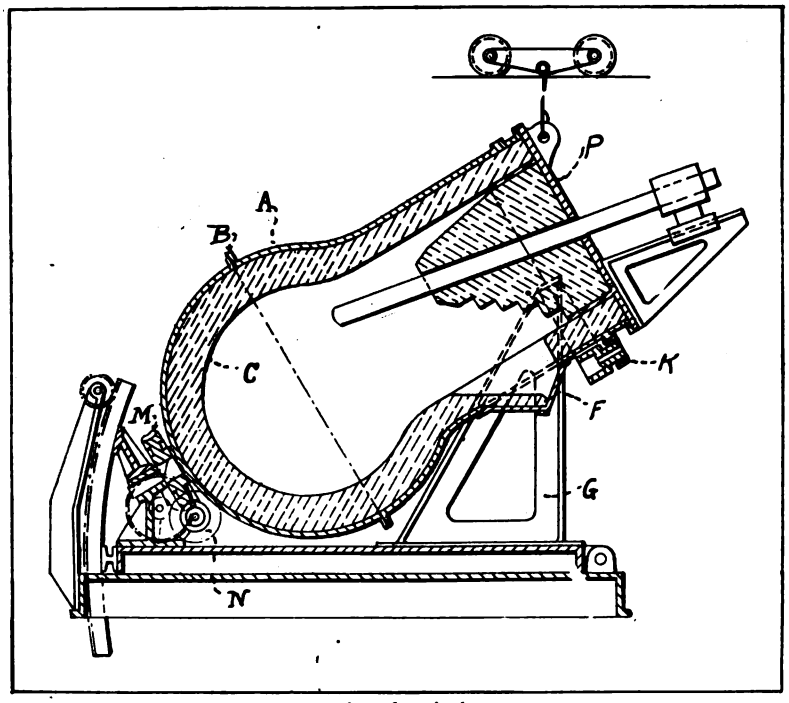
Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

ROTATING ELECTRIC FURNACE

THE electric furnace, which is shown in the cut, is of the tipping class; the pivot on which it turns in the tipping process is seen at the front corner of the base-plate. At the rear of the furnace is the tipping mechanism of standard type. At the rear end, M, the body is carried by a pivot in the axial line. In front the neck of the furnace rests on a saddle with rollers, K. The outlet, D, is provided with a cover, F, to prevent loss of charge in the rotating of the furnace. From time to time, as may



Rotating electric furnace

appear desirable, the furnace is rotated about its axis. This rotation is effected by the helical gear, M, and N, the front support, which is the saddle already mentioned on the top of the standard, G, holding the neck of the furnace in position during the turning. The effect of the turning is to protect the lining to some extent by preventing injurious localization of heat. Economy is also supposed to be produced by the absorption of the heat of the lining by the charge as it comes in contact with the hot lining in all parts of the interior.

Volcanoes in the island of Java have a very destructive form of eruption called "lahars." In periods of inaction the crater fills with water, forming a lake; when the volcano starts into activity, the first effect is to heat the water to the boiling point; the hot water then overflows the crater wall, making crevices in its sides, and, carrying mud and rocks with it, destroys life and everything it encounters. In one instance the crater was a lake containing some fifty millions of cubic yards of water. The eruption came, the hot water cut an outlet for itself in the side of the crater, poured down the mountain and killed fifty thousand people, devastating a region fifteen by twenty miles in area.

Germany, during the war, had extensive experience in substitutions. They formerly used one-quarter of the world's copper and a large proportion of the aluminum. As far as possible copper was replaced by steel. Aluminum was replaced by zinc and it is said that motors even were wound with it. Iron was galvanized by exposure to vaporized zinc. This produces no perceptible increase in thickness so that it can be used for screws without danger of filling the thread. Cadmium was a substitute for tin in solder. Ferrosilicon was used for heavy resistance work, especially in electric cookers and to replace nickel. In electric apparatus cotton was replaced by paper, and artificial cellulose silk for the natural product. Enamel was used as an insulator. Bakelized paper was used for mica. Resinous gums were found in the great forests on the Baltic and elsewhere. To economize in the use of India rubber impregnated paper was employed and mixtures of mineral substances with sulphur and other substances took the place of hard rubber. The above, of course, is only a very small proportion of the substitutions.

Chloropicrine, one of the poisonous gases used in the war, is cited as a good insecticide and rat killer. It is especially recommended for use on ships, on which the rats are apt to be most troublesome and difficult to get rid of.

The atmosphere has been found to follow one law near the surface of the earth and another at high elevation. On the surface of the earth the highest temperature is found at the equator and the coldest or lowest temperature at the equator. But at high altitudes the low temperatures are over the equator and the highest temperatures are over the polar regions.

The tarry residue from the distillation of petroleum as a fuel possesses a higher calorific value than that of coal; one part of the residue is equal to nearly twice its weight of the solid fuel. It presents difficulties in utilization as a fuel as it is liable to burn out the fire box of a boiler; this trouble is overcome to some extent by the use of brick lining. The fire brick get hot and this in itself is a good feature, as tending to maintain the combustion, while also protecting the shell of the furnace. Enough air must be supplied to prevent the formation of smoke and also to prevent the deposition of coke upon the nozzle of the burner. There is also some liability to corrosive action on the tubes and flues of a boiler in which it is used.

Italy and France are both much exercised over the fuel situation; Italy is electrifying her railroads and after eight years' work on the problem will effect a saving of one and a half millions of tons per annum. The power stations are to be placed along the slopes of the Appennines and will utilize turf and lignite, for Italy has no coal mines. In France the utilization of what they call white, green and blue coal is actively debated. White coal is the water power derived from glaciers and snow-clad mountains, as the water streams down the mountain sides, the name suggesting its origin. Green coal is the power from rivers; extensive installations on the rivers of France are already planned for early attack by the engineers. Blue coal describes the utilization of tidal power. The rise of the tide in France is so great that it is particularly available, and the utilization of its rise by advanced constructions in the way of tidal mills will do much to help along the cause.

The best course for aircraft to take in strong wind to reach a given place in a shortest time has been investigated by a German scientist, who finds that the curved course is generally the best.

In the winter of 1915-1916 over 100 inches of snow fell in the inland regions of New England and only a little less on the coast. The conclusion has been reached that the old-time New England winters of exceptional severity were no more numerous than at present, while it is believed, however, that the famous winters of 1716-1717, 1786-1787 were worse than any of recent times.

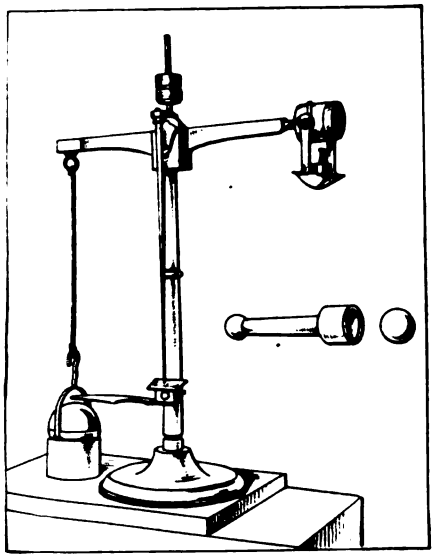
The sensibility of the human eye to the most favorable conditions has been tried, and it is found that the light of a candle at 27 kilometers distance is the extreme limit of the optic range. The calculation is made that the human eye is effected by 1.25×10^9 erg per second, which is one and one-quarter billionths of the energy unit.

The very ingenious suggestion for a scale of purity of chemicals and other materials has been proposed in Germany. One part of impurity in ten is to be called the first grade, one particle in a hundred is the second grade, one particle in 1,000 is the third grade, and so on, as far as desired. It will be seen that each grade gives the numerical value of the exponent of the power of ten expressing the impurity. The first grade is 10^1, the second grade will be 10^2, the third grade 10^3, and the author feels that, when 10^6 or the one-millionth of impurity, constituting the sixth grade is reached, it is safe to stop.

Digitized by Google

VISCOSITY METER

THIS instrument, for which very accurate results are claimed, is simplicity itself. A cup with a handle and a ball fitting the same are the essential elements. Three symmetrically placed projections, about one-thousandth of an inch high, prevent absolute contact of ball and cup. To use it the cup has some of the oil to be tested placed in it and the ball is placed in the cup. There must be enough oil to fill the channel surrounding the edge of the cup after the ball is in place. After five or ten seconds' application of firm pressure by the hand of the operator, the cup with the ball in it is inverted, and the time required for the ball to fall out is taken. The time required is directly proportional to the viscosity of the oil. The action of the instrument depends on the rate at which the oil film thickens, and the excess of oil in the channel ensures accurate action of this factor. Another way of using the instrument is to totally immerse the ball in a vessel of oil and to lower the cup over it, taking care to trap no air. After the same pressing for five or ten seconds, the time required for the ball to drop, when the cup is raised, is taken and gives the relative viscosity. For oils of low viscosity the balance arrangement shown in the cup is used. As just described the entire weight of the ball is the detaching force, but with the balance this force can be adjusted by weights in the pan, so that any desired fraction of the weight may come into action. One-tenth or one-twentieth or other fraction of the weight of the ball may be brought into action to detach it and break up the film. The viscosity figure is the quotient of the time in seconds divided by the constant of the instrument. The handle is insulated so that the heat of the hand will not affect the results.



Viscosity meter

To protect against mosquitos a French authority recommends cattle, who will monopolize the bites. Our readers will remember that footprints of cattle in wet ground, forming receptacles for water, have been recognized as an element in breeding mosquitos. The protection of fish who will eat larvae is recommended, and it is claimed that duck weed, a familiar water plant, will kill the larvae of the anopheles mosquito.

Currents of electricity passed through the earth from a generator or battery have been used with considerable success in investigating the geology of the ground. A fault has been thus detected in strata and stratifications have been followed out quite in detail and with considerable accuracy.

In England the methods of fixing the taxation of motor-cars has had a definite effect on the size and type of their engines, the object being to get power without incurring a heavy tax as a penalty. It is considered that a moderate speed engine is the lightest on account of its low inertia, the latter varying with the square of the speed. Taxing on a basis of the piston area has led to the adoption of small bore, long stroke engine cylinders, resulting in a heavy engine. The cars themselves are heavy and hard on the roads. In former times the ship duties used to have the effect of causing the shape of ships to be governed by considerations of avoiding the full extent of the tax, and it is said, that very bad models resulted from these efforts.

Ambidexterity is discussed in one of our contemporaries. Some years ago the novelist, Charles Reade, came out strongly in behalf of teaching children to use both hands indifferently. Our contemporary takes the ground that it is not advisable to take any special pains to teach it, as most ambidextrous work is not symmetrical, one hand having to do quite a different operation from the other. Rowing a boat is one exception where ambidexterity applies.

In the latest battle cruisers building in England it is hoped to get the weight of engine, boilers and water contents of the same down to 74 pounds per shaft horse-power. In destroyers, where every effort is made to reduce the weight, this figure has been reduced in some instances to 32 pounds. It is the use of the high speed engine and of the turbine, which, of course, is also a high-speed motor, that the weight has been so reduced.

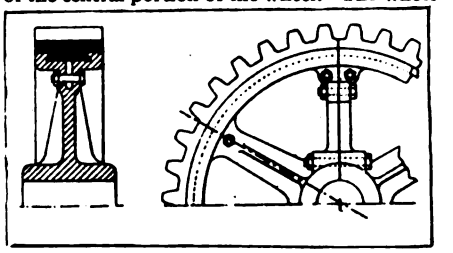
Some of our photographic readers will be interested in trying the following printing process. A non-pigmented gelatine coated paper, such as a carbon double transfer process paper, is used. It is sensitized by a solution of one part of potassium bichromate in a hundred parts of water with a little over one-half part of copper sulphate (900 c.c. water; potassium bichromate 9 grams; copper sulphate 5 grams). The solution is applied with a sponge or brush. It is quite non-sensitive while wet. It is dried in the dark room and is printed until the half lights show. As long as it is dry, exposure to light must be carefully avoided. It is washed copiously until all the yellow disappears. By using a 1% solution of pyrogallol with 5 drops of acetic acid to the ounce, a sepia colored development can be obtained. Equal parts of pyragallol and of pyrocatechine in 200 parts of water with 2 parts of tartaric acid and about ¼ of the volume of a 10% solution of alum gives another color similar to that of everyday photographs. To get a purple tint a 1% solution of metaquinone or metol with half the quantity of gallic acid may be used.

An English concern is introducing rules graduated in what they call octaval notation for the fractions of an inch. An inverted degree mark separates the octaval notation on its right from the regular notation in inches on its left. The left hand or first figure of octaval notation indicates eighths, the next figure indicates 64ths, the next figure indicates 512ths and so on each figure indicating the next highest power of eighths as a deponent of a fraction. Thus, 0.234 would indicate 2/8 + 3/64 + 4/512 of an inch.

In Australia there is great trouble due to lack of standardization in the engineering world. There are eight different specifications for cement used by the railroad and public works. There are twenty different voltages at which electric power and light are supplied. It is considered that the starting of industrial manufacturing concerns in Australia is impeded by this course.

GEAR WHEEL WITH REPLACEABLE RIM

THE cut shows very clearly the construction of this gear wheel whose rim on which the teeth are carried is made in two parts, each with a dovetailed rib around its inner periphery. This rib or projection slips into a corresponding groove on the periphery of the central portion of the wheel. The wheel is also made in two halves. Thus the toothed sectors can be slid on and off, and are secured by transverse screws. This construction makes the replacing of broken teeth a simple matter. The broken or imperfect segment is taken off and a new one put on, without the necessity of making a new wheel or of sending the entire wheel off to the shop for repairs.



Gear wheel with replaceable rim

The rebuilding of the cities of France in the devastated region is receiving a great deal of attention and has created a new term for the study of methods of reconstruction of cities, "urbanism." The determination is not to neglect considerations of aesthetics, and the right angles of the streets of Philadelphia have been cited in France, as something to be avoided.

Bricks made from a mixture of finely ground and incinerated clay have been tried in France. The clay is treated to a heat of 925 to 1,200 deg. C., in a rotating furnace. The clay is wet down to slake any lime, which may be present, is dried and mixed with the cement. The mixture is wet down again, and made into bricks in a press, which are allowed to dry slowly.

In Alsace petroleum is produced to a not inconsiderable extent. As far as the explorations have gone it is concluded that fifty thousand tons a year can be produced for the next fifty years. Since 1813 some 2,500 wells have been sunk. It comes from depths of 100 to 700 yards. It is often impounded in subterranean galleries, and is pumped therefrom. It leaves the oil-bearing sands with some difficulty.

A famous meteorological station in British India records one of the heaviest annual rainfalls in the world—10.81 meters, about 33 feet per annum. But this is exceeded in the Sandwich Islands; there in one year a precipitation of 14.27 meters was recorded, only a little less than fifty feet. The greatest rainfall in one day was 81 centimeters, about 32 inches. A curious thing in the same place is that only ten miles may separate places of abnormally heavy and of so little precipitation. Thus one station reports an annual fall of over thirty feet of rain; ten miles distant another station reports about four and a half feet precipitation. In another instance stations four miles apart report annual falls of about thirty feet at one and less than five feet at the other.

The British Navy is the largest single user in the world of non-ferrous metals. They have been having endless trouble with corrosion of the condenser tubes. Of course in this case almost inevitably brass or copper comes in contact with iron or steel so as to establish a galvanic couple with the liability of rapid corrosion of the iron.

Digitized by Google



RADIO TELEPHONE AND TELEGRAPH APPARATUS



Two-Step Audio Frequency Amplifier

An amplifier, designed for maximum simplicity and minimum expense, for experimental work

By M. B. Sleeper

THE amplifier, to many experimenters, represents a more difficult problem than it really is, though there are important points which must not be overlooked. The two-step type, described in this article, was built in EVERYDAY'S laboratory so that experimenters might see what can be done in the way of an efficient instrument, designed to fit the financial resources and the shop equipment of the average radio man.

Given the elements of an amplifier, the tubes and sockets, transformers, rheostats, and jacks, there are almost as many ways of arranging them as there are constructors. In the drafting room, a designer must justify every part of his layout. If experimenters would put themselves to this test, making themselves show a reason for each step they take as they plan an instrument, they would be surprised in the improvement both in the appearance and results of their apparatus. The mere fact that a thing "fits" does not justify its place in the design.

Particularly in planning an amplifier, the circuit must be considered and given an equal weight with the other factors. If leads are run back and forth over the set there is sure to be trouble from howling because of the feed-back effects which will occur between the grid and plate circuits. On some equipment, elaborate precautions are taken with grounded shields between the steps, but no trouble was experienced in this set.

The criticism may be made that biasing resistances, transformer condensers, and other details have been omitted. The answer is simply that this set worked as well as a manufactured amplifier which was equipped with those things, and cost more than six times as much as it did to make this one.

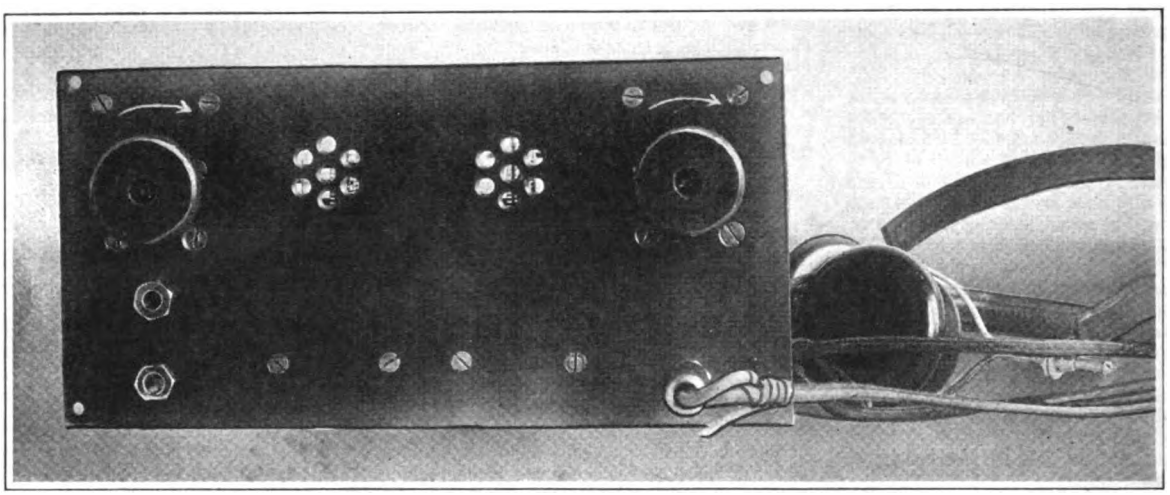


Fig. 1. On the front of the panel are the rheostat controls, jacks for detector, first step and second step of amplification, and observation windows for the filaments

GENERAL DESIGN

Fig. 1 shows the front of the panel, on which are the rheostats, jacks, and observation windows. The upper jack, of the double circuit type, allows the telephones to be inserted directly in the plate circuit of the detector. The lower jack, at the left, is for the first step, and the third, at the right, is for the second step. A bakelite panel, 5 by 10 by ⅛ in., was used for the panel.

Arrows above the rheostat handles indicate the direction of turning for increased resistance. It should be noted that the clock-wise direction is used, in standard practice, for increasing whatever is controlled. No pointers were used as, for this purpose, they are not essential and only add to the work.

On the rear, as can be seen from Figs. 2 and 3, are the instruments which make up the completed amplifier.

TELEPHONE JACKS

Practically all amplifiers are equipped with telephone jacks instead of binding posts. They permit a quick change from one step to another, and can be used to change circuits which would otherwise require elaborate switches.

The jacks used for this set are of the Federal type. The detector jack is of the double circuit construction, as shown in Fig. 7. Both the first and second steps are closed circuit types, although it is better to use an open circuit jack for the second step. Then, though the filament of the second tube is lighted, no plate current will be consumed by that tube when only the first step is being used.

Because a ⅛-in. panel was used, a little trouble was experienced in mount-

Digitized by Google

ing the jacks. This was overcome by making the holes in the panel only large enough to take the threaded portions of the front nuts, instead of the regular way with the hexagonal parts flush with the panel. This can be seen from the side views, Fig. 3.

Rheostats

Half a dozen different kinds of rheostats were tried and found unsatisfactory before the type finally adopted was worked out. Rheostats are expensive and most of them take up considerable space on the panel. This design, shown in Figs. 3 and 5, is very simple and fitted in nicely with the other instruments.

First, two pieces of 1/8-in. bakelite were cut to a size of 1¼ by 1 in. Then the head of an 8-32 iron screw was cut off, leaving the threaded part 1 in. long. Next, the bakelite was put in a vise, and the screw hammered down on the four corners of the piece. This made a series of regular depressions in the bakelite, in which No. 24 Advance wire was wound.

The mounting posts were cut from 3/16-in. square brass rod, threaded with 6-32 tap for the screws through the panel, and drilled for the screws which hold the resistance units to the posts.

The centers of the rheostat handles are just 1¼ ins. below the centers of the supporting posts. This made it possible to use the upper transformer supports as stops for the rheostat contact arms. The contact arms are just short enough so that they clear the resistance element supporting posts, and pass on to the unwound portions of the small bakelite pieces, opening the filament circuits.

Flexible leads from the contact arms provide connections to those sides of the rheostats. Looking at them from the front, the resistance windings are open at the right, and connected to the filament circuits at the left.

Audio Frequency Transformers

Federal transformers were selected for this set, because of their small size and high efficiency. Still, they were too large to mount directly on the panel without too much crowding. Accordingly, eight pieces, ¾ in. long, were cut of ¼- by 3/16-in. brass tubing. These pieces, put on 8-32 machine screws, act as spacers to hold the transformers back from the panel. This gives the necessary room, under the transformers, for the shafts of the rheostat controls.

Also, the binding posts of the transformers are made even with the terminals of the jacks, an advantage in wiring. The four posts hold the transformer as rigidly as if it were directly on the panel.

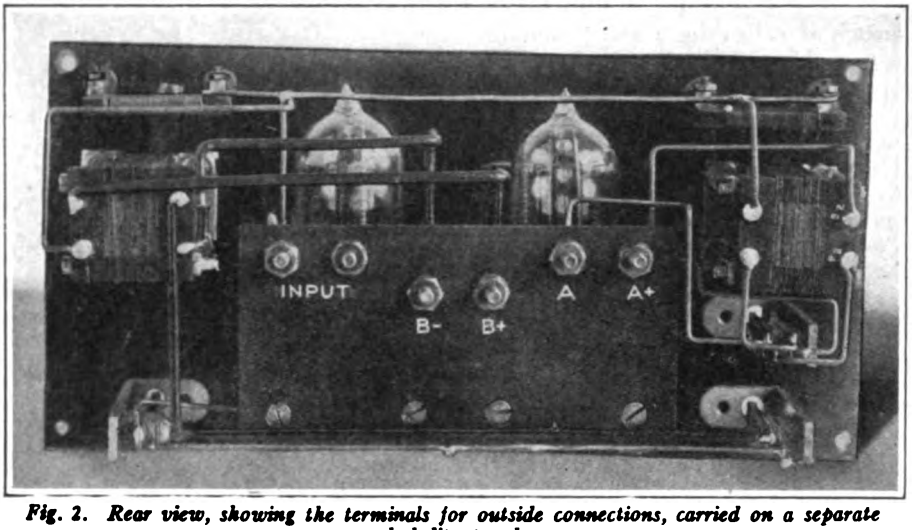


Fig. 2. Rear view, showing the terminals for outside connections, carried on a separate bakelite panel

Tube Socket Mounting

In Fig. 3, the audion sockets can be seen, and Figs. 5 and 6 show the mounting panel. The sockets themselves were made of 1 5/16-in. lengths of brass tubing 1⅜ ins. inside diameter. Short lengths of threaded rod, soldered to the tubes, were used to hold them down on the mounting panel.

A bakelite panel 1/8-in. thick, 5 ins. long and 2½ ins. wide, was cut out for the socket mounting. In this piece were drilled the holes for the audion contact pins, socket mounting rods, and contact spring screws. Experimenters who use manufactured audion sockets can readily change the arrangement of the panel without departing from the general idea.

To hold the socket panel to the main panel, four brass angles were made from ⅜- by 1/16-in. strip. Four more were made at the same time to hold the rear connection panel. When holes must be drilled in parts of this sort, it is always advisable to drill them

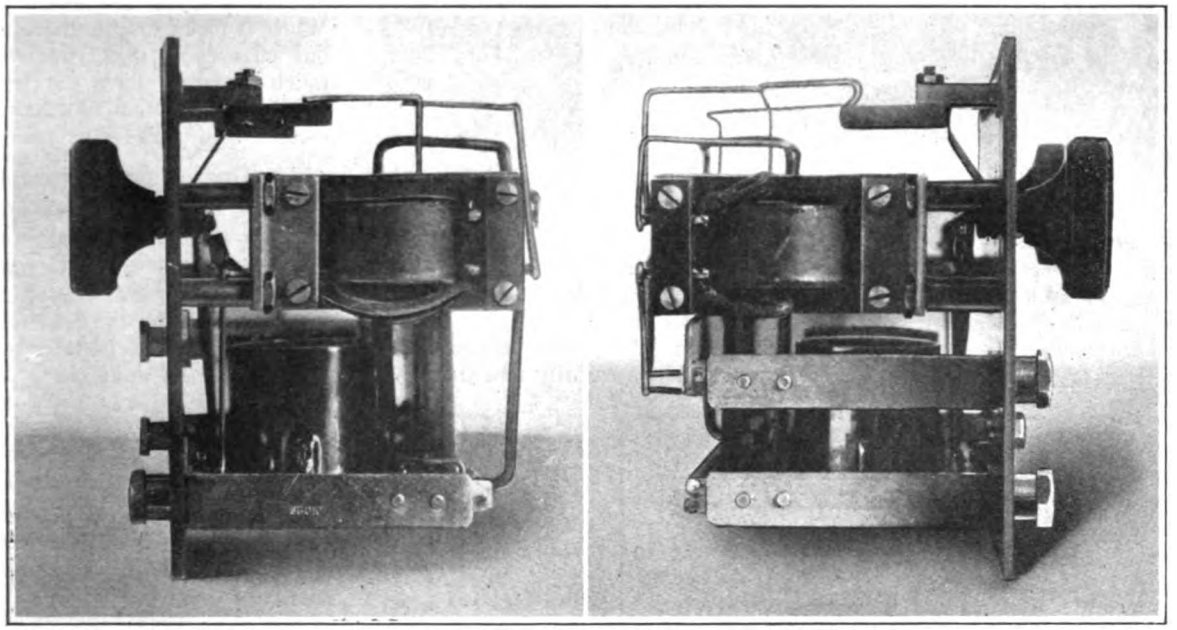


Fig. 3. The methods of mounting the transformers and jacks are shown in these end views

Digitized by Google

before bending, to make the work easier. These angles are held by the same screws which hold the contact springs, as illustrated in Fig. 6.

Connections to the contact springs were soldered to the heads of the screws on the upper side of the panel. This made the wiring easier than it would have been to connect at the bottom, though it called for clever manipulation of the soldering iron.

Connection Panel

Another 1/8-in. bakelite panel, 5 by 2½ ins., was used for the connections. As explained before, it is held by brass angles to the socket mounting panel. Three sets of terminals are provided for connections to the input, or plate circuit of the detector, and the A and B batteries.

The terminal screws are slightly staggered so that the wires will not interfere with each other. Lacking an engraving machine, the letters were simply scratched deeply and filled with white lead. Paraffin and zinc oxide are easier to handle, but are apt to melt out if the bakelite is heated while the connections are being soldered.

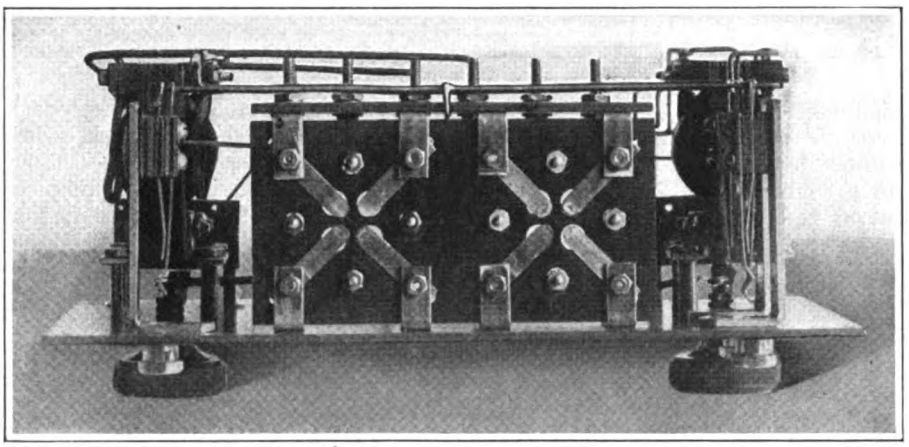


Fig. 6. This view shows the brass angles which carry the tube panel and rear connection panel

Wiring

One of the easiest ways to spoil the appearance of an instrument is to wire it in a slipshod manner. Good wiring adds greatly to the looks of any apparatus. For this amplifier, No. 14 bare copper wire was used. The wire was first cut to 12-in. lengths, and rolled straight between two boards. Then, as each connection was made, the distances were carefully measured, and the wires cut and bent in sharp angles. This process takes a little extra time, but it is well spent.

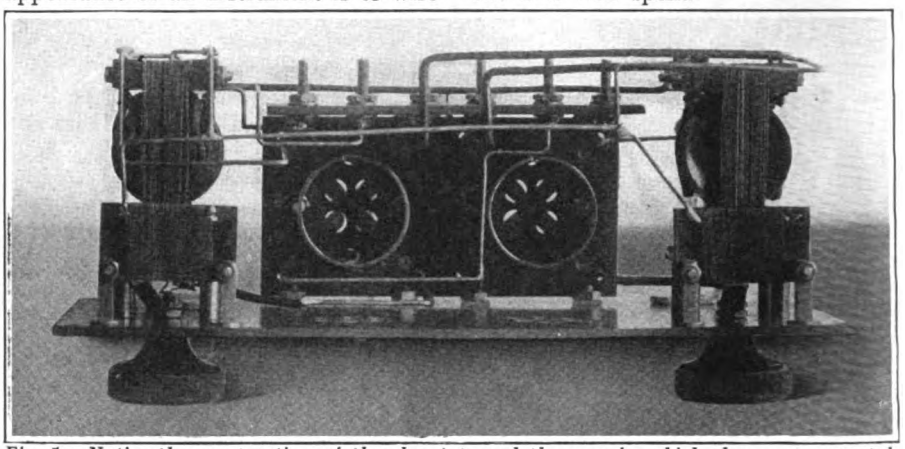


Fig. 5. Notice the construction of the rheostats and the way in which they are supported. The posts which hold the transformers also act as stops for the rheostat contact arms

A word of warning:—To judge from the work of some experimenters, the prevalent idea is that a joint must have an ounce of solder to insure a perfect connection. As a matter of fact, a drop is as good as a pound, and looks far better.

Where it was necessary to run two wires close together, Empire tubing was slipped over the wire. This was not done throughout, however, because it was not necessary, and Empire tubing is expensive.

Fig. 7 gives the amplifier circuit. While it looks simple, there are numerous chances to make mistakes. It is much easier to have the wiring right the first time than to have to hunt trouble and make changes.

Use of the Amplifier

To use this amplifier with an audion detector, it is only necessary to connect the plate to the input terminal which is joined to the transformer post marked P 2, and the positive terminal of the detector B battery to the P 1

(*Concluded on page* 358)

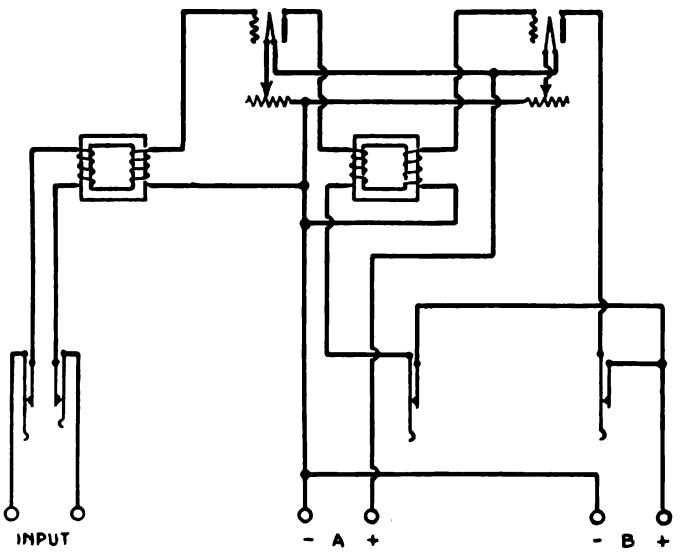


Fig. 7. Diagram of connections for the two-step amplifier

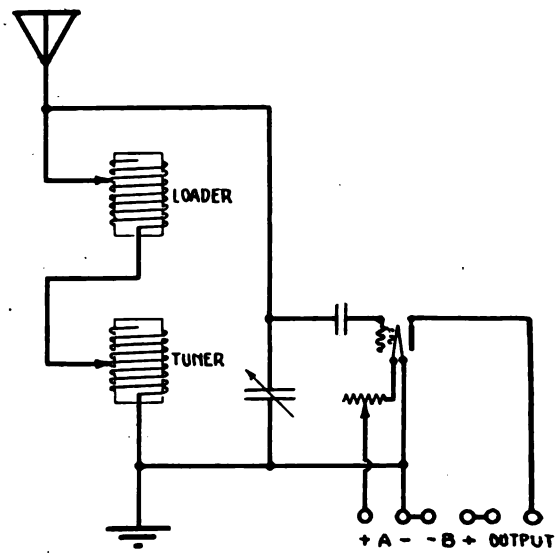


Fig. 8. Wiring of the receiver, previously described, with the amplifier

Digitized by Google

The Radio Department

A Discussion of Current Topics of Interest to Manufacturers and Experimenters.

"WHAT are you doing this summer?" is a seasonable question from one radio experimenter to another. Perhaps the static and fading have discouraged you in favor of cooler pursuits than groping through the X's for the signals which are just too faint to hear. Again, you may have found the laboratory too warm, or the heat of the soldering iron, perhaps, has consumed your ardor for radio work in the summer time.

The manufacturers would like to have radio a less seasonable business. As matters stand now, the sales during the months of June, July and August average, according to some reports, as low as ten per cent of the average monthly business in November, December, January and February.

To help equalize sales and production the year round, experimenters should do all they can to buy in the summer for their winter needs. The average radio man does not realize what a load is put upon the manufacturers by the winter peak.

Considering first the interests of the experimenters themselves, this peak is largely responsible for slow deliveries at a time when radio activities are at their height. The only way to overcome this difficulty is for the manufacturers and dealers to take the chance of overstocking, and tying up large amounts of money, hazardous undertakings in these times.

To meet the winter load, materials and supplies must be purchased from two or four months in advance. If the manufacturers play safe in ordering, they are quite apt to find themselves caught by January without materials and no prospect of getting them in time to meet the complaints of their customers whose work is held up really because of their own short-sightedness.

A few facts about the supply market will give experimenters an idea of the manufacturers' problem. Machine screws and nuts are almost impossible to buy, in some cases because material is hard to get, and, again, the demand exceeds the supply to the extent that many machine screw companies refuse to accept orders. Magnet wire is even harder to buy, particularly that requiring silk insulation. Copper, scarce enough, is easier to get than silk, a large part of which comes from Italy. Bakelite and wooden cases take two, three, or even four months to get, according to the nature and quantity of the order. Freight shipments complicate matters still further, and add one to three months to the date of delivery.

Summing up these facts, it is obviously important for experimenters to buy now if they want to have the things they will need for the winter's work. Help the manufacturers and dealers to smooth out the peak load.

THE commercial application of aircraft, tho it has made slow progress, has made good in the transportation of mail. In this connection much is being done to increase the factor of safety by the use of radio. It is now possible to guide a machine through the fog to the landing field, but, at the present stage of development, the radio operator in the airplane cannot determine his position over the field with sufficient accuracy to enable the pilot to bring the machine when the mist is so dense that the ground cannot be seen from a height of three or four hundred feet.

What is needed now is some sort of a radio barrage to surround the field, or some means by which the pilot or radio operator can tell when the machine is directly over the landing field. Knowing this, it would be comparatively safe for an airplane to descend within a short distance of the earth without risking a collision with smokestacks or church steeples.

Mail planes can now travel through fogs which obscure the earth, being guided by the radio compass. When the supplementary device is brought out by means of which planes can be brought down safely, the mail and other aerial service will be much more extensively used.

DID you ever stop to think of the efficiency of the telephone receiver? Offhand, what would you imagine to be the ratio of the energy in the useful sound to the electrical energy in the magnet?

W. Hahnemann and H. Hecht have found that, at frequencies between 500 and 1,000 cycles, the efficiency of a sensitive receiver is from 0.1 to 1.0 per cent. There seems to be no likelihood that anyone will soon bring out an instrument to supplant the telephone receiver, but these figures certainly show an opportunity for improvement. The sensitiveness of the ear can be appreciated when it is realized that the sensation of sound can be produced by a fraction of the infinitesimal energy picked up by the radio antenna.

THERE will be several articles in the August issue of EVERYDAY which will appeal particularly to experimenters. One is a description of a new inductance, similar in form, but entirely different in the method of winding from the ordinary concentrated coils. In addition there will be tables and other data concerning the use and design of receiving inductances.

Many unusual features are incorporated in the Uni-control receiver, built by the Wireless Improvement Company, which will be described next month. Detailed photographs and circuits will be given.

The article on loop antennas, promised for this month, will be published in the August number. There are many design features about loop antennas which are not understood or appreciated by the experimenters. This may account for their unpopularity, tho, properly built and used, they give excellent results. These points will be covered in the coming article.

In addition, there will be other articles on the construction of apparatus, both for sending and receiving.

BOOK REVIEWS

THE HOW AND WHY OF RADIO APPARATUS. By H. W. Secor. 160 pages. Illustration. 9¼ in. by 6 in. Cloth bound. Published by the Experimenting Publishing Co., New York City.

This book, made up largely of material which has been published in the *Electrical Experimenter Magazine,* is in a way a review of the various kinds of instruments employed for various purposes in radio transmitting and receiving.

While there is a great deal of instructive material in this book, it appears that perhaps too much space has been given to apparatus now obsolete, a failing which is shared by the large majority of books of radio work. While such material has a very important place, the radio experimenter demands new material, forgetting the old as soon as it has become common knowledge.

In the first five chapters, induction coils, transformers, transmitting condensers and inductances, and spark gaps are described and their operation explained. The following five chapters are devoted to receiving apparatus and include a discussion of mechanical and vacuum tube amplifiers.

The remainder of the book takes up the measurement of wavelength and decrement, construction of radio antennas and the calculation of inductances.

There are, in this book, many points of interest to both beginners and advanced students.

SUPER RANGE RECEIVER. By M. B. Sleeper. An illustrated pamphlet, 8½ by 11 ins. Published by the General Apparatus Co., New York City.

This pamphlet gives detailed scale drawings for the construction of an E range audion receiver for 6,000 to 20,000 meters, either damped or undamped waves.

(*Continued on page* 358)

Digitized by Google

Radio Equipment for Small Boats

The Advantages and Use of Radio Apparatus on Motor Boats and Yachts. The Direction Finder is also discussed

THERE are, in general, two classes of men who own motor boats and small yachts—one class has the conviction that nothing should be installed unless it is absolutely essential; the other class is comprised of men who want everything which adds to convenience or safety. Both classes fight shy of radio.

Although wireless equipment, even on a boat which makes trips of considerable length, may not come under the heading of necessities, it certainly belongs among the devices of safety and comfort. The reason that radio is used on so few boats and yachts is probably because of the technical understanding which appears, to the uninformed, to be required for the operation of a transmitter and receiver.

The technical part should not trouble any man who has enough of an electrical and mechanical sense to master the circuits and appliances of boat engines. As for the telegraph code, the pleasure and interest in operating a radio set is a sufficient incentive for learning quickly the use of the dots and dashes.

Of course, no one can form an accurate opinion regarding the utility of a radio installation on his particular craft until he knows something about the apparatus and its use.

The boat owner whose son has a radio station at home can, by means of the wireless, keep in touch with affairs which require his attention but not his presence. Messages can be sent through commercial and government stations which are dotted along the coast. These are augmented by the great number of experimental stations where the owners are always glad to receive and relay messages without charge. There are so many radio installations now that a boat within transmitting range of land can almost invariably reach one station or another.

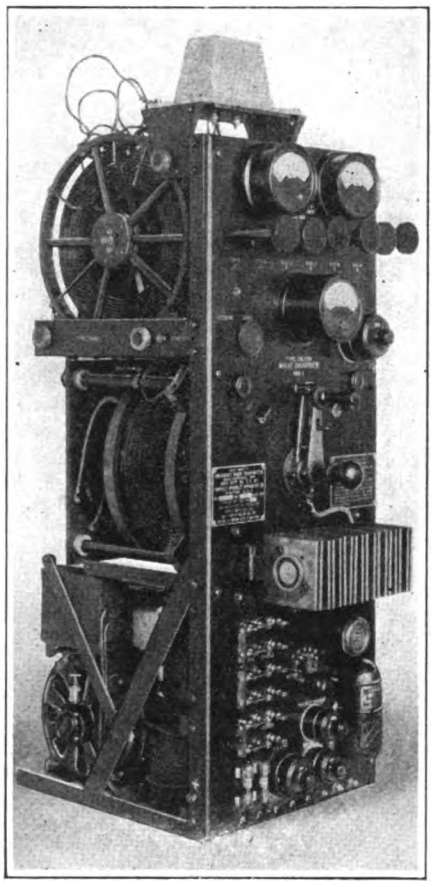


Fig. 4. A 200-watt set, operating on storage batteries or ship's mains, from the Wireless Specialty Company

Of still greater and more general application is the use of radio as a safety device. The statements regarding communication with the land stations show the ease with which a boat in distress can obtain assistance. International radio regulations require ship and commercial land stations to maintain a receiving watch on 600 meters. The 200-meter experimental wavelength is near enough to 600 meters that private stations are generally in tune for the calling wave.

Another feature, comparatively new, is the direction finding stations which are located at certain light houses, and others, operated by the Navy, at the harbors. Near any of these points it is only necessary for a vessel to request a bearing report, and, by triangulation between two or more compass stations, the ship is located and informed of its

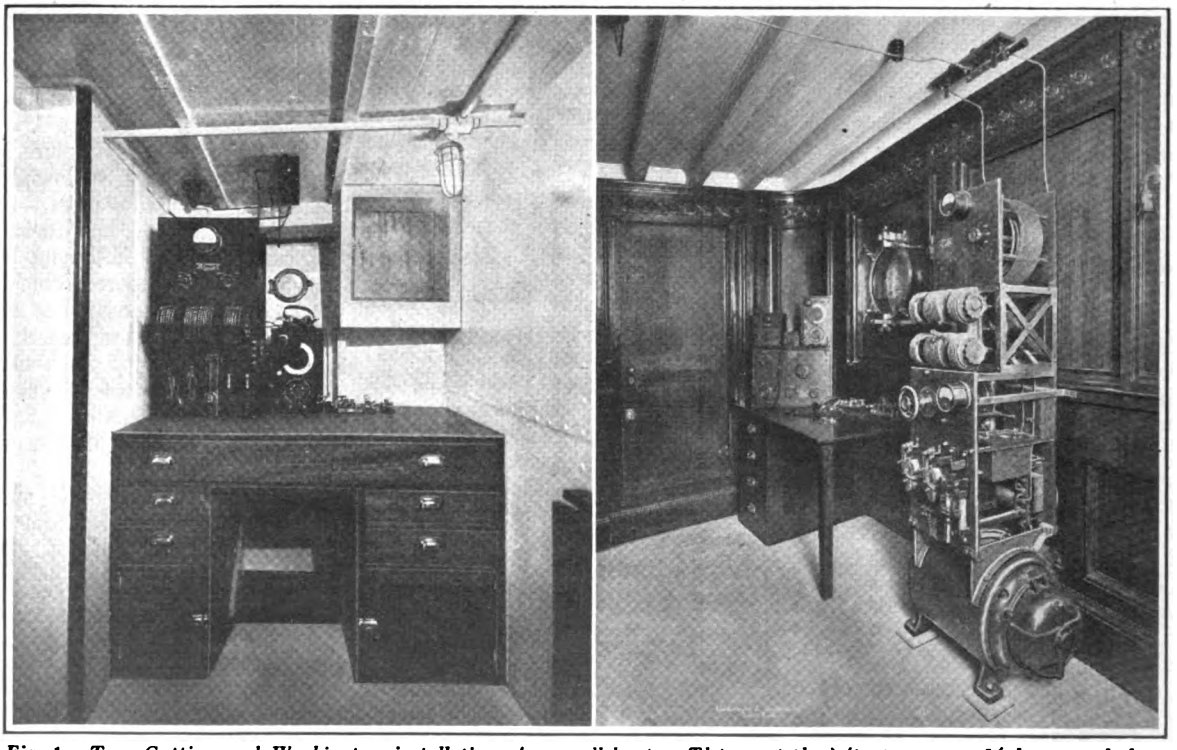


Fig. 1. Two Cutting and Washington installations for small boats. The set at the left operates on ½ k. w., and that at the right, 2 k. w. This type of equipment, because of its simplicity, is well adapted for use by inexperienced operators

Digitized by Google

position. If a direction finder is installed on the boat, the operator can obtain his own bearings on any land station.

Several types of transmitting and receiving sets are shown in the illustrations which accompany this article. These are typical examples, though there are many variations in design, size and power.

Fig. 1 shows two installations of Cutting and Washington equipment, the one at the left on a Russian submarine chaser, and at the right on the Noma, a more spacious craft.

The sub chaser set is made up of the transmitting panel, at the left, and the receiver, at the right. On the table are the detector and telegraph key, and overhead, a lightning switch. Power for the transmitter is supplied by a motor generator, not in view.

A set of this type is suitable for 45 to 50 ft. boats or larger craft. The motor-generator, operating on 110 volts d. c., draws 1,500 watts from the line, and delivers somewhat more than 500 watts, 500 cycles alternating current, to the transmitter. When no generating system has been installed already, a small engine, coupled directly to an a. c. generator, can be furnished.

The transmitting range of the Cutting and Washington ½ k. w. set, when used with the necessarily small antenna of a 50 ft. craft, is normally between 75 and 100 miles, although much greater distances can be covered when a very sensitive receiving set is employed at the land station. On larger yachts, where higher and longer antennas can be put up, the transmitting range is considerably increased.

There are several advantages in this type of set. No transformer is employed to step up the voltage. Consequently, there is no danger of injury from high potentials. The usual open spark gap is not used, but instead, a closed type which is practically silent in operation.

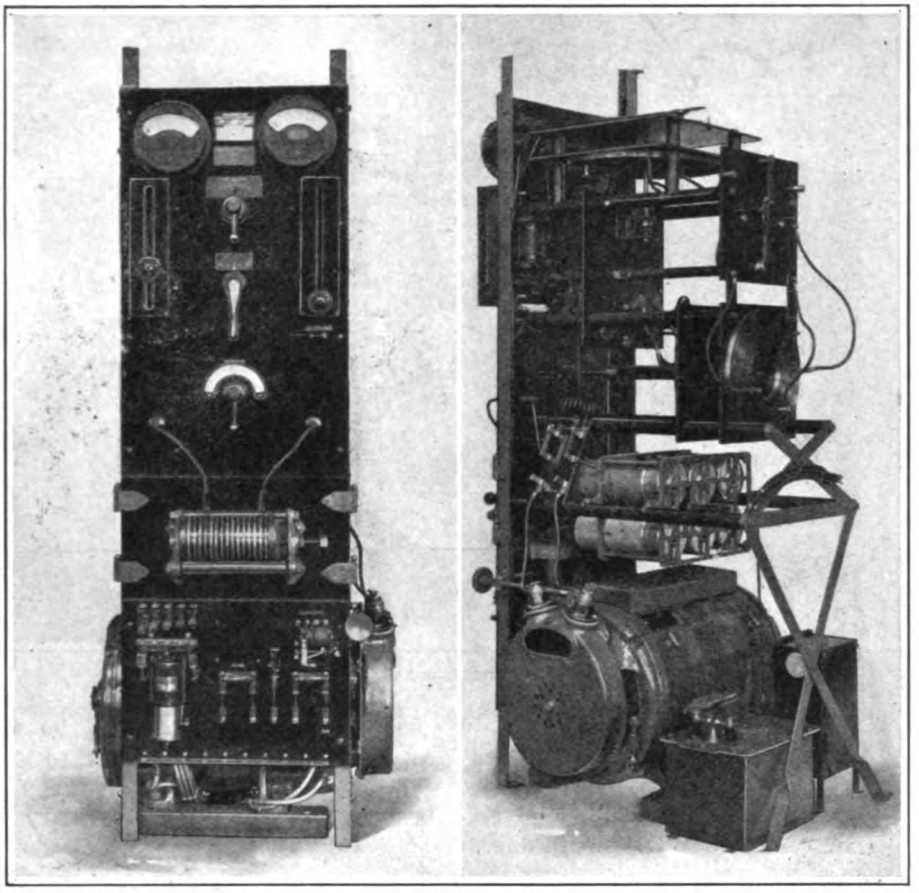


Fig. 6. Larger boats can accommodate 2-k.w. installation such as this Radio Corporation equipment

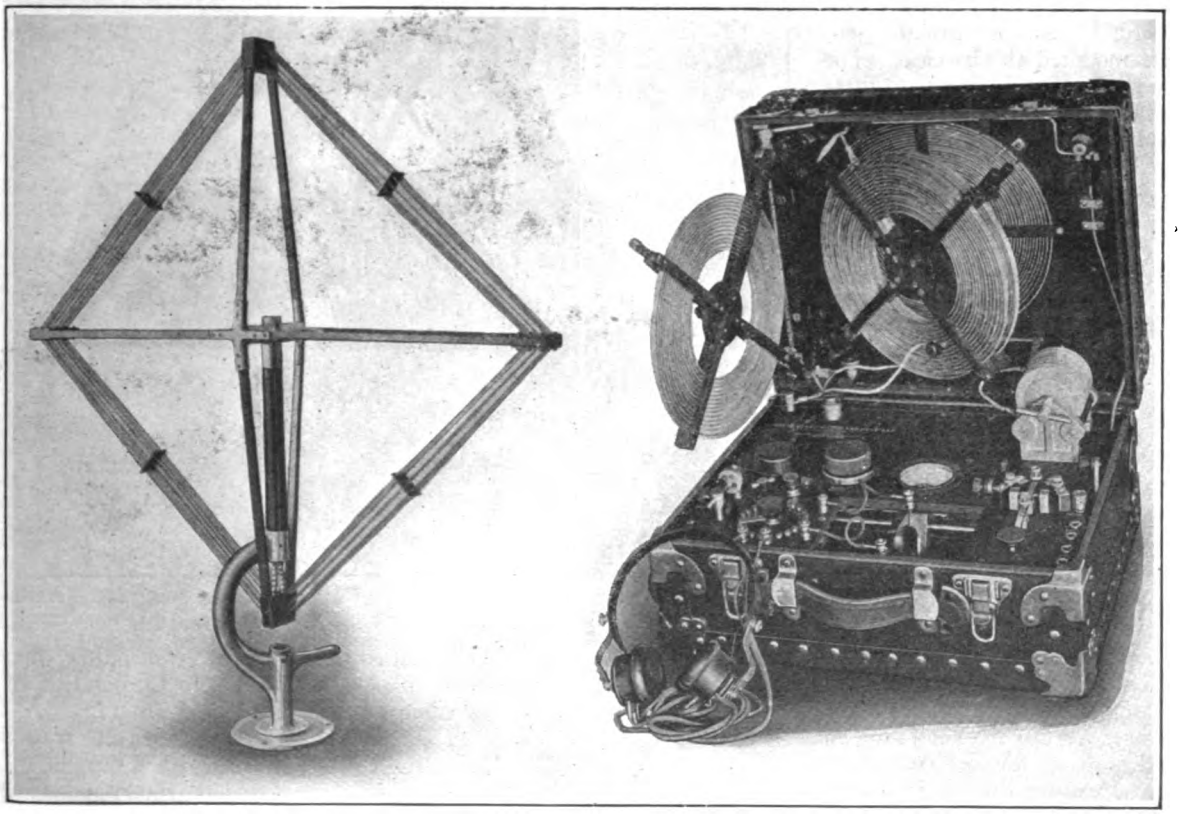


Fig. 2. At the left, a radio pelorus or direction finding loop. Right, a portable 250-watt transmitter and receiver for motor boats and yachts

Digitized by Google

For longer distance communication, the 2 k. w. equipment, at the right of Fig. 1, is designed. With it a more complete receiver is furnished, capable of operation over a wide range of wavelengths. Communication over several hundred miles can be carried on with a suitably equipped land station.

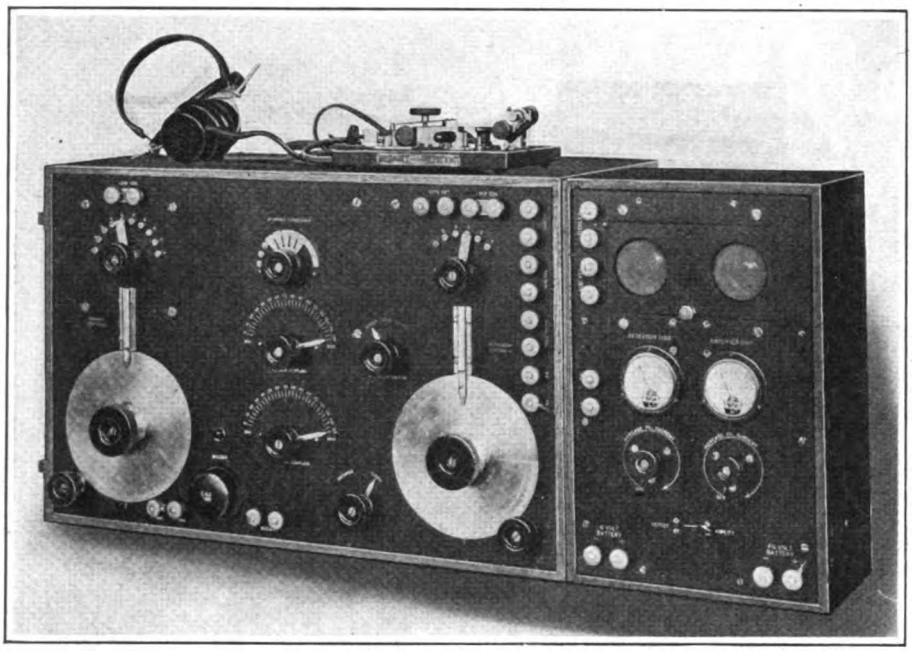


Fig. 5. A receiver of great selectivity and sensitivity, suitable for ship work

Fig. 2, at the right, illustrates a 250-watt portable transmitter and receiver, built by the Wireless Specialty Apparatus Company. The overall dimensions of the case, when closed, are 17½ by 15 by 10 ins., with a weight of 55 lbs., making it an excellent outfit for small boats. All the necessary apparatus, with the exception of the generator, are mounted in the case. The U. S. Navy has used many of these sets for landing parties, where communication back to the ship was necessary.

Power can be supplied from a motor-generator, a belted generator, a combination gas engine and generator, or a hand-operated generator, delivering 500-cycle a.c. current to the set. The engine driven outfit is shown in Fig. 3. A gasoline engine unit, complete in itself, is provided. The engine is of the single cylinder, four-cycle type, mounted on a portable oak frame. This unit weighs 130 lbs., while the portable hand-driven generator weighs only 77 lbs.

An antenna of the usual type can be used on shipboard, or a portable, umbrella type if, for any reason, the apparatus is to be carried ashore.

No switch is needed on the set to change from transmitting to receiving as there is an automatic control on the telegraph key. When the key is up, in the normal position, the receiving set is connected. Pressing the key to send, changes the circuit to the transmitter.

Another type of transmitter which can be used for small craft, although it is designed primarily as an auxiliary for large sets, is shown in Fig. 4. The input of this set is only 200 watts, permitting it to be run from the ship's current or storage batteries if desired.

The dimensions over all are 44 by 19 by 15 ins. and the weight 210 lbs. All the controls are at the front of the panel, so that the set can be installed in a corner or other convenient place where it will occupy a minimum of useful space.

In Fig. 5, a Wireless Specialty receiving set, equipped with an audion and one-step amplifier is shown. This receiver represents the most advanced design. The efficiency of the tuning circuits and the advantage gained by the vacuum tubes, make possible the reception of signals over very great distances, depending, of course, upon the power of the transmitter and the size of the receiving antenna.

On the top of the case are the telephones and a crystal detector for emergency use. Wavelengths from 150 to 6,800 meters can be received with this set.

Only slight modifications are required to make the set just described suitable for loop reception, or radio compass work. For this purpose, a loop antenna or radio pelorus, Fig. 2, is employed. A small compass is secured to the axis of the loop, near the handle.

To determine the direction from which signals are being sent, the pelorus is rotated until the signals are of maximum intensity. Then the compass indicates the direction of their origin. Such an equipment is of great advantage, particularly on larger yachts which must be piloted with great care in fogs. Some ships have gone for days without making any other observations than those obtained by the radio pelorus. Again, this apparatus makes it possible to enter a harbor when, otherwise, it would be necessary to stand outside until the fog lifted.

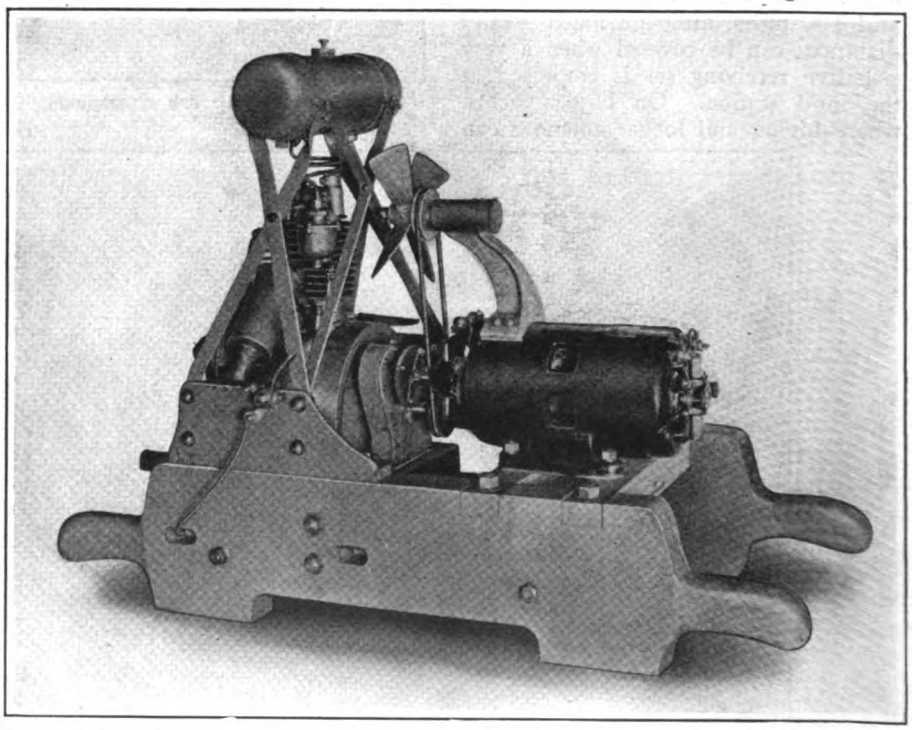


Fig. 3. The Wireless Specialty generator unit can be used on boats not equipped to furnish current for a radio transmitter

A 2-k.w. transmitter, manufactured by the Radio Corporation of America, is illustrated in Fig. 6. This is a commercial type set, transmitting at 500 cycles with a quench spark gap or synchronous rotary spark gap. The

(*Continued on page* 358)

Digitized by Google

Tapping Single Layer Inductances

Describing a Method of Tapping by Which a Constant Percentage Wavelength Increase Can be Obtained

THE average experimenter in determining the tapping points for a loose coupler or tuning coil, generally follows some rule of thumb, such as bringing out leads every ten turns or so. When this is done, the wavelength increases are larger at the start, growing smaller.

For example, a loose coupler primary or tuning coil is wound with No. 24 S.S.C. wire on a tube 5 ins. in diameter and 5 ins. long, tapped every 15 turns. The inductance at each tap will be:

Tap	Lcms.	Tap	Lcms.
1	60,750	9	2,147,000
2	203,000	11	2,481,000
3	405,000	11	2,835,000
4	628,000	12	3,240,000
5	901,000	13	3,594,000
6	1,195,000	14	4,007,000
7	1,499,000	15	4,354,000
8	1,802,000		

If the coil is used with a capacity of 0.0003 mfd., for example, the wavelengths at the different taps will be:

Tap	Wavelength	Tap	Wavelength
1	254 m.	9	1513 m.
2	465	10	1627
3	656	11	1740
4	816	12	1860
5	977	13	1961
6	1126	14	2061
7	1263	15	2158
8	1383		

The percentage increase at each step is:

Tap	Increase	Tap	Increase
1		9	8%
2	83%	10	7
3	41	11	7
4	24	12	6
5	19	13	5
6	15	14	5
7	12	15	4
8	9		

How the Constant Percentage Is Obtained

The foregoing tables show clearly that, when a coil is tapped at regular intervals, the wavelength steps at the beginning are large. However, the order, in a properly designed coil is reversed. That is, the wavelength increases are small, growing larger. This is accomplished by making the percentage of increase constant.

To accomplish this, the following rule should be observed in tapping coils. After deciding upon the percentage of wavelength increase at each tap, express the percentage as a decimal, place a 1 before the decimal, square the expression, multiply the decimal fraction by 0.7 keeping the 1 and, again multiply that result by the length of the first tap. The final value thus obtained will be the length of the second tap, measuring from the start of the winding.

This probably seems complicated, but an example will clear up the difficulties. Suppose that a coil 3 ins. in diameter is to be wound with No. 24 S.S.C. wire. The first tap should be taken off about ¼ in. from the start of the winding. Let us assume that an increase in wavelength of 20 per cent is required at each tap. To find the distance from the beginning of the winding at which the second tap is to be taken, the following process must be carried out:

1. Express the percentage of increase as a decimal.
   .20
2. Place a 1 before the decimal.
   1.20
3. Square the expression.
   $1.20 \times 1.20 = 1.4400$
4. Multiply the decimal by 0.7, keeping the one.
   $(.44 \times 0.7 = .308)$ 1.308 or 1.31
5. Multiply the result by the length of the first tap.
   ¼ in. $\times$ 1.31 = 0.328 or 0.33

How the Method Works Out

To show that the result of using this method gives, for practical purposes, a constant percentage increase, with small wavelength advances at the beginning of the coil, let us work out an example.

Assume a coil 3½ ins. in diameter, 10 ins. long, wound with No. 24 S.S.C. wire giving 42 turns per inch. The problem is to find out at what turns the taps are to be taken off. The pamphlet "Inductance Tables", by M. B. Sleeper, will be found very helpful in determining the inductance at each tap, as it does away with all calculations.

The first tap must be decided arbitrarily. It should be small, about ½ in. Therefore, in the table, we shall indicate the length of tap 1 as ½ in. Then, following the example above, the length of the subsequent taps can be figured. It should be noted that the length of each tap is measured, not from the preceding tap, but from the start of the winding.

In the accompanying table, the wavelength with antenna capacities of 0.0001 and 0.001 mfd. are shown to illustrate that the percentage of wavelength increase is constant, independent of the capacity. The percentages actually obtained are shown. These agree quite well, for it is impossible to wind coils to give the exact calculated values.

To aid those who may not understand the process of obtaining the constant by which each tap is multiplied, to give a certain percentage increase, a table has been made for different values. If, perhaps, a 10 per cent increase is required, the length of the succeeding taps are found by multiplying their predecessors by 1.147 in a manner similar to that employed in the example.

The advantage of this method of tapping coils is that a much greater selectivity is obtained with the first part of the coil, than when the increases are incorrectly proportioned. This applies to straight tuning coils and loose couplers.

Many experimenters are under the impression that the primary of a loose coupler requires very close tuning, but the adjustment of the secondary can be rough. The opposite is true. The resistance of the antenna and the earth make the decrement of the primary high. Therefore, the method of tapping just described can be used for the primary. In the secondary circuit, however, taps and a variable air condenser are required, as the decrement is low.

Multipliers for Constant Percentage Wavelength Increase

Per cent	Multiplier	Per cent	Multiplier
4	1.057	15	1.226
6	1.087	20	1.308
8	1.116	25	1.394
10	1.147	30	1.483
12	1.178		

Tapping Table for 20 Per Cent Wavelength Increase

Tap No.	Length of Tap Ins.	Turns	Lcms.	λ with 0.0001 mfd.	Per cent Increase	λ with 0.001 mfd.	Per cent Increase
1	0.5	21	70,560	158		501	
2	0.65	27	109,400	197	24	620	23
3	0.85	36	165,800	243	23	769	24
4	1.11	47	259,500	299	23	941	22
5	1.44	63	370,400	362	21	1144	21
6	1.87	79	564,500	448	21	1418	24
7	2.43	102	794,000	531	19	1681	19
8	3.16	133	1,111,000	626	18	1985	19
9	4.11	173	1,588,000	751	20	2378	20
10	5.34	224	2,205,000	880	17	2801	18
11	6.94	291	3,034,000	1037	18	3278	18
12	9.12	383	4,098,000	1240	20	3814	17

Digitized by Google

A PORTABLE RECEIVER

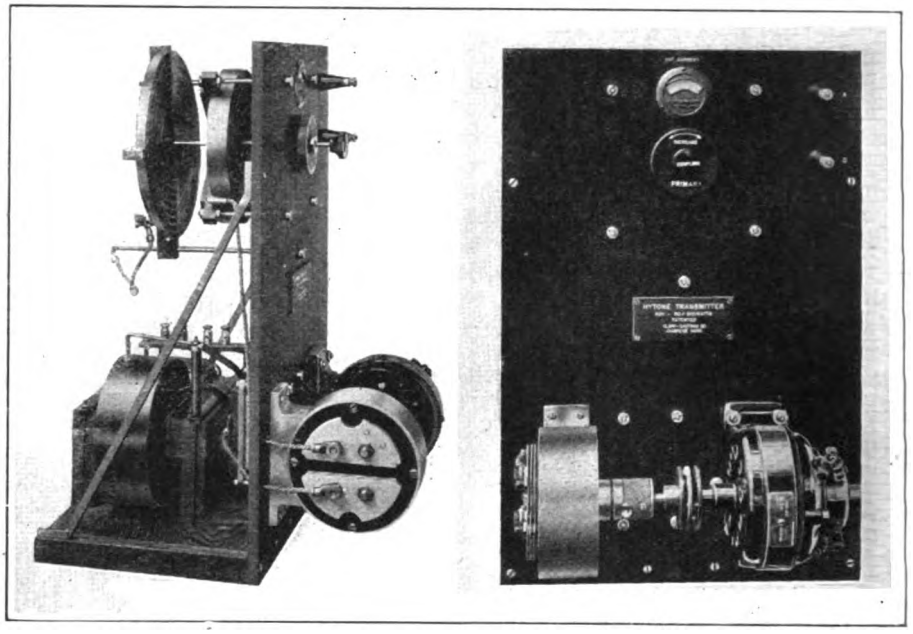
AN excellent receiver, suitable for those who want an inexpensive radio set and one which can be easily operated, is shown below. The set, of the single circuit type, is made by the Esbro Company.

When the cover is closed, the box measures approximately 9 ins. long, 7 ins. wide and 6 ins. high, a convenient size for carrying. On the panel are the test buzzer and push button, inductance switch, and galena detector.

The detector construction is quite interesting, for it is simple and at the same time designed for universal adjustment. The vertical post is in two parts. A machine screw is threaded tightly into the lower section. This part is counterbored half way, and a spring put over the screw and fitted into the counterbore. The upper part is also threaded and counterbored. When the detector is assembled, the upper part carrying the contact rod and wire, is threaded onto the screw. Then the concealed spring maintains a tension on the upper section sufficient to hold it wherever it is set.

Two binding posts are provided at the front for a telegraph key by means of which the test buzzer can be operated for code practice. The buzzer battery is mounted beneath the panel. All the instruments are mounted above and below the panel, according to standard practice. By unfastening six screws, the set can be removed from the box.

With an antenna of 0.003 mfd., this set tunes from 200 to 2,500 meters, making it useful as a time signal receiver, as well as for amateur and commercial short wave reception.



A NEW HYTONE TRANSMITTER

EXPERIMENTERS will welcome the introduction of a new type of ½ k. w. transmitter equipped with the Clapp-Eastham Hytone gap.

The panel design is a big step forward, brought about by the persistent demand for a 200-meter set with a panel mounting. Moreover, all the best and newest features are incorporated in this transmitter.

The ½ in. bakelite panel is 24 ins. high and 16 ins. long. At the top are the antenna and ground terminals, set in heavy bushings, antenna radiation meter, and controls for the oscillation transformer coupling and primary inductance. The secondary inductance is varied by a clip. On the lower part of the panel is the Hytone gap, redesigned for this set, and the driving motor.

Behind the panel are the other instruments. Bakelite strips are used to support the nickel-plated ribbon of the oscillation transformer. Five turns are provided in the primary and 10 in the secondary. Connections are made with heavy copper braid. Insurance against condenser trouble is obtained by the use of a Dubilier mica condenser.

The output of the transmitter is approximately 5 amperes in a 10-ohm antenna, giving 250 watts.



PRESS DISPATCHES FROM NAUEN

RADIO press dispatches are sent out daily from the high-powered station at Nauen, Germany, on the following program:

At 9,400 meters, undamped waves, at 2.30 P. M., and 9.00 P. M., Greenwich time. After each series on undamped waves, the dispatches are repeated on damped waves at 4,700 meters for stations not equipped to receive undamped signals.

Experimenters should have no difficulty in copying Nauen if they have a two-step amplifier. Many stations along the Atlantic coast are able to hear Nauen when they are using only an audion detector.

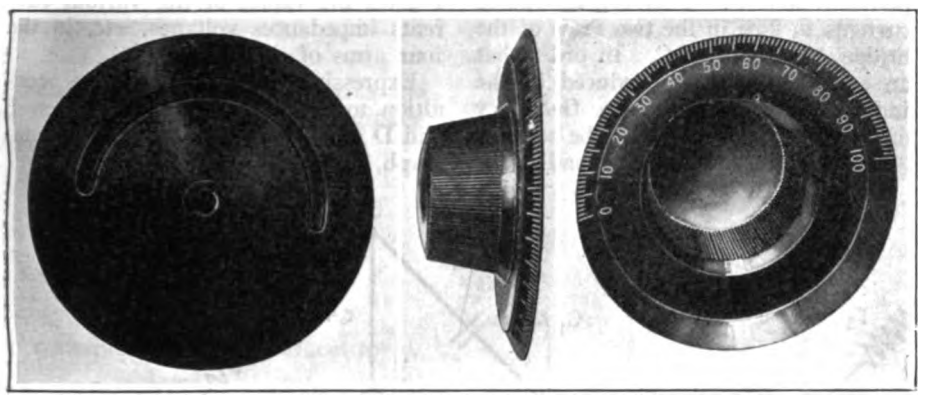
Digitized by Google

Knobs for Radio Equipment

Some side lights on knob design, with a very interesting conclusion

By Douglas Rigney

IN prehistoric days there lived a cave-man. Smaller than his fellows, he was in constant terror of the heavy-handed tactics of his neighbors. One day, pursued by the chief bully of his village, he attempted to climb a tree, only to have the branch which he grasped snap off in his hand. Preservation is the first law of Nature,



Views of the Grebe dials, showing the details of the new design

and in obedience to that law our midget cave-man attempted to ward off the giant, and in so doing tapped the giant on the head with the branch of the tree. What astonishment was his, to see his brawny opponent sink to the earth and lose forthwith all interest in the proceedings. Thus came into being man's first weapon—the club.

Your city policeman carries a club, but its relation to our cave-man's truncheon represents generation upon generation of improvement. The cave-man's weapon was a log, which hurt his hand almost as much as it did his opponent's head. The patrolman's billy is a balanced, smoothed piece of seasoned ash, which fits his hand like a glove. Nor is it alone in weapons that we find the ingenuity of man has improved his implements. From the common ax-handle to the finest dental instrument, tools used manually are made to fit the hand.

Let us now glance at the instruments used in the latest and newest art—Radio. Behold, what a horrible collection of misfits are the knobs which at present adorn radio apparatus. Built after the general pattern of a door-knob, they are excellent things to grasp. One may hold them with the grip of death. But let the operator after having finally tuned in a C. W. station attempt to release his grip on the knob! Alas, his fingers have not the fine co-ordination of a Paderewski, and one of them is sure to give a final spasmotic push to the knob—and the whistling C. W. fades.

It may be that the neglect of mechanical design in amateur radio apparatus is due to the persistent and pernicious theory that the amateur revels in "junk", that he is supremely pleased with a collection of wires and coils, held together by the grace of Providence. Surely the modern experimenter in radio has outgrown such superstitions. Such, at least, is the belief of A. H. Grebe & Co., Inc., in whose factory has been developed the new type of knob, illustrated herewith.

Moulded of bakelite, these knobs are fashioned in the form of a truncated cone. One does not grasp them with the strength of the fingers so much as by the pressure of the weight of the arm. By exerting this pressure, a firm grip may be secured and when it is desired to release the knob, the operator must merely draw back his arm, leaving the adjustment exactly as he desires it. In addition, the knob and its dial are moulded in one piece, and on the back of the latter a groove is cut, in which a stop is fitted, to limit the swing of the dial. Imagine the action of a cone-clutch, with the fingers and knob forming the engaging members, and you have the theory of the new Grebe knob.

Consider also the appearance of this knob, as compared with those formerly in use. Just as the cave-man finally learned to smooth the knots and bark from his club, so this new design has eliminated the bumps and unsightly warts which ordinarily form part of knob design. A slightly knurled surface is the only non-slip device needed with this type of knob. Pressure, easily applied and relieved, does the rest. A glance at the picture of the CR-3 receiver, shown with the new knobs attached, will give a good idea of the improved appearance of apparatus using symmetrical dials and knobs. Observe that the switch handles and binding posts have been made to conform in design to the knobs, adding to the general effect.

These knobs are to be made standard Grebe equipment in the near future, and if the testimony of the few people who have used them is to be credited, they should prove very popular. They are made for the modern amateur, who desires apparatus in which efficiency of operation and beauty of design are given their proper values.



The CR-3, fitted with the new scales and knobs

Be sure to read in The Radio Department, page 347, about the radio manufacturers, and their problems. If you expect them to make your problems theirs, you must make their problems yours.

Digitized by Google

A Simple Method of Measuring Inductances at Low Frequencies

Any Experimenter Can Make His Own Inductance Bridge by Following the Instructions Given in This Article

By V. Lynde Freeman

IN the work shop of the experimenter as well as in the larger laboratories, it is often desirable to have at hand a quick and reliable means of measuring small inductances. By a simple modification of the Owen Alternating Current Inductance Bridge such an instrument becomes available for the measurement of inductance values usually met with in radio telegraphy. As will be seen later, by the proper choice of the constants of the bridge, one can be so constructed that the value of inductance of millihenries is given by the value of resistance in tens of ohms necessary to balance the bridge.

The inductance values determined by this method are of course the low frequency values. For single layer or two layer banked winding coils or other coils of low distributed capacity, the high and low frequency inductances do not differ greatly.

Before describing a laboratory type of bridge it may be well to go into the theory of its operation.

THEORY OF OPERATION

A schematic diagram of this bridge is shown in Fig. 1 and consists of the two fixed capacities, C_1 and C_2, the fixed resistance r_1, the two variable resistances r_2 and R, and the inductance to be measured L. The alternating electromotive force is applied to the bridge through the transformer T to the points A and C. This voltage causes currents to flow in the two arms of the bridge ABC and ADC. In order that an audible signal be produced in the indicating instrument, the frequency of the supply current should be between 300 and 1,000 cycles per second.

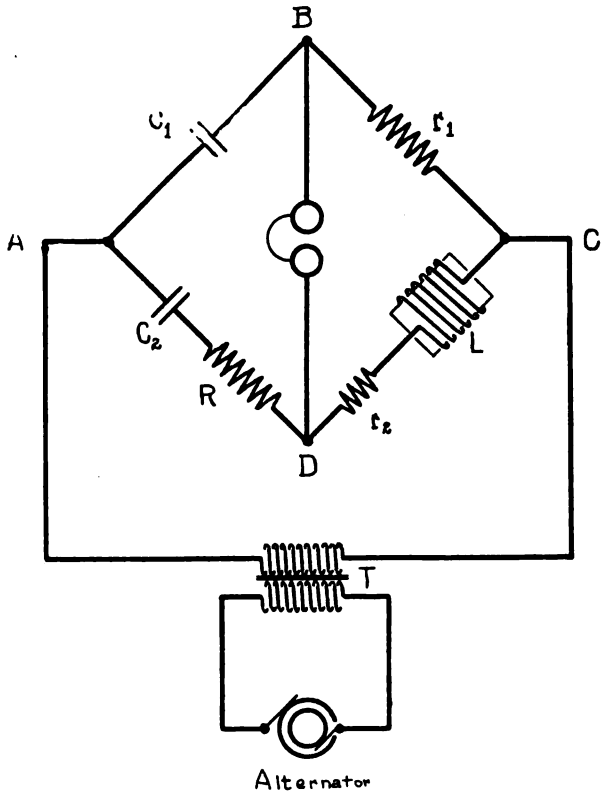


Fig. 1. The general circuit employed for measuring inductance

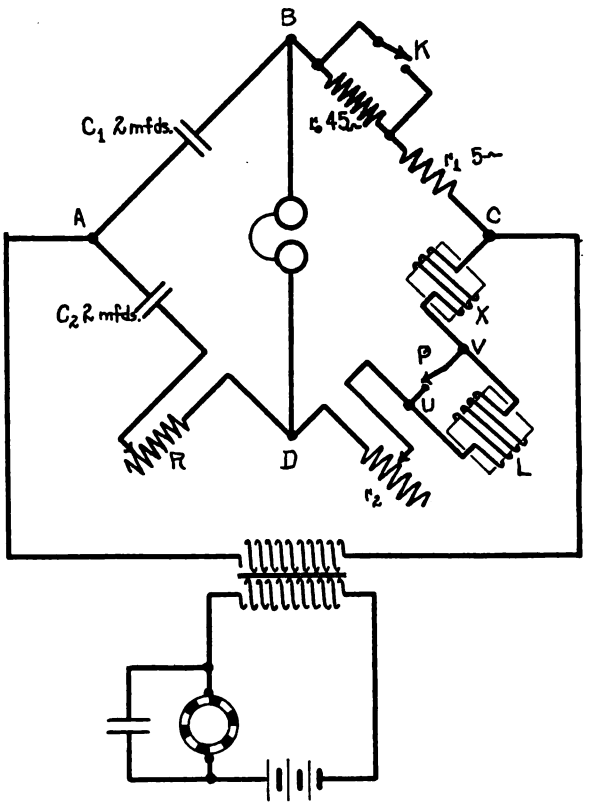


Fig. 2. Diagram of the complete inductance bridge

When the resistances R and r_2 are adjusted until the current from B to D through the telephone receivers is zero, the bridge is said to be balanced and obviously the current i_2 in AB is equal to the current in BC. Similarly, the current i_2 in AD is equal to the current in DC. Since the current through the telephones is zero the voltage BD is equal to zero.

In order that this condition obtains the ratio of voltage across AB to the voltage across BC must be equal to the ratio of the voltage across AD to the voltage across DC.

Since the voltage across an impedance, or resistance is equal to the current flowing through it multiplied by its numerical value, we can calculate the voltage across each of the arms of the bridge in terms of its constants and the currents through these arms. Table 1 gives the values of the various currents impedances voltages, etc. in the four arms of the bridge.

Expressing algebraically the condition to give zero voltage between B and D as mentioned in the above paragraph, we have:—

$$\frac{\text{Voltage AB}}{\text{Voltage BC}} = \frac{\text{Voltage AD}}{\text{Voltage DC}} \quad \ldots\ldots (1)$$

Upon substituting the values from Table 1 and solving the equations we find that

$$L = r_1 RC_1 \quad \ldots\ldots (4)$$

$$\frac{r_2}{C_1} = \frac{r_1}{C_2} \quad \ldots\ldots (5)$$

For those readers who are interested in the way at which these results were obtained the following is given:

Substituting the values of voltage across the various arms from Table 1 in Equation (1) it becomes

Digitized by Google

$$\frac{-j\frac{i_1}{\omega C_1}}{i_1 r_1} = \frac{i_2\left(R - j\frac{1}{\omega C_2}\right)}{i_2(r_2 + j\omega L)} \quad (2)$$

$$\text{or} \quad \frac{-j\frac{1}{\omega C_1}}{r_1} = \frac{R - j\frac{1}{\omega C_2}}{r_2 + j\omega L}$$

Clearing fractions

$$-j\frac{r_2}{C_1\omega} - j^2\frac{\omega L}{C_1\omega} = r_1 R - j\frac{r_1}{\omega C_2}$$

Since $j = \sqrt{-1}$ ..... (3)

and $j^2 = -1$

$$-j\frac{r^2}{\omega C_1} + \frac{\omega L}{\omega C} = r_1 R - j\frac{r_1}{\omega C_2}$$

Equating the real terms to reals and the imaginary terms to imaginary, those containing j, we have:

$$\frac{L}{C_1} = r_1 R$$

$$-j\frac{r_2}{\omega C_1} = -j\frac{r_1}{C_2\omega}$$

Upon simplification this reduces to

$$L = r_1 R C_1 \quad .....(4)$$

and $$\frac{r_2}{C_1} = \frac{r_1}{C_2} \quad .....(5)$$

As we can see from (4) the inductance varies directly with the resistance R if r_1 and C_1 are constant.

Since (4) and (5) are independent of frequency the operation of the bridge is more or less independent of the wave form of the applied electromotive force. For this reason a buzzer or an induction coil can be used to supply the indicating current to the bridge.

Description of a Type of Buzzer for Use in the Laboratory

Fig. 2 is a diagram of a bridge similar to the one described but modified to admit of better accuracy of operation. The switch k short circuits the resistance r_0 and is used as a means for direct reading in a sense in that the changing the range of the bridge as will be described later.

In order that the bridge may be value of inductance in millihenries is very closely equal to the resistance of R in terms of ohms, we must choose the constants in the following way. This numerical example of course is but one of the possible solutions but a bridge based on these results has been made up and found to give very good results.

Calculation of Constants

Let us assume the following values of the constants with the switch k open:



Fig. 3. Winding for a non-inductive resistance

$C_2 = 2$ microfarads $= 0.000002$ farads

$C_2 = C_1$

$R = 10$ ohms

$L = 1$ millihenry $= 0.001$ henry

Let x be so small that it may be neglected except as explained later.

Substitution of these values in (4) gives us at once the value of $(r_0 + r_1)$

$(r_0 + r_1) \times 10 \times 0.000002 = 0.001$ henry or 1 millihenry

from which $(r_0 + r_1) = 50$ ohms.

It may be convenient to measure inductances of smaller values so we may determine the value of this resistance in arm BC of the bridge so that 1 millihenry as before is balanced by 100 ohms at L. In this case the value resistance can be calculated as above.

$r_1 \times 100 \times 0.000002 = 0.001$ henry or 1 millihenry

$r_1 = 5$ ohms

The switch k as seen from the figure is arranged so that when it is open the resistance in BC is 50 ohms and when closed the resistance is 5 ohms. This gives a greater range for measurements as explained later on in this article.

Source of Voltage

The alternating or pulsating voltage for supplying the bridge may be obtained from an alternator or a small medical induction coil, the primary of which is connected in series with an interrupter. A commutator having a number of segments and driven by a small motor can be used also. The condenser shown in Fig. 2 is to reduce the sparking of the contacts. The number of interruptions of the circuit per revolution of the commutator multiplied by the revolutions of the motor per second should be at least equal to five hundred for good operation.

Other Apparatus Used

Ordinary paper condensers similar to those used by the telephone companies of proper capacity can be used for C_1 and C_2. If it is impossible to obtain the desired size of condenser the values of r_1 and r_0 can be recalculated as explained above.

The resistances r_1, r_2, r_0, and R should be non-inductive and they can be made up easily from small insulated Advance resistance wire.

This wire is mentioned as its resistance varies only slightly with temperature. Fig. 3 shows the manner of winding this wire upon a wooden mandril so that it will be essentially non-inductive. The wire is adjusted to the proper length for the desired resistance before it is wound up. Each of these units is dipped in paraffin to protect them from moisture. Resistance boxes can be made up from .1, 1., 10. and 100 ohm units of this type and mounted in boxes.

Correction Factors

In order to compensate for the distributed capacities in the bridge a small inductance is connected in the arm D C of the bridge at x. The inductance is very small and consists of a few turns of wire on a core about 2 in. in diameter. Upon closing the switch P and applying the voltage to the points A C of the bridge, the two resistances are adjusted until minimum sound is heard in the telephones. The value of R needed for balancing the bridge is a correction factor R_c which must be subtracted from subsequent readings of R taken on an inductance to be measured.

TABLE 1

Let $\omega = 2\pi f$ — ω = angular velocity — J = vector operator

$j = \sqrt{-1}$ — f = frequency of the supply current

Bridge Arm	Current	Impedance	Impedance expressed in the vector notation	Voltage expressed in the vector notation
AB	i_1	$\frac{1}{\omega C_1}$	$O - j\frac{1}{\omega C_1}$	$-j\frac{i_1}{\omega C_1}$
BC	i_1	r_1	$r_1 + J\,O$	$r_1 i_1$
AD	i_2	$\sqrt{R^2 - \left(\frac{1}{C_2\omega}\right)^2}$	$R - J\frac{1}{C_2\omega}$	$i_2\left(R - j\frac{1}{C_2\omega}\right)$
DC	i_2	$\sqrt{r_2 + \omega^2 L^2}$	$r_2 + J\omega L$	$i_2(r_2 + j\omega L)$

Note—For a more complete treatment of the above, refer to Radio Telegraphy by J. Mills, Chapter I.

Digitized by Google

The Bureau of Standards Radio Classification

The System Used by the Bureau of Standards to Classify Information on Radio Subjects

CLASSIFICATION OF RADIO SUBJECTS

A. Radio Wave Phenomena
- A 1. Electromagnetic theory
- A 2. Radiation and absorption
- A 3. Transmission phenomena
- A 4. Atmospherics
- A 5. Directional properties
- A 6. Waves on wires

B. Antennas
- B 1. Elevated (condenser) antennas
- B 2. Ground and underground antennas
- B 3. Special types of antennas
- B 4. Coil Aerials
- B 5. Directive antennas
- B 6. Direction finders
- B 7. Ground connections
- B 8. Constants of antennas
- B 9. Artificial antennas

C. Electron tubes
- C 1. Electron emission
- C 2. Ionization phenomena
- C 3. Properties of electron tubes
- C 4. Electron tube generators
- C 5. Electron tube detectors
- C 6. Amplifiers
- C 7. Radiotelephony with electron tubes
- C 8. Regulator tubes
- C 9. Modulators
- C 10. Heterodyne
- C 11. Applications to radio measurements
- C 12. General.

D. Radio Measurements
- D 1. Wave length
- D 2. Capacity
- D 3. Dielectric Constant
- D 4. Inductance
- D 5. Resistance
- D 6. Decrement
- D 7. Phase difference (Power loss)
- D 8. Current
- D 9. Voltage
- D 10. Signal intensity
- D 11. Cathode-ray oscillograph
- D 12. Direction of waves
- D 13. General

E. Properties of Materials
- E 1. Insulating Materials
- E 2. Electrolytes
- E 3. Magnetic Materials
- E 4. Conductors

F. Radio Theory
- F 1. Simple radio circuits
- F 2. Coupled circuits
- F 3. Resonance
- F 4. Damping
- F 5. Harmonics
- F 6. Modulation
- F 7. Beats
- F 8. High-frequency resistance
- F 9. Inductance
- F 10. Capacity
- F 11. Negative resistance
- F 12. Rectification
- F 13. Short Waves

G. Radio Research
- G 1. Suggested subjects
- G 2. Programs
- G 3. Personnel

H. Radio Instruction
- H 1. Military
- H 2. Commercial
- H 3. Courses of study
- H 4. Schools

I. Miscellaneous Radio Apparatus and Methods
- I 1. Transmitting sets
- I 2. Arcs
- I 3. Receiving sets
- I 4. High voltage generators
- I 5. Large current generators
- I 6. Inductors
- I 7. Condensers
- I 8. Resistors
- I 9. Spark gaps
- I 10. Transformers
- I 11. Amplifiers
- I 12. Alternators, high-frequency
- I 13. Induction coils
- I 14. Detectors, crystal
- I 15. Detectors, miscellaneous
- I 16. Buzzers
- I 17. Recording devices
- I 18. Automatic devices
- I 19. Telephone receivers
- I 20. Interrupters
- I 21. Modulating methods
- I 22. Frequency changers
- I 23. Protective devices
- I 24. Rectifiers
- I 25. Electric filters
- I 26. Shielding and grounding
- I 27. Laboratories
- I 28. Manufacture
- I 29. Impulse excitation
- I 30. Switchboards

J. Radio Communication and Applications
- J 1. High power
- J 2. Continuous waves
- J 3. Radiotelephony
- J 4. Aircraft
- J 5. Submarine
- J 6. Navigation
- J 7. Radio beacons
- J 8. Commercial
- J 9. Private
- J 10. Traffic
- J 11. Press
- J 12. Stations
- J 13. Installation
- J 14. Operating
- J 15. Interference
- J 16. Railroad
- J 17. Forestry
- J 18. Mining
- J 19. Military
- J 20. Naval
- J 21. Amateur
- J 22. Time Signals
- J 23. Standard wave transmission
- J 24. Photographs—Transmission of
- J 25. Induction signalling
- J 26. Ground telegraphy
- J 27. Buzzerphone
- J 28. Furnaces
- J 29. Wired wireless
- J 30. Duplex systems
- J 31. Codes
- J 32. Secrecy systems
- J 33. Wave length assignment
- J 34. Radio control system
- J 35. Tree telegraphy
- J 36. Historical
- J 37. National developments

K. Radio Miscellaneous
- K 1. Bibliographies
- K 2. Patents
- K 3. Symbols
- K 4. Terminology
- K 5. Standardization (rules)
- K 6. Legislation and regulation
- K 7. Engineering precautions
- K 8. Towers
- K 9. Graphical methods
- K 10. Tables
- K 11. Biographical
- K 12. Non-technical
- K 13. Societies
- K 14. Reports of meetings
- K 15. Design
- K 16. Miscellaneous
- K 17. Specifications

L. Electrical Subjects Related to Radio
- L 1. Motor generators
- L 2. Switches
- L 3. Telephony
- L 4. Batteries, primary
- L 5. Batteries, secondary
- L 6. Battery-charging devices
- L 7. Thermophones
- L 8. Generators
- L 9. Relays
- L 10. Transformers
- L 11. Oscillographs
- L 12. Galvanometers
- L 13. Reactance Coils
- L 14. Ammeters
- L 15. Voltmeters
- L 16. Electrodynamometers
- L 17. Piezoelectric phenomena
- L 18. Submarine cable
- L 19. Frequency meters
- L 20. Wave form analysis
- L 21. Telegraphy
- L 22. Bridges
- L 23. Mercury vapor tubes
- L 24. X-Ray tubes
- L 25. Miscellaneous

M. Miscellaneous
- M 1. Visual signalling
- M 2. Airplane mail service
- M 3. Lightning
- M 4. Photoelectric Prenomena
- M 5. Vacuum apparatus
- M 6. Mathematics
- M 7. Mechanics
- M 8. Sound
- M 9. Heat
- M 10. Light
- M 11. Chemistry
- M 12. Infra-red signalling
- M 13. Submarine signalling

INDEX TO CLASSIFICATION

Abacs—see Graphical methods (K-9)
Aircraft (J-4) see also Transmitting (I-1) and Receiving Apparatus (I-3)
Airplane—see Aircraft (J-4)
Airplane Mail Service (M-2)
Alternators, high-frequency (I-12)
Amateur (J-21)
Ammeters (L-14)
Ammeters—Radio. See Current Measurement (D-7)
Amplifiers (electron tube) (C-6)
Amplifiers (miscellaneous) (I-11)
Antennas (B)
Apparatus—miscellaneous radio (I)
Applications—radio (J)
Applications of Electron tubes to Radio Measurements (C-11)
Arcs (I-2)
Artificial antennas (B-9)
Atmospherics (A-4)

Digitized by Google

Audibility—see (A-4) Signal Intensity (D-10)
Audions—see Electron Tubes (C)
Autodyne—see Beats (F-7)
Automatic devices (I-18)

Balloon—see Aircraft (J-4)
Battery-charging devices (L-6)
Batteries, primary (L-4)
Batteries, secondary (L-5)
Beats (F-7)
Bibliographies (K-1)
Biographical (K-11)
Braun tube—see Cathode-Ray Oscillograph (D-11)
Bridges (L-22)
Buzzerphone (J-27)
Buzzers (I-16)

Capacitive coupling—see Coupled Circuits (F-2)
Capacity—measurement (D-2)
Capacity—theory (F-10)
Cathode-ray oscillograph (D-11)
Cathode-ray tube—see Cathode-Ray Oscillograph (D-11)
Chemistry (M-11)
Codes (J-31)
Coil Aerials (B-4)—see also Direction Finders (B-6)
Induction Signalling (J-25)
Coils—properties of—see Inductors (I-6)
Commercial radio instruction (H-2)
Commercial radio communication (J-8)
Constants of antennas (B-8)
Condensers (I-7)
Conductors (E-4)
Continuous waves (J-2)—see also Electron Tubes (C) Arcs (I-2) Alternators (I-12)
Corona—see Electrical Subjects—Miscellaneous (L-25)
Courses of study (H-3)
Coupled circuits (F-2)
Current measurement (Radio) (D-8)

Damped waves—see Spark Gaps (I-9)
Damping—theory (F-4)
Decrement (D-6)
Decremeters—see Decrement (D-6)
Design (K-15)
Detectors, crystal (I-14)
Detectors—Electron Tube (C-5)
Detectors, miscellaneous (I-15) see also Negative Resistance Theory (F-11)
Dielectric constant—measurement (D-3)
Dielectric loss—see Phase Difference (D-7)
Direction finders (B-6) see also Coil Aerials (B-4) Radio beacons (J-6)
Direction finding—see Aircraft (J-4) Direction Finders (B-6) Directional Properties (A-5)
Direction of waves—Measurement (D-12)
Directional properties of radio waves (A-5)
Directive antennas (B-5)
Dischargers—see Spark Gaps (I-9)
Duplex systems (J-30)

Eclipse phenomena—see Transmission Phenomena (A-3)
Eithoven—see Galvanometers (L-12) Recording devices (I-17)
Electrical filters (I-25)
Electrodynamometers (L-16)
Electrolytes (E-2)
Electromagnetic theory (A-1)
Electron emission (C-1)
Electron relays—see Electron Tubes—Amplifiers (C-6)
Electron tube detectors (C-5)
Electron tube generators (C-4)
Electron tubes (C)
Elevated (condenser) antenna (B-1)
Engineering precautions (K-7)

Filters—electrical (I-25)
Fog Signalling—see Radio Beacons (J-7)
Forestry (J-17)
Frequency changers (I-22)
Frequency (Measurement)—see Radio Measurements—Wave Length (D)
Frequency meters (L-19)
Fullerphone—see Buzzerphone (J-27)
Furnaces (High-frequency) (J-28)

Galvanometers (L-12)
Gaps—see Spark (I-9) Arc (I-2)
Generators (L-8)
Graphical methods (K-9)
Ground connections (B-7)
Ground telegraphy (J-26)
Ground and underground antennas (B-2)

Harmonic analysis—see Wave-form analysis (L-20)
Harmonics (F-5)
Heat (M-9)
Heterodyne (C-10) see also Beats (F-7)
High-frequency alternators (I-12)
High-frequency oscillograph—see Cathode-Ray Oscillograph (D-11)
High-frequency resistance (F-8)
High power radio communication (J-1), see also Stations (J-12)
High-speed traffic—see Automatic Devices (I-18)
High voltage generators (I-4), see also Rectifiers (I-24)
Historical (J-36)
Hot-Wire instruments—see Current Measurement (D-7)

Impulse excitation (I-29)
Incendiary radio—see Engineering Precautions (K-7)
Inductance—Measurement (D-4)
Inductance—Theory (F-9)
Induction coils (1-I3)
Induction signalling (J-25)
Inductive coupling—see Coupled Circuits (F-2)
Inductors (I-6)
Infra-red signalling (M-12)
Installation (J-13)
Instruction—Radio (H)
Insulating materials (E-1), see also Phase Difference (D-7)
Interference (J-15)
Interrupters (I-20)
Ionization Phenomena (C-2)

Kenotrons—see Electron Tubes (C)

Laboratories (I-27)
Lamps—see Electron Tubes (C)
Large current generators (I-5)
Legislation and regulation (K-6)
Light (M-10)
Lightning (M-3)
Longitude determination by radio—see Time signals (J-20)
Loops—see Coil Aerials (B-4) and Direction Finders (B-6)

Magnetic materials (E-3)
Manufacture (I-28)
Mathematics (M-6)
Measurements—Radio (D)
Mechanics (M-7)
Mercury vapor tubes (L-23)
Meteorology—see Atmospherics (A-4)
Methods—Miscellaneous radio (I)
Military radio communication (J-19)
Military radio instruction (H-1), see also Military Radio Communication (J-19)
Mining (J-18)
Miscellaneous—Radio (K-16)
Miscellaneous electrical subjects (L-25)
Modulating methods (I-21)
Modulation—Theory (F-6)
Modulation—see also Radiotelephony (J-3) and (C-7)
Modulators—Electron tube (C-9)
Motor generators (L-1)

National developments—(radio) (J-37)
Naval radio communication (J-20)
Navigation—Radio applications to (J-6), see also Submarine Radio (J-5)
Negative resistance—Theory (F-11)
Nomograms—see Graphical Methods (K-9)
Non-technical radio (K-12)

Operating (J-14)
Oscillation transformers—see Transformers (I-10)
Oscillographs (L-11)

Quenched gaps—see Spark Gaps (I-9)

Patents (K-2)
Personnel (G-2)
Phase difference (power loss) (D-7)
Photoelectric phenomena (M-4)
Photographs—Transmission of (J-24)
Piezoelectric phenomena (L-17)
Pliotrons—see Electron Tubes (C)
Power loss—see Phase Difference (D-7)
Power tubes—see Electron Tubes—Generators (C-4)
Press traffic (J-11)
Private Radio Communication (J-9)
Programs (Research) (G-2)
Propagation—see Transmission Phenomena (A-3)
Properties of electron tubes (C-3)
Properties of materials (E), see also Radio Measurements (D)
Protective devices (I-23)

Radiation and reception (A-2)
Radiation—see also Transmission Phenomena (A-3)
Radio beacons (J-7), see also Direction Finders (B-6)
Radio control system (J-34)
Radiotelephony (J-3)
Radiotelephony with electron tubes (C-7)
Railroad radio communication (J-16)
Reactance coils (L-13)
Received signals—see Signal Intensity (D-10)
Receiving sets (I-3)
Recording devices (1-17)
Reactification (F-12)
Rectifiers (I-24), see also Photoelectric Phenomena (M-4), Electron Tubes (C), Detectors, Miscellaneous (I-15)
Regulator tubes (C-8)
Relays (L-9)
Reports of meetings (K-14)
Research—Radio (G)
Resistance measurement (D-5)
Resistors (I-8)
Resonance (F-3)
Resonance transformers—see Transformers (I-10)
Rotary gaps—see Spark Gaps (I-9)

Safety—see Engineering Precautions (K-7)
Schools (radio) (H-4)
Secrecy systems—Radio (J-32)
Shielding and Grounding (I-26)
Short waves (F-13)
Signal Corps—see Military Radio (J-19)
Signal intensity measurement (D-10)
Simple radio circuits (F-1)
Societies—Radio (K-13)
Sound (M-8), see also Signal Intensity Measurement (D-10)
Spark gaps (I-9)
Special types of antennas (B-3)
Specifications (K-17)
Standard wave transmission (J-23)
Standardization (K-5)
Static—see Atmospherics (A-4)
Stations (J-12)
Strays—see Atmospherics (A-4)
Submarine—Radio communication (J-5)
Submarine cable (L-18)
Submarine signalling (M-13)
Suggested subjects for research (G-1)
Switchboards —Radio (I-30)
Switches (L-2)
Symbols—Radio (K-3)

Tables (K-10)
Telegraphy (L-21)
Telephone receivers (1-19)
Telephony (wire) (L-3)
Terminology radio (K-4)
Theory—Radio (F)
Thermal ammeters—see Current measurement (D-7)
Thermionic tubes—see Electron Tubes (C)
Thermocouples—see Current Measurements (D-8)
Thermoelements—see Current Measurements (D-8)
Thermophones (L-7)
Time Signals (J-22)
Towers—Radio (K-8)

Digitized by Google

Traffic (J-10)
Traffic regulations—see Legislation (K-6)
Transformers (commercial) (L-10)
Transformers (radio) (I-10)
Transmission phenomena (A-3)
Transmitting apparatus—see Stations (J-12)
Transmitting sets (I-1), see also Electron Tube Generators (C-4)
Tree telegraphy (J-36)
Triodes—see Electron Tubes (C)
Tropical radio—see Interference (J-15)
Tubes—see Electron Tubes (C)
Tuning—see Resonance (F-3)
Ultraudions—see Electron Tubes (C)
Undamped waves—see Continuous Waves (J-2), Electron Tubes (C), Arcs (I-2), Alternators (I-12)
Vacuum tubes—see Electron Tubes (C)
Vacuum apparatus (M-5)
Valves—see Electron Tubes (C)
Vibration galvanometers—see Galvanometers (L-12)
Visual signalling (M-1)
Voltage measurement (D-9)
Voltmeters (L-15)
Wave form analysis (L-20)
Wave length measurement (D-1)
Wave length assignment (J-33)
Wave phenomena—Radio (A)
Waves on wires (A-6)
Wired wireless (J-29)
X-Ray tubes (L-24)

THE foregoing classification and index, published through the courtesy of Dr. S. W. Stratton, Director of the Bureau of Standards, offers very considerable advantages to those who keep a file of notes and articles, or a directory of publications in which radio articles have appeared.

Dr. Stratton has stated that this is not a final classification, and has asked for suggestions on any subjects or methods by which it can be made more complete. In its present form, however, it serves admirably the needs of engineers and experimenters.

There are two methods of using the classification. One is to purchase a standard Irving-Pitt loose-leaf binder which takes 8½- by 11-in. paper. Heavy cardboard sheets, bearing the classification letters, will serve for the main divisions. Then clippings can be pasted or fastened with rubber cement to sheets bearing the subdivision numbers. This system has the disadvantages of being cumbersome, and requiring the cutting of the publications.

A better way is to keep the publications intact, and simply note the name, date, and page on a card arranged in a small index.

RADIO EQUIPMENT FOR SMALL BOATS

(*Continued from page* 350)

former is mounted at the front on the small center panel. The rotary gap is carried on the shaft of the motor generator. Insulated terminals and the phase adjusting handle can be seen in the side view.

Any one of three wavelengths, 300, 450 or 600 meters, can be selected by the handle at the front of the upper panel. A set of this sort is generally used on such boats as can accommodate an operator, or where one of the crew is capable of handling the radio apparatus.

BOOK REVIEW

(*Continued from page* 347)

The set is of the standardized panel type so designed as to simplify to the greatest extent the work of building a long wave receiver.

The particular value of this pamphlet lies in the fact that specific directions are given on the condensers and inductances so that the set can be depended upon to operate over its rated range of wavelengths at maximum efficiency. With a set of this type and a single wire 300 ft. long, European stations have been copied clearly at New York, without the use of an amplifier.

TWO STEP AUDIO FREQUENCY AMPLIFIER

(*Continued from page* 346)

side of the transformer. The detector B battery is left in circuit, as no provision is made on the amplifier to supply the detector plate potential.

A quick adjustment of the amplifier rheostats puts the set in operation, after the detector has been adjusted. Oftentimes the operation is improved by changing tubes, for, though they are designed to have similar characteristics, vacuum tubes do vary.

This amplifier can be used with the radio frequency amplifier described in the March, 1920, issue of EVERYDAY ENGINEERING. The audio frequency amplifier is simply inserted in the detector circuit. With this combination, signals which can be barely heard with only a detector, come in so loudly that the phones cannot be kept on the ears.

Fig. 8 gives a wiring diagram of the amplifier used with the audion receiver described in the March, 1920, issue.

A SIMPLE METHOD OF MEASURING INDUCTANCE AT LOW FREQUENCIES

(*Continued from page* 355)

METHOD OF PROCEDURE

1. Determine the correction factor R_c as explained under corrections.

2. Calibration of the bridge.

Connect a standard inductance of known value across the terminals UV and readjust the resistances R and r_2 until minimum sound is heard in the receivers.

Subtract from the value of R obtained to produce balance the correction factor R_c. To obtain the multiplying factor M of the bridge divide the value of inductance in millihenrys by the result obtained above.

$$\frac{\text{Inductance in millihenrys}}{R - R_c} = M$$

This factor is approximately .1 when the switch k is open and .01 when it is closed.

MEASUREMENT OF AN UNKNOWN INDUCTANCE

1. Obtain the value of the correction factor R_c and the multiplying constant of the bridge M as explained above.

2. Connect the inductance to be measured to the terminals U and V of the bridge and readjust R and r_2 until a balance is obtained.

The unknown inductance is then calculated in the following way.

L in millihenrys $= M (R_u - R_c)$

where R_u is the value of R for balance when L unknown is connected.

A numerical example may help to illustrate the method. Suppose $R_c = 2$ ohms. Let switch K be open. Connect a 1 millihenry coil to the terminals of the bridge and suppose the value of R = 13 ohms. The multiplying constant of the bridge is then:

$$M = \frac{1 \text{ millihenry}}{13 - 2} = \frac{1}{11} = .091$$

Suppose now that when the unknown inductance is connected to U and V and the resistance R necessary to balance the bridge is 75 ohms, the inductance can be calculated as follows:

$$L = .091 \quad (75 - 2)$$
$$= 6.64 \text{ millihenry}$$

In the April 7th issue of *The Aeroplane*, under the heading "On American Credulity" is suggested (by an American paper) the transmission of power to an aeroplane in flight by "wireless."

Suppose two power-transmitting stations are 10 miles apart, a machine can only be five miles from the source of power, so the wireless power-wave that reaches the machine would have proceeded through space five miles, not direct to the aeroplane but in every direction. That is, the power-wave reaching the machine would be part of huge wave in the form of a sphere five miles in radius (for of course wireless waves travel through the earth as well as the atmosphere) having a total area of 8,758,000,000 sq. ft.

If we assume the aerial on the machine covers 10 sq. ft. the energy derived by the receiving apparatus will be only $\frac{1}{875{,}800{,}000}$ of the total transmitted from the source, or only 0.000,000,000,114 per cent. If the machine requires a constant 400 h.p. the total transmitted power will have to be 350,320,000,000 h.p.

I think this will show what possibilities this system has!—G. GORDON DENOON.

Digitized by Google

MAKING WOOD FIRE RESISTANT WITH PAINT

FIRE retardent paints are the most practical means so far discovered by the Forest Products Laboratory by which small amounts of wood can economically be made fire resistant. The only other known methods of decreasing the inflammability of wood are to keep it wet, or to inject into it certain chemicals under pressure. These methods, though more effective than painting, are usually either impracticable or too expensive to be considered.

Ordinary calcimine or whitewash has proved in tests to be as fire resistant as any paint covering tried. It is cheap and convenient to use. Although it will not prevent the burning of wood exposed continuously to a high heat, a good coat of calcimine on wood will decrease the danger of a blaze spreading from burning cigarettes, sparks, matches, and similar small sources of fire. Calcimine is, of course, more effective for inside than for outside use.

For exterior use numerous patented fire retardent paints are available. An effective outdoor paint which has been developed at the Forest Products Laboratory consists of linseed oil, zinc borate, and chrome green. This paint has maintained its fire-resisting properties through more than three years of exposure to the weather.

RUST PROOFING

THERE is a constant demand for cheap, simple treatments of iron and steel which will give uniform coatings which are rust-proof. Sherardizing and galvanizing are well known, as is also the Bower-Barff process, which produces a surface composed mainly of Fe_3O_4. To this list may be added the recently improved phosphatic coatings which seem to be cheaper than the other processes and to give a uniformity of coating that is much in its favor.

The processing solution is composed of phosphoric acid, iron phosphate and manganese dioxide. The bath must be used under controlled conditions and is kept in constant circulation. The articles are immersed for from one to two and a half hours at a temperature of 210-212 degrees F. The treatment is considered finished when the evolution of gas ceases, whereupon the work is dried and dipped in a paraffine oil mixture and afterwards set upon pans or racks to drain. The materials treated are said to be resistant to rust and stand exposure very satisfactorily. The process is particularly adapted for the treatment of tools, motor parts, typewriter parts, and other similar pieces which should be rustproof and at the same time attractive in appearance.—*Scientific American.*



"You've Gone Way Past Me, Jim"

"Today good old Wright came to my office. All day the boys had been dropping in to congratulate me on my promotion. But with Wright it was different.

"When I had to give up school to go to work I came to the plant seeking any kind of a job—I was just a young fellow without much thought about responsibilities. They put me on the payroll and turned me over to Wright, an assistant foreman then as now. He took a kindly interest in me from the first. 'Do well the job that's given you, lad,' he said, 'and in time you'll win out.'

"Well, I did my best at my routine work, but I soon realized that if ever I was going to get ahead I must not only do my work well, but prepare for something better. So I wrote to Scranton and found I could get exactly the course I needed to learn our business. I took it up and began studying an hour or two each evening.

"Why, in just a little while my work took on a whole new meaning. Wright began giving me the most particular jobs—and asking *my* advice. And there came, also, an increase in pay. Next thing I knew I was made assistant foreman of a new department. I kept right on studying because I could see results and each day I was applying what I learned. Then there was a change and I was promoted to foreman—at good money, too.

"And now the first big goal is reached—I am superintendent, with an income that means independence, comforts and enjoyments at home—all those things that make life worth living.

"Wright is still at the same job, an example of the tragedy of lack of training. What a truth he spoke when he said today, 'You've gone 'way past me, Jim—and you deserve to.' Heads win—every time!"

Yes, it's simply a question of training. Your hands can't earn the money you need, but your head can if you give it a chance.

The International Correspondence Schools have helped more than two million men and women to win promotion, to earn more money, to know the joy of getting ahead in business and in life.

Isn't it about time to find out what they can do for you?

You, too, can have the position you want in the work of your choice, with an income that will make possible money in the bank, a home of your own, the comforts and luxuries you would like to provide your family. No matter what your age, your occupation, your education, or your means—you can do it!

All we ask is the chance to prove it—without obligation on your part or a penny of cost. That's fair, isn't it? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6066-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Show Card Writer
Electric Car Running	Outdoor Sign Painter
Heavy Electric Traction	RAILROADER
Electrical Draftsman	ILLUSTRATOR
Electric Machine Designer	DESIGNER
Telegraph Expert	BUSINESS MANAGEMENT
Practical Telephony	Private Secretary
MECHANICAL ENGINEER	BOOKKEEPER
Mechanical Draftsman	Stenographer and Typist
Toolmaker	Cert. Pub. Accountant
Ship Draftsman	Traffic Management
Machine Shop Practice	Commercial Law
Gas Engineer	GOOD ENGLISH
CIVIL ENGINEER	Common School Subjects
Surveying and Mapping	CIVIL SERVICE
MINE FOREM'N OR ENG'R	Railway Mail Clerk
ARCHITECT	STATIONARY ENGINEER
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

WIRELESS MANUAL

We make a charge of 25c for it issuing a coupon receipt redeemable on a purchase of $5 or more.

No. K-12
Ready May 25

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble.

Our 180 page combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments.

MANHATTAN ELECTRICAL SUPPLY CO., INC.

New York—17 Park Place
Chicago—114 So. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.

Digitized by Google



RADIO INTERNATIONAL

VACUUM TUBE DETECTOR
or
SINGLE STAGE AMPLIFIER

Single tube Detector and Amplifier Units are among the most useful of the Interchangeable panel instruments in the International Experimental Apparatus Line.

READY FOR IMMEDIATE DELIVERY

AUDION DETECTOR RTD-102-A $15.00

SINGLE STAGE AMPLIFIER RTA-104-A . $26.00

F. O. B. NEW YORK CITY

Write to Department 21 for our new FREE six-page catalogue.

International Radio Telegraph Company

326 BROADWAY NEW YORK CITY

We're Prompt!

You don't have to wait from three weeks to three months, for the apparatus you order. On everything except apparatus specially constructed to order, you'll have the benefit of

RECO QUALITY

Shipment Guaranteed Within Twenty-Four Hours

Audions and Amplifiers

Audion Control . . $22

Without bulb or B batteries:—

1 Step Amplifier

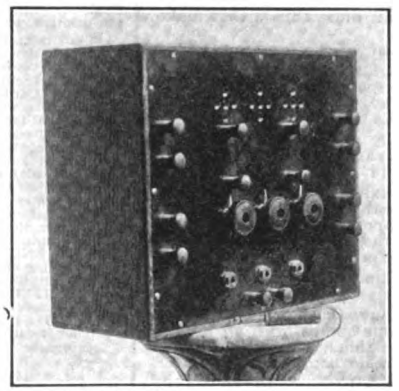
Without Detector . $28

With Detector . . . $33

2 Step Amplifier

Without Detector . $45

With Detector . . . $50



10-Ampere Reco Key

Mounted on Italian marble base, with solid silver bar contact points, finished in brushed brass or nickel. Absolutely no side play in this Key. A great big special at $6.50 postpaid.

If you want a bright, snappy, monthly bulletin that means something; send us 6c in stamps.

NEW! An Adapter for Tubular Bulbs—fits any socket; is rugged—simple and 100 per cent. efficient, and positively vibration-proof—Immediate Delivery $1.50

Radisco Agents for the South
C. D. BLAIR
P. O. Box 859
Richmond, Va.

The Radio Engineering Co.
Baltimore, Md.

614 North Calvert Street

PRACTICALLY ANYTHING A RADIO MAN WANTS IS SOLD AT THE STORE OF THE

American Electro Technical Appliance Company

HERE ARE SOME OF THE INSTRUMENTS KEPT IN STOCK

Filament Ammeters for Radio work, made by Reiler-Smith. 0—1, 0—2 Amperes. List Price, $8.20 SPECIAL $6.90

Loose Couplers, $5.00, $10.00, $15.00, $19.00.
Tuning Coils, 4,000 Meters, $4.75; 1,250 Meters, $3.50.
Murdock Variable Condensers, .001 MFD, $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 MFD, 70c; .003, 90c.
Oscillation Transformer (Murdock Type), $5.00.
Lightning Switch, 600 V.-100 AMP., $6.94.
Switch Points 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
White Metal Dials, 3", 50c.
Binding Posts, 9c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; DeForest Type, $1.50.
Western Electric Phones, $12.00.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Loads of Other Apparatus on Hand.

AMERICAN ELECTRO TECHNICAL APPLIANCE COMPANY

DEPT. EM, 235 FULTON STREET NEW YORK CITY

NAPIER'S RODS AND THEIR USE

(*Continued from page* 323)

addition of 3 to 9. It can all be seen in the cut. This gives 12. The 2 is put down as the fourth figure of the answer and the 1 is carried to the next addition, giving 1 and 4 and 1 to be added, making 6, the fifth number of the answer. The last or left-hand number of the product is 2. There is no addition for the left hand number; often there is 1 to be added to it from the preceding addition, which may have given 1 to carry.

The rods were sometimes made square and the four sides used for different sets of multiplications. It was his practise with four-sided rods to put the alternate sides in reverse; this is shown in the cut. The rods were very popular in old times; at the tercentenary of Sir Charles Napier, which was celebrated in Edinburgh a few years ago, a number of sets were exhibited, which had come down from former days. On square rods the numbers were so selected that the sum of the index numbers on alternate faces were equal. The sequence of numbers on the four faces of the rods ran as follows: 9, 8, 0, 1; 7, 9, 2, 0; 6, 9, 3, 0; 3, 4, 6, 5 and so on. They ran ten to the set, and a typical size was 2½ inches long and 3/16 inch square.

When square rods with reversed figures are used, the top index figure has to be omitted, and only nine squares put on each rod.

TO MAKE A HOLE IN GLASS

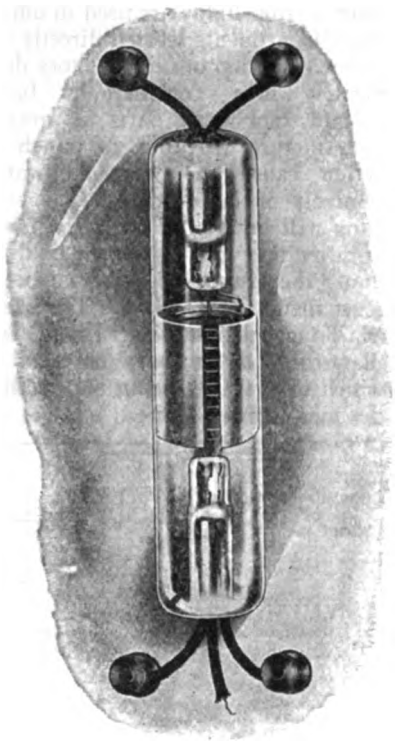
MAKE a circle of clay or cement rather larger than the intended hole; pour some kerosene into the cup thus formed, ignite it, place the plate upon a moderately hard support, and with a stick rather smaller than the hole required, and a hammer, strike a rather sharp blow. This will leave a rough-edged hole, which may be smoothed with a file. Cold water is said to answer even better than a blow.

While phosphorus is an excellent ingredient in bronzes if used properly, it can likewise become harmful if not employed in the right manner. Too much phosphorus in the copper and tin bronzes (without zinc in them) will cause the tin to separate in hard "tin-spots." When zinc is present in the bronzes, a very small amount of phosphorus only can be employed. A large amount causes blowholes. The amount of phosphorus to use is as follows: When no zinc is present, about 0.25 per cent. When zinc is present, from 0.01 to 0.02 per cent.

Digitized by Google

AUDIOTRON

The Original Tubular Vacuum Detector, Amplifier, Oscillator



NOW FREE FROM ALL RESTRICTIONS

Dealers and Amateurs!—

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now offered for amateur and experimental uses in radio communication without any restrictions whatever. They are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

All patent questions also have been definitely settled. AUDIOTRON is the first and only amateur vacuum tube licensed under Fleming. Vacuum tube patents are basic and have been sustained by the Federal Courts.

Be sure to get genuine AUDIOTRONS. They outclass any other form of detector and are absolutely free from all legal restrictions or difficulties. These new uses make it even more necessary to insist on the genuine. You can always tell a real AUDIOTRON by the name stamped plainly on the glass.

Insist on the name AUDIOTRON on every tube you purchase. Fully guaranteed by the AUDIOTRON Mfg. Co. (*Read the guaranty below.*)

Your last chance for an AUDIOTRON *double filament* DETECTOR

Manufacturing reasons make it impossible to continue the present hand made AUDIOTRON.

This type has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40.

The few thousand that will still be produced, however, will be of the same standard of excellence that has characterized every AUDIOTRON. Already recognized as the most sensitive detector on the market, these few that still remain, with all restrictions on amateur use lifted, are undoubtedly the greatest opportunity ever offered to amateur radio operators.

See your dealer at once or order direct. Be sure to benefit by this last opportunity to secure a hand made super-sensitive double filament AUDIOTRON Detector, Amplifier, Oscillator.

$6.00 each

No Increase in price

The AUDIOTRON Exclusive Guaranty: Each and every AUDIOTRON is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AUDIOTRON MFG. COMPANY

(*Successors to the AUDIOTRON Sales Co.*)

Dept. V Lick Bldg. San Francisco, California

Dealers—

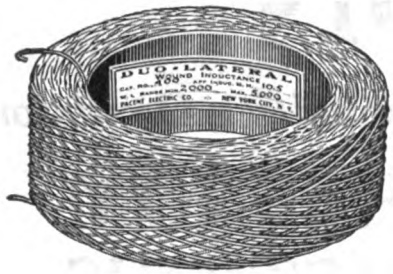
Get in touch with the AUDIOTRON Mfg. Co. at once. We will give you full information about settlement of all patent difficulties. *You will also be interested in our new proposition for wide awake dealers.*

After the present supply is exhausted, new types of AUDIOTRON, manufactured entirely by machinery, will be offered for sale. Our extensive advertising during the Fall will establish definitely the superiority of the AUDIOTRON and will create new sales for you. Be sure to take advantage of our full co-operation at once. Prepare to cash in on the AUDIOTRON reputation, established since 1915.

Write us today for full details.

Digitized by Google

NEW RADIO PRODUCTS *and* PERSONAL SERVICE



In endeavoring to give personal service to our ever growing clientele, we realize that new and more modern products make for the betterment and improvement of radio work and to this end we offer you the latest scientific achievement in radio

DUO LATERAL WOUND COILS

made in several different sizes covering every wavelength, these coils have staggered winding and a lower natural period, lower high frequency resistance, very low distributed capacity, lower D. C. resistance and higher self inductance, which makes it an ideal part of any set and superior to all other coils for amateur work.

Radio Engineers have made extensive tests of these coils and give them their highest recommendations.

ORDER BY CATALOG NUMBER AS LISTED

Catalog Number	Working Wavelength Range in Meters	Inductance in Millihenries		List Price Each Unmounted
25	130 to 250	.045	.045	$ .90
35	180 to 450	.075	.073	1.00
50	250 to 700	.156	.15	1.10
75	400 to 900	.36	.34	1.20
100	500 to 1400	.66	.57	1.30
150	600 to 2000	1.40	1.35	1.40
200	1000 to 2500	2.50	2.30	1.50
250	1200 to 3500	4.2	4.	1.60
300	1500 to 4500	6.25	6.1	1.80
400	2000 to 5000	10.62	10.2	2.00
500	3000 to 6000	17.6	17.3	2.20
600	4000 to 10000	25.0	22.0	2.50
750	5000 to 12000	38.0	35.3	2.70
1000	8000 to 15000	72.8	68.3	2.90
1250	10000 to 20000	116.6	112.3	3.50
1500	15000 to 25000	171.5	162.2	4.00

We also carry a large stock of high grade electrical apparatus, including a very complete line of heating appliances.

You have our most courteous invitation to spend a few moments in our spacious show rooms and look over our complete stock. We will gladly show you any instrument or part you may desire to examine. It will be a revelation to you, besides it is part of our service.

OUR WORD OF HONOR TO YOU IS OUR GUARANTEE. LET US PROVE IT.

Write Dept. F6 for literature and price lists

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DiBlasi, Secy. J. Stantley, Treas.

6 Warren Street - - - - New York

SUMMER CONSTRUCTION

of that new radio set should incorporate new, efficient and inexpensive improvements. "ARRANBEE JACKS AND PLUGS" accomplish such a purpose.

Use "ARRANBEE JACKS AND PLUGS" for cutting in additional headsets; on receiving or audion control panels in place of binding posts; for miniature experimental board for conveniently variable vacuum tube or other circuits, and for hundreds of other practical uses.



"ARRANBEE JACKS AND PLUGS" mean a new era in construction of future radio instruments. Go to your dealer NOW and ask him for them. He will get them for you if you want them. Made by the makers of the famous "STANDARD VT BATTERY."

"ARRANBEE JACKS AND PLUGS," nickel plated, $1.50 per dozen.

RICHTER & BYRNE, *Manufacturers*

198 Roebling Street, Brooklyn, N. Y.

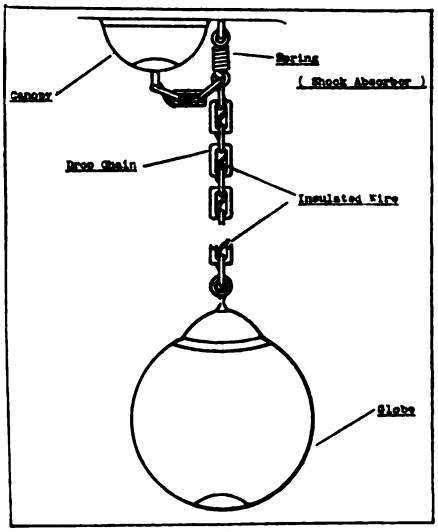
PACENT ELECTRIC CO., Inc., SOLE EASTERN AGENTS, 150 NASSAU ST., NEW YORK CITY.

Should you know of a worthy young man desirous of obtaining a good technical education and making a good future for himself refer him to our announcement on page 379 of this number.

SIMPLE APPLIANCE SAVES LAMPS

By A. A. Michaud

HUNDREDS of shop managers and plant office managers are apt to overlook the largest and most important expense factor entering into lighting costs and by drawing their attention to it, they will eliminate the underlying cause and in consequence, lower the lighting bill considerably. This applies to hundreds of cases where powerful electric drop-lights are used in offices or shop departments located directly below a machine shop or other factory department, where considerable banging around, moving of parts in process of manufacture, trucking, or punch press action, causes the floor to vibrate excessively or jar quickly. The sudden bang will invariably break the filament or sever the wire in the lamp, directly under the disturbance, and a new lamp must then take its place. The filament of Tungsten lamps are more fragile than those of ordinary carbon lamps, which are rapidly being superseded by the more efficient type.



Spring suspension to save fragile lamps

An office using 40 250-volt, 200-watt lamps, and located under a machine shop (where only *light* parts were being manufactured) came under the writer's observation, and it developed that a daily average of four lamps were replaced at a cost of $1.75 each, or a total daily expense in that department alone of $7.00. As this daily loss was continued for a long time in an office with only 40 lights, located under a machine shop making *light* parts, the reader will appreciate the great saving to a company having many large offices and shops that come directly under departments making *heavy* parts, and the unnecessary expense incurred in some cases must amount to thousands of dollars annually. In fact, inasmuch as the bad lamps are usually replaced by the electrician or assistant before or after office hours—there being nearly adequate light during the day from nearby

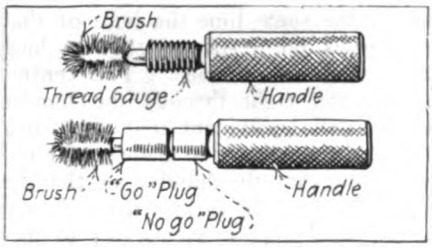
Digitized by Google

lights not coming directly under the cause of destruction—this unnecessary expense is not likely to come under the observation of a responsible person. And, again, it is hardly necessary to mention the inconvenience sometimes felt when there is no light at all at a time when it is most needed, as in the case of sudden darkness brought about by an impending storm, or at a time when night work is required, in the offices that use very little artificial light during the day.

The accompanying drawing shows the practical remedy that was adopted several months ago by the concern using only 40 large drop lights in their offices, and the worth while saving has proved its practicability, and at the present time the lights in the shop are being equipped with these springs.

BRUSH AND GAGE COMBINATION

A CONCERN in Springfield, Mass., has brought out the gage illustrated herewith. The brush serves to clean the dirt from the hole to be gaged, and it is claimed that, thus equipped, the life of the gage is lengthened by not coming in contact with a hole charged with gritty substances. The bristles



Brush and gage combination

are of slightly varying lengths so that when the brush is used in connection with a thread gage they tend to clean out the thread at both top and bottom. As plug gages are usually finished to limits of 1/10,000 of an inch with highly polished surfaces, the importance of inserting the gage into clean holes is important as it reduces the time needed for checking and refinishing due to wear from grit.

DIE STOCK FOR SMALL DIES

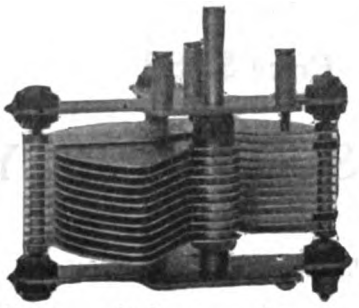
IN various classes of automobile and electrical work and also in machinery making, it is necessary to thread small screws or studs that cannot be removed from the place in which they are screwed very easily and which would be difficult to handle with the ordinary form of "T" handle die stock.

The tool illustrated is made by turning down a piece of steel to the size required to handle standard small, round dies. The shank of the device is a piece of pipe or tube, a 3/8-in. gas pipe being used in some cases, and this

(*Continued on page* 364)

THE NEW

A. R. Co Variable Condenser

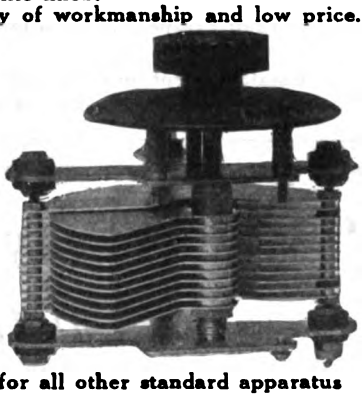


We offer Radio Men something out of the ordinary in variable condensers. This new model is a step ahead of its rivals in that the plates are made of aluminum and heavier than those found in the average condensers. The rotary plates are rounded at one end, not the usual semi-circular type, thus affording a straight line capacity, which is a very valuable feature in Wave Meter work. The zero capacity in an instrument of this type is considerably lower than that of usual condensers.

Shaft on which rotary plates are mounted is carefully machined from tool steel. Instrument can be quickly mounted in case or behind panel.
Made in two capacities, furnished unmounted only, with or without dial of fine black moulded composition and bakelite knob.
Backed up by Radisco guaranteed quality of workmanship and low price.

Capacity	Unmounted	With Dial & Knob
.0005 mf.	$5.00	$6.00
.001 mf.	6.25	7.25

Shipping weight 2 pounds.



Prices quoted do not include carrying charges to Pacific Coast or duty paid for Canadian use.

RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry the RADISCO COILS, Better "B" Batteries and are our Agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM.

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace
ATLANTIC CITY, N. J.
Independent Radio Supply Co.,
118 So. New Jersey Ave.
BALTIMORE, MD.
Radio Engineering Co.,
614 North Calvert St.
BEINVILLE, QUEBEC, CAN.
Canadian Radio Mfg. Co.
BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street
BROOKLYN, N. Y.
Kelly & Phillips Electric Co.,
312 Flatbush Ave.
BRONX, NEW YORK
Amateur Wireless Equipment Co.,
1390 Prospect Ave.
CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.
EUREKA, PEORIA, ILLINOIS
Klaus Radio Co.
KANSAS CITY, MO.
McCreary Radio Supply,
4th and Delaware Streets
LOS ANGELES, CALIF.
The Wireless Shop,
511 West Washington St.
MONTREAL, CAN.
J. B. Miller,
1600 Hutchinson St.
McKEESPORT, PA.
K. & L. Electric Co.,
427 Olive Street
NEW ORLEANS, LA.
L. A. Rose,
121 Camp Street
NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street.
NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave. "8HA"
PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets.
PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington Street.
PITTSBURG, PA.
Radio Electric Co.,
3807 Fifth Ave.
SEATTLE, WASH.
Northwest Radio Service Co.,
1801 Sixth Ave.
SCRANTON, PA.
Shotton Radio Mfg. Co.,
P. O. Box 3,
Branch 8 Kingsbury St.,
Jamestown, N. Y.
SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street
TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street.
WASHINGTON, D. C.
National Radio Supply Co.,
808 Ninth Street, N. W.
WICHITA, KAN.
The Cosradio Co.,
1725 Fairmount Ave.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY - Newark, New Jersey

Digitized by Google

ATTENTION AMATEURS



The only practical adapter

Price $1.50

RADISCO AGENCY

We make up sets to specifications

Made by the

AMATEUR WIRELESS EQUIPMENT CO.

1390 Prospect Ave., Bronx, N. Y.

Catalogue sent on receipt of 10c, which may be deducted from first order.

AWE NY CO

Dealers write for proposition

"Sparks" says:

"Lasting Satisfaction

is measured to a great extent by the initial quality of the radio apparatus you purchase."

Our high grade line of Standard-make Commercial and Amateur Radio equipment embodies the latest ideas in design and workmanship which assure you of lasting satisfaction under all operating conditions.

Our Specialty

is rendering you such Service that you may always know your interests will be looked after as to Quality and price.

Call on us when in town. Your wants will be Quickly and Satisfactorily looked after.

Our latest catalog is yours for 10 cents to cover postage. Write for it today.

"Quality Radio Apparatus and service"

The International Electric Co.

Eugene Dynner, President

226-A Fulton Street New York, N. Y., U. S. A.

PRECISION AUDION CONTROL UNITS

TYPE AU-1	DETECTOR PANEL	$24.00
TYPE AU-1X	DETECTOR PANEL (For Tubular Audions)	$27.50
TYPE AU-3	TWO STAGE AMPLIFIER	$57.50
TYPE AU-4	TWO STAGE AMPLIFIER WITH DETECTOR	$67.50

Standard, compact instruments, mounted on dull grained finished Bakelite panels, tubes behind the panels. All types one size, measuring 7⅜" by 8⅜" and fitted in standard interchangeable cases measuring 4¾" by 7⅝" by 8⅝" hand rubbed mission finish, and provided with hinged cover permitting inspection and tube renewals.

All instruments arranged to be used with regenerative circuits and sold without tubes or plate batteries.

J. EDW. BROADBELT, JR.

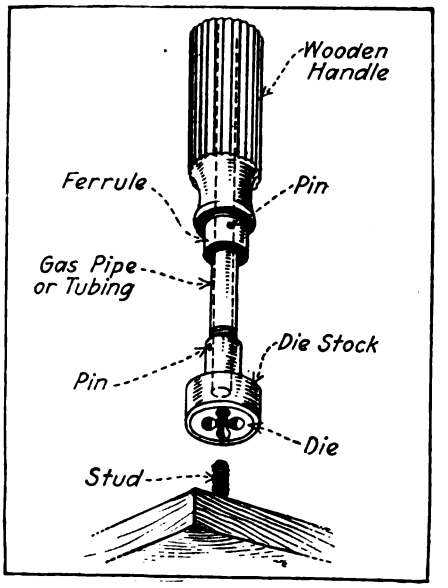
Maker of **PRECISION RADIO EQUIPMENT**

553 E. Thirty-eighth Street Baltimore, Md.

BE SURE AND ORDER YOUR COPY

OF EVERYDAY ENGINEERING MAGAZINE FOR AUGUST NOW TO INSURE GETTING IT

pipe is provided with a wooden or metal handle. A pin through the handle is used to secure that member to the shank and care should be taken in driving the pins at both ends of the tool so that they will be put to one side of the hole. This will hold the shank from turning just as securely as though they were driven right through the tube



Die stock for small dies

and at the same time the bore of that member is not restricted so that long studs may be threaded. The central hole is cut right through the handle and it will be evident that very long threaded pieces may be made as the rod will pass into the handle as the die feeds down. The various uses of such a tool will suggest themselves to mechanical men.

HANDY OILER FOR TOOLS

MANY workmen and mechanics allow their tools to rust because of the bother of oiling up a rag and rubbing the tools over every time they leave them. To be continually fussing with an oil-can and an oily rag is more or less inconvenient so here is a little kink to relieve the situation.

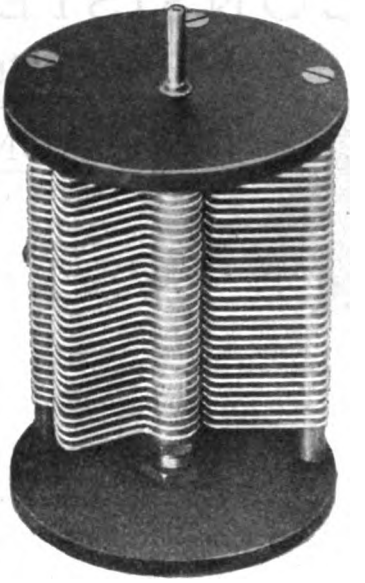
Procure a small tin with a cover similar to a salve box. Then cut a strip of felt or heavy flannel just a little wider than the depth of the box and coil the strip of cloth inside until the box is completely filled. Press the layers together and squeeze in as much of the cloth as is necessary to make a compact mass.

Then saturate this felt-filled box with machine oil. When in the proper condition it will remind one of an ink-pad. Then when a tool is to be oiled simply remove the box cover and draw the tool over the oily padding as much as necessary and the job is done without soiling the hands. Replace cover on box when not in use to keep out the dust.—*L. B. Robbins.*

Digitized by Google

The G. A. Standardized Condenser

GIVES THAT DEGREE OF PRIDE AND SATISFACTION YOU EXPECT FROM AN EXPENSIVE INSTRUMENT



While designed as a precision laboratory instrument, the G. A. STANDARDIZED CONDENSERS are invariably the choice of those who require maximum efficiency in receiving sets or vacuum tube transmitters.

Under actual comparison with condensers having moulded composition insulation, the signal strength and sharpness of tuning of a receiver is greater with the G. A. STANDARDIZED CONDENSERS. In vacuum tube transmitters, the radiation is increased as much as 20%, due to the perfect insulation of the Bakelite end plates. The capacity ratio of G. A. condensers is higher than that of any other make. The condenser can be mounted by securing the upper end plate to the panel. Radisco or similar dials can be used.

SPECIFICATIONS:—Small size, 0.00001 to 0.000585 mfd., 29 plates, height over shaft, 3½ ins. Large size, 0.000015 to 0.00115 mfd., 59 plates, height over shaft, 6⅝ ins. 3/16 in. shaft protrudes 1 in., threaded for 6/32 screw. End plates ¼ in. Bakelite 3¾ ins. diam.

PRICE:—Small size, $8.85, wt. 2 lbs. Large size, $13.65, wt. 4 lbs. Calibration curve for either size, $0.50.

Send 3c stamp for the G. A. Bulletin of Radio and Model Supplies

BUY YOUR SUPPLIES AT THE G. A. STORE

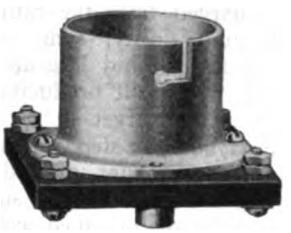
G.A.

OPEN UNTIL NINE O'CLOCK EVERY EVENING

THE GENERAL APPARATUS COMPANY

4310-A Broadway at 183rd St. New York City

O, What a Pal



was Mary, but say boy, do you know an up-to-the-minute radio installation is SOME pal too?

We manufacture high grade apparatus only.

Here is a good value—The Ace V.T. Socket—with grid leak at $1.50 each. Better buy Ace equipment than be sorry you did not. Ask your dealer.

The Precision Equipment Company

2437 Gilbert Ave., Dept. B, Cincinnati, Ohio

Federal Radio Accessories

Are the Recognized STANDARDS for Their Respective Uses.

BULLETIN 102 W.A.

Gives full description. Besides it contains valuable information on

AMPLIFICATION of Radio Signals

Send 6c in Stamps today and receive this Bulletin.

FEDERAL TELEPHONE AND TELEGRAPH CO.
1756 Elmwood Avenue
BUFFALO, N. Y.

Recognized as the largest and best

Service Radio School

INCORPORATED

Send ten cents for descriptive catalogue to
Dept. E, 900-902 Penna. Ave., N. W., Washington, D. C.

PACENT ELECTRIC COMPANY

Builders and specialists in Electrical, Radio and Laboratory equipment.

SALES AGENTS
for
DUBILIER CONDENSERS,
DUO-LATERAL COILS,
GREBE APPARATUS,
MAGNAVOX PRODUCTS,
RAWSON METERS,
STANDARD VT BATTERIES,
and other first class equipment.

Telephone Beekman 5810
150 NASSAU STREET, NEW YORK CITY

REWINDING A. C. MOTORS

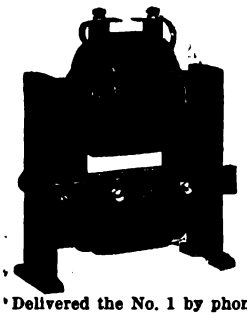
And all methods for connecting and reconnecting are clearly shown in the ELECTRICAL WORKERS FRIEND. 66 diagrams with detailed explanations solving every rewinding and reconnecting problem. Electricians and Experimenters will find this book exactly what the name implies "The Electrical Workers Friend." Price $4.00 Cash with order or (C.O.D.—U.S.A. only).

HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Penna.

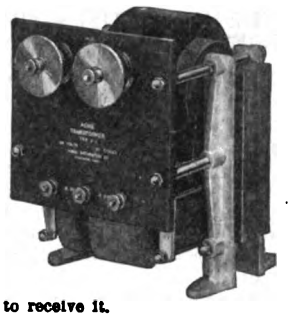
Subscribe to Everyday Engineering Magazine Now And You Will Be Sure to Get Every Issue. See Special Offer On Page 294—Books Given Away Free.

Digitized by Google

CONSISTENT RESULTS



Testimonials



ACME 250

Boston—New York

"To 1DQ:

"Your sigs come in great here OM. Am 25 miles north of New York City. I only wish you could exchange places for a night. All the thirteen messages received OK. Delivered the No. 1 by phone this A. M. Mrs. P——— was glad to receive it.

"I radiate only three amps now. Set isn't tuned up good at all. Expect to get six amps very soon and maybe then you will not have any trouble in getting me. (It's 180 miles.)

"I know Boston pretty well OM. Was up there for a year with the United Fruit Co.'s Ships. "73" to all. Tell 1AE I hear him but QRM bad from New York City."NAME ON REQUEST.

(*1 AE Uses an ACME TRANSFORMER*)

ACME ½ KW—1100 MILES

"I have now used the **Acme ½ KW Transformer** for about five months. During that period I have worked the following stations outside of my district in spite of the bad conditions that exist in New England and in spite of the fact that I am in the heart of a fairly large city.

2BB 2BM 2BN 2DA 2JU 2KX 2TF 2XH 3CC 8CB 8CC 8DR 8DV 8DY 8EN 8EV 8JQ.

These are the stations actually worked and I have received numerous cards from all distances up to 1100 miles. The record being Capleville, Tenn., just 1100 miles, where I was copied QSA with single auditron bulb and loose coupler." NAME ON REQUEST.

ACME 1 KW—1700 MILES

St. Louis, Mo.

"The following relay message received from the "K———," after working him several times while he was near Panama. Speaks mighty well for the 1 KW ACME TRANSFORMER.

'Letter received through Hicks. Will be in Gulf of Mexico 22nd. Listen for you 9 P. M. nightly. YOU STRONG OFF PANAMA. Write upon return to New York.'"

NAME ON REQUEST.

BULLETINS ON REQUEST

ACME APPARATUS COMPANY

24 Windsor Street Cambridge 39, Mass.

TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS

To the Radio Engineer Radio Manufacturer Radio Amateur

You cannot afford to do without the

PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS

In it, you will find all the latest information on **Transmitters, Receivers, Bulbs, Radio Telephony, Elimination of Strays,** and every other **important radio topic.**

Subscription per year { **$9.00 (in U. S.)** / **9.60 (abroad)** }

Address

Secretary,

INSTITUTE OF RADIO ENGINEERS

COLLEGE OF THE CITY OF NEW YORK

Arnold Loose Couplers

Combination Loose Coupler Parts and accessories.

Send 4c stamp for literature which is sure to interest you.

J. F. ARNOLD 2082 Lexington Av., N.Y. Established 1910

RADIO APPARATUS on the **INSTALLMENT PLAN**

Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.

J. DONALD VANDERCOOK

LOMBARD Box 442 ILLINOIS

SEMI-LUMINOUS PAINT

SOON after the discovery of radium by the Curies in 1898 certain fluorescent and phosphorescent mineral compounds were found to be so sensitive to the radio activity of this element that they show luminescence when only brought near it, actual contact being unnecessary. A fine quality of zinc sulphid known as Sidot's blende proved to be the most responsive, says W. S. Andrews in the *General Electric Review.* Sir William Crookes by the invention of his ingenious spinthariscope brought this phenomenon of radio-active luminescence prominently before the public eye. This device consists of a dark chamber enclosing a disk of cardboard that is coated with zinc sulphid. A small wire is fixed above the disk so that one end of it is very close to the sulphid but not touching it and a microscopic speck of salt of radium is attached to this end of the wire. When this combination is observed through a magnifying lens of proper power, the zinc sulphid is seen to be perpetually scintillating with innumerable little stars in the vicinity of the radium. This remarkable appearance is caused by the alpha rays that are discharged from the radium with tremendous velocity, some of which bombard the sulphid like atomic cannon balls, every hit producing a flash of light on the target.

A next obvious step was to mix a very minute amount of radium salt with finely powdered zinc sulphid so that it might be combined with a suitable adhesive and used as a self-luminous paint. For a long time this paint was looked upon only as an interesting scientific curiosity, but during recent years it has been applied in various useful ways to make small objects constantly visible in the dark. For example, it is now used extensively on the hands and dials of watches and clocks, making it easy to tell the time in total darkness; also on the pointers of aeroplane and prismatic compasses and other instruments. One of its most recent and convenient applications is on electric switch buttons, drop chain sockets, etc., thereby guiding a person directly to the switch in a dark room.

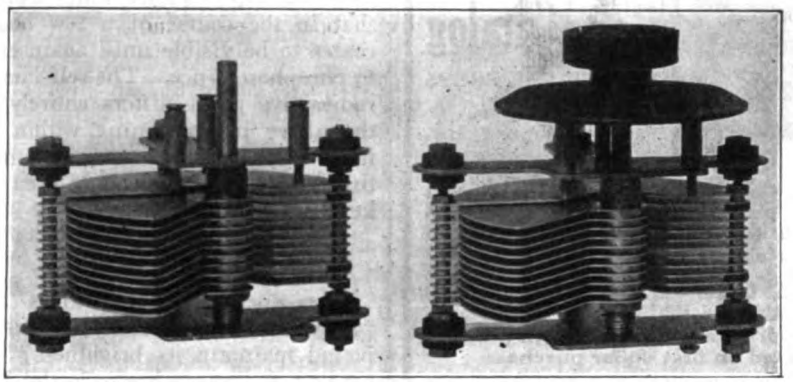
Phosphorescent Paint.

This radio-active self-luminous paint must not be confounded with an article that has been on the market for many years under the name of "Balmain's luminous paint," which was invented by Professor Balmain, of the London University, about the year 1875. The base of the Balmain paint is a special preparation of phosphorescent calcium sulphid, and it requires the excitation of a strong light to make it shine. It absorbs the luminous radiation and then emits it again as a soft phosphorescent

(*Continued on page* 368)

Digitized by Google

"THE ATLANTIC RADIO COMPANY VARIABLE CONDENSER"



THE "ARCO" VARIABLE CONDENSER, illustrated above, is made in two capacities—.0005 Mfd. and .001 Mfd.

The rotary plates are rounded on one end, affording a straight-line capacity — a valuable feature in wave meter work. The condenser is furnished unmounted only, but with the addition of Dial and Knob, if desired. Dial is of moulded composition, scale in white—0-100 reading. Bakelite Knob. We can guarantee this condenser in every way as to quality, reliability and satisfaction. The low price is decidedly an innovation.

PRICES:

Capacity	Unmounted	With Dial and Knob
.0005 Mfd.	$5.00	$6.00
.001 Mfd.	6.25	7.25

"BULLETIN 14"—describing and illustrating the best in RADIO EQUIPMENT will be mailed upon receipt of 10 cents in stamps. This amount may be deducted on your first order of $1.00 or over.

ATLANTIC RADIO CO., Inc.

New England Distributors "Radisco" Products

88 BROAD STREET **BOSTON 9, MASS.**

COMMERCIAL EXPERIMENTAL wicony RADIO PRODUCTS EDUCATIONAL LABORATORY

A More Comprehensive WICONY SERVICE

The Radio Art has long known *Wicony* to stand for *perfection* as applied to Navy, Army and Commercial radio apparatus.

The Radio Art will now know *Wicony* to stand for *perfection* as applied to specially designed amateur and experimental radio apparatus.

Radio Dealers, amateurs and *experimenters* have been freely consulted. Therefore, this new service is really yours—outlined by men who would consider the matter from *your* point of view.

Watch for further announcements in Radio periodicals.

DEALERS: It will pay you to write us now.

WIRELESS IMPROVEMENT COMPANY

Radio Engineers, Manufacturers and Distributors.

47-B West Street **New York City**

"ASK ANYONE WHO HAS USED IT"

What Our Patrons Say:

"You manufacture a brand of phones that surpass all of equal price and most of higher price." (Name on Request.)

Brandes Wireless Headset



Superior, 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOG M

C. BRANDES INC. 32 Union Square, Room 822, New York

WIRELESS RECEIVER SPECIALISTS

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

RADIO APPARATUS

Distributors of reliable Radio apparatus for experimenters in every branch of the Radio field!

"Pittsco" The sign of service.

"Remember" We carry an immense stock.

Honey-Comb Coils

LITZENDRAHT WIRE.		(While they last.)
LL-75	330-1030 meters	$1.60
LL-100	450-1460 "	$1.70
LL-150	660-2200 "	$2.00
LL-200	930-2850 "	$2.10
LL-250	1300-4000 "	$2.30
LL-300	1550-4800 "	$2.50
LL-400	2050-6300 "	$2.80
LL-600	4000-12000 "	$3.00
LL-750	5000-15000 "	$3.20
LL-1000	6200-19000 "	$3.50
LL-1250	7000-21000 "	$3.90

Note:—These are the genuine DeForest litz coils.

Transmitting Condensers

(Dubilier)

Type	Watts	Cap	Price
D-100	250	.007	$19.00
D-101	500	.007	$30.00
D-102	1000	.007	$45.00
D-103	1000 Spec.	.007	$50.00
D-150	For C. W. or spark coil transmitters, .0024 MF., 8000 volts		$ 5.00

F. D. Pitts Co. Boston, Mass. Transmitting Transformers

(New Type Acme)

Acme	250 Watt	mounted	$16.00
"	250 "	unmounted	$13.00
"	500 "	mounted	$22.00
"	500 "	unmounted	$18.00
"	1000 "	mounted	$33.00
"	1000 "	unmounted	$28.00

F. D. Pitts Co. Boston, Mass. Continuous Wave, Power Transformers

(For Wireless Telephone)

Acme	200 Watt	C. W. Power trans. unmounted	$16.00
"	200 "	C. W. Power trans. mounted	$20.00
"	50 "	C. W. Power trans. mounted	$15.00
"	50 "	C. W. Power trans. unmounted	$12.00

F. D. Pitts Co. Boston, Mass. Modulation Transformers

(For Wireless Telephone)

Acme	A-3 unmounted	$4.50
"	A-3 semi-mounted	$5.00
"	A-3 mounted	$7.00

F. D. Pitts Co. Boston, Mass. Quenched Gaps

Amrad	G-1 1	K. W. type	$29.75
"	G-2 ½	K. W. type	$18.85
"	G-3 ¼	K. W. type	$13.50

F. D. Pitts Co. Boston, Mass.

Important! Every article sent to any part of the U. S. A. Postage prepaid. We want your business. Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

12 Park Square Dept. F.

BOSTON, MASS., U. S. A.



DUCK'S No. 14 264 Pages Electrical and Wireless Catalog

JUST OFF THE PRESS

175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.

244-246 Superior Street, Toledo, Ohio

BURGESS "B" BATTERIES

SEVERAL SIZES FOR SPECIAL WORK



SEND FOR CATALOGUE

BURGESS BATTERY COMPANY

HARRIS TRUST BLDG.- CHICAGO, ILL.

"POROX"

"Trade Mark"

High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.

Special Batteries made to order also duplicating of foreign batteries.

Prices on request.

ALBERT MULLER

8758 Queens Boulevard

Jamaica, Long Island, N. Y

SEMI-LUMINOUS PAINT

(*Continued from page* 366)

glow which gradually fades away, so that in the course of a few hours it ceases to be visible until again excited to phosphorescence. The self-luminous radi-active paint differs entirely from the above in containing within itself its own exciting power, so that it continues to shine indefinitely even when kept in perpetual darkness.

Life of Radium.

The question is sometimes asked, "How long will the self-luminous compound maintain its brightness?" According to recent research the "half-period" decay of radium is 1750 years. Based on this assumption, and taking for example one gram of radium to start with, one-half of this will disappear by spontaneous decomposition in 1750 years, leaving half a gram. During the next period of 1750 years one-half of this remainder will disappear, leaving one-quarter gram, and so on. It is thus evident that, for all practical purposes, the life of the radium content may be considered unlimited. Not so, however, with the zinc sulphid, the quality of which in itself is subject to considerable variation according to its purity and the method of its preparation. There appears to be a certain amount of luminous quality locked up, so to speak, in the zinc sulphid. This quantum of light-producing ability may be liberated and used up quickly and with high intensity by strong excitation, or slowly and with a lower intensity by a weaker excitation. Therefore, assuming the use of a uniform quality of zinc sulphid, the useful life of a very bright self-luminous compound will naturally be shorter than that of a compound showing a weaker luminescence will depend on the percentage of radium element mixed with the zinc sulphid.

Factors Determining Life of Luminous Paint.

An incandescent lamp may be taken as a familiar illustration of this argument. We may compare the voltage used on the lamp to the radium, and the filament to the zinc sulphid. We all know that an incandescent lamp operated at a voltage well below normal has a very long life and, vice versa, when it is operated at a voltage much higher than normal its life is short. These results are practically parallel with the results which obtain in connection with self-lumious paint. The normal voltage for an incandescent lamp is arbitrarily described by conditions under which it will produce a satisfactory light for a reasonable number of hours, and these same conditions may be applied to the consideration of a proper degree of brightness for self-

Digitized by Google

luminous radium-zinc compounds. If a compound containing, say 100 micrograms of radium element per gram of zinc sulphid has a useful life of 20 years, it is reasonable to infer that by doubling the radium content the luminescence will be increased about twofold; but the useful life will be halved, or reduced to 10 years.

The satisfactory luminescent intensity of a radio-compound will depend largely on the purpose for which it is used, this is also involving the area of the luminous surface employed, so that no fixed standard of light per unit of surface can be adopted. For army and navy purposes the United States Government calls for a guarantee on self-luminous paint that it shall maintain an undiminished luminosity for 2 years.

It is well known that the phenomenon of radio-activity is not confined to radium. A product of thorium, known as radio-thorium, is intensely radio-active, but it has a much shorter life than radium, its half period of existence being estimated at only 3 or 4 years. Meso-thorium, from which radio-thorium is evolved, is a by-product of the incandescent gas mantle industry and on account of its relative cheapness as compared with radium it is now being used extensively either by itself or combined with radium in the production of self-luminous paints.

UNITED STATES AND THE WORLD

The United States has only 6 per cent of the population of the world and only 7 per cent of the land, yet it produces:

20 per cent of the World's supply of Gold,

25 per cent of the World's supply of Wheat,

40 per cent of the World's supply of Iron and Steel,

40 per cent of the World's supply of Lead,

40 per cent of the World's supply of Silver,

50 per cent of the World's supply of Zinc,

52 per cent of the World's supply of Coal,

60 per cent of the World's supply of Cotton,

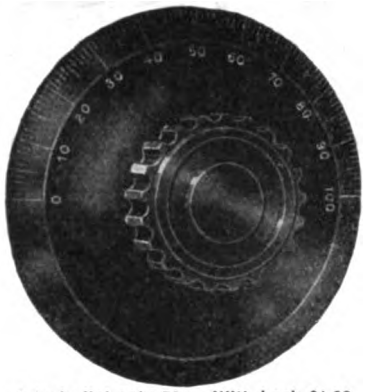
60 per cent of the World's supply of Copper,

60 per cent of the World's supply of Aluminum,

66 per cent of the World's supply of Oil,

75 per cent of the World's supply of Corn,

85 per cent of the World's supply of Automobiles.



3 inch dial only 75c. With knob $1.30 Postpaid
3⅞ inch dial only $1.00. With knob $1.70 Postpaid

A More Improved INDICATING DIAL

This new dial made of same quality and workmanship as our famous smaller one, is marketed to fulfill the demand for a dial to fit the standard ¼ inch Shaft. Made of black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter is 3⅞ inches, and 3/16 inches thick. Bevelled edge. Knob has set screw to clamp shaft of instrument.

Moorhead Electron Relay New Style.....$6.00
Moorhead V.T. Amplifier..... 7.00
Moorhead Extra Hard V.T..... 7.50

Shipping weight 1 pound. Guaranteed. Licensed under Fleming and De Forest Patents.

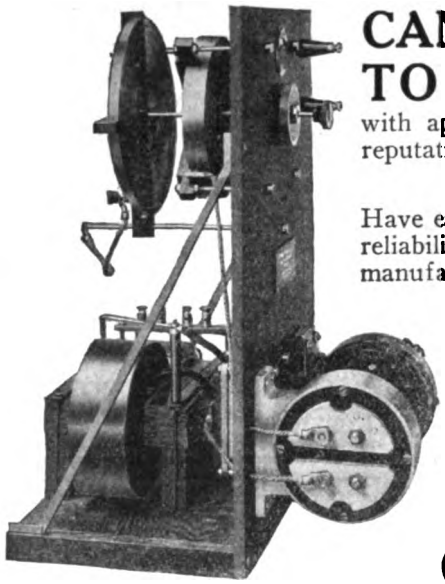
OUR NEW CATALOG now ready for distribution contains 24 snappy pages of news and descriptions of all standard Radio parts, including the above indicating dial.

Sent anywhere upon receipt of 10c.

For sale at all Radisco Agencies and by

A. H. CORWIN & CO.

4 West Park Street **Newark, N. J.**



½ KW. PANEL TYPE HYTONE TRANSMITTER. PRICE $250.00

CAN YOU AFFORD TO EXPERIMENT

with apparatus without an established reputation?

OUR PRODUCTS

Have earned an enviable reputation for reliability during 13 years of continuous manufacture.

OUR LINE

is most complete and is carried by most good dealers.

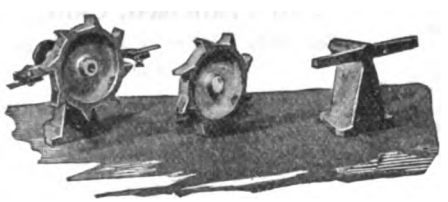
OUR CATALOG

will be mailed for 6c stamps and our prices are most reasonable—quality considered.

Clapp Eastham Co.

131 Main Street, Cambridge, Mass.

WILCOX ROTARY GAP



Belt-driven
Solid balanced rotor
Large steel shaft
Long brass bearing
Well quenched
Short leading spark
Clear tone
High Efficiency

COMPLETE $10.00
Postpaid

The WILCOX LABORATORIES Inc.

Lansing Dept. D Michigan

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary

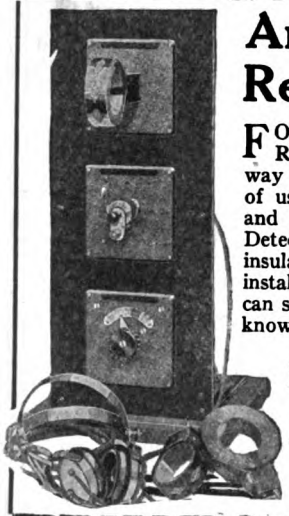
We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today**

Dodge's Telegraph and Wireless Institute 33rd St. Valparaiso, Indiana

Digitized by Google

DE FOREST



An Inexpensive Radio Receiving Set for Amateurs

FOR the beginner in Radio work, this DeForest Simplified Radio Receiving Station offers the easiest and least expensive way to secure accurate, efficient and expertly designed apparatus of usual DeForest superior quality. The set is complete; Aerial and Ground connections, "Honey Comb" Tuning Coils, Crystal Detector, Tuning Condenser, Head Telephones, all necessary wire, insulators, back-board, base mounting, etc. Full instructions for installing and operating accompany the apparatus. The beginner can secure no better apparatus and with this set will gain practical knowledge and experience.

Our booklet, "How to Set Up an Amateur Radio Receiving Station" explains this and other sets and gives much information for the Amateur. Sent postpaid for 10 cents a copy.

DE FOREST RADIO TEL. AND TEL. CO.

Inventors and Manufacturers of High Grade Radio Apparatus

1415 Sedgwick Avenue, New York City
Lee DeForest, Inc., 415 Market St., San Francisco
Western Distributors

DE FOREST

A NEW DETECTOR

That can either be used as a Panel Unit, as advocated by this magazine or "on the table," and only one knob is used for Position and Pressure. Instantly adjustable to any spot on the crystal. Price includes tested galena. Base 5 ins. by 2¼ ins. $2.50. Base 5 ins. by 5 ins. 3 cups $5.00.

Just write for information and list

THE BARWICK RADIO SUPPLY CO.

89 Britannia Ave. Hamilton, Ont., Can.

YOUR FUTURE IS ON THE SEAS



Be a Ship Officer

Join America's Mighty Merchant Marine

Hundreds of first, second and third mates, masters and captains are needed by the big shipping companies and America's great merchant marine.

Salaries up to $412 per month and living expenses.

Ships flying the American flag pay the biggest salaries of any in the entire world.

Learn Navigation at Home or on Board Ship.

Captain Warren Sheppard's Course on Ocean Coast and Lakes Navigation is now ready. It is a life time of practice placed before you for quick mastery. Captain Sheppard was instructor for the United States Shipping Board during the war. All of his students received licenses—from third mate to master. Not one failed. He offers this same sure method to you at a very low price. You cannot fail.

Valuable Booklet FREE

Fill out the coupon below and return to us. A 36-page booklet telling how you may become a ship officer at a big salary will be sent you free. Don't delay. Officers urgently needed.

FREE COUPON

World Technical Institute
Dept. 102 Fuller Bldg., Jersey City, N. J.

Gentlemen:—Send to me free booklet. "Your Future is on the Seven Seas." (*Write Plainly*)

Name .....
Address .....

No Seals - No Secrets —*BUT SERVICE!*

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus.

A. H. GREBE & CO., Inc.

71 Van Wyck Blvd., Richmond Hill, N.Y.

Send for

HALCUN Radio Catalogue

Full Line of Amateur Requirements

Halcun Radio Co.

San Francisco, Calif.

Formerly Haller Cunningham Elec. Co.

RADIO MEN

THE Mutual Purchasers Association will save you money on all

WIRELESS APPARATUS

Write Dept. E10 for details.

Mutual Purchasers Association

2-4 Stone Street, New York

COMMON CAUSES OF AUTOMOBILE NOISE

(*Continued from page 299*)

strips or candle wicking between the lamp glass and its metal frame.

The points where the lamp brackets attach to the frame should be inspected to make sure that the bolts or rivets which hold these are tight. Then test the radiator retention bolts to see that this is firmly held against the pads upon which it rests on the frame. See that the fan bearings are not worn unduly and that all the fan blades are tight, because a loose fan blade striking the radiator will not only cause considerable noise but will ultimately wear through the radiator cooling section and permit loss of water.

If the cooling fan operates on plain bearings, care should be taken that these bearings are well lubricated as an annoying squeak will develop if they are dry. It will be evident that if the radiator holding bolts or those which hold the engine in place on the frame are loose, that every time the car runs over a rough pavement, noise will result because a comparatively heavy piece of machinery will be moved up and down to take up the play caused by the loose retention bolts. This movement may be only a small fraction of an inch, yet the noise it will produce will be large in proportion to the slight degree of movement permitted. If either the gear case or the engine base is not securely bolted, a pronounced pounding noise will be noticed that will be intermittent in character, and will be considerably more noticeable when the car is operated over rough roads.

(*To be continued*)

PRODUCING ALCOHOL FROM WOOD

THE first step in the process of obtaining alcohol from wood is digestion at a pressure of 115 lb. for fifteen minutes in dilute sulphuric acid. The cooked wood is transferred to a series of cylindrical cells so connected that water may be passed through them in rotation. From these cells an extract called "acid juice" is obtained which holds in solution practically all the sugar mixed with other water-soluble ingredients. This liquid is neutralized, either with high-grade limestone or slaked lime. Calcium sulphate is produced, which requires about twelve hours for settling. The clear juice is drawn off and cooled to about 88 deg. Fahr., yeast added, and the fermentation carried in the usual way. The juice must be slightly acid, as ordinary yeasts do not operate well in alkaline solutions. By distillation the alcohol is obtained, and may be readily refined.

Digitized by Google

EFFECT OF OILS ON STRENGTH OF GLUES IN PLYWOOD

PLYWOOD may be used near machinery and tanks with little likelihood of being dangerously weakened by the action of oil or gasoline on the glue joints. This fact is evident from a test lately completed at the Forest Products Laboratory. Plywood panels glued with animal, vegetable, blood albumin, and casein glues were immersed for nearly a year in engine oil and gasoline. At regular intervals specimens were removed from the liquids and tested for joint strength. All the glues weakened somewhat during the early part of the test, the animal and vegetable glues more than the casein and blood albumin glues. The total loss of strength in any case, however, was small enough to be negligible under most conditions of service. A glue shear strength of 100 to 125 pounds per square inch is considered sufficient for practically any purpose for which plywood is used. Only in two or three instances did the strength of the casein and blood albumin glues fall below 150 pounds per square inch. Engine oil, castor oil, and gasoline seemed to have practically the same effect on the glue joints. During the 45 weeks' test, the wood absorbed 60 per cent of its original weight in engine oil and 70 per cent of its original weight in gasoline. The absorption of these oils did not cause any noticeable swelling of the wood.

HOW TO DETECT PAPER IN SHOES

THE substitution of paper for leather in shoes is so well done, that it is impossible to tell from ordinary observation whether paper is used in the shoe or not. Even experienced shoe buyers find it difficult to tell and usually rely on the statement of the manufacturer. The *Scientific American* outlines a simple test that is usually effective in determining whether or not a shoe is all leather. If paper is used, it is usually in the upper sections of the heel. If the point of a pocket knife is pressed on this part of the shoe, with the width of the blade parallel with the layer, it will readily sink in if the heel is of paper, but leather will resist quite heavy pressure from the knife. If paper is found here, it is good evidence that it has been used elsewhere in the shoe. Another test is to bend the counter inward. If it is of leather, it will at once spring back into shape, but if paper or fiber is used the counter will remain bent. A similar test can be applied to the toes of the shoe. If the box is pressed in, it is so resilient that it will spring back if of leather, but will remain permanently dented if made of paper.

LEARN DRAFTING

At Home—In Spare Time

as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.

Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.









Draftsmen Get $35 to $100 a Week

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

Draftsmen are needed in greater numbers, and receive better salaries than ever before.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1146, 14th & T Sts., N. W., Washington, D.C.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1146, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below: (Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting	Ship Drafting
Automobile Drafting	Statistical Drafting
Electrical Drafting	Radio Drafting
Aeroplane Drafting	Automotive Drafting
Special Machinery Drafting	Hydrographic Drafting
Sheet Metal Drafting	Machine Design
Structural Drafting	Tool Design
Highway Drafting	Shop Mathematics
Patent Drafting	Builders' Course
Topographical Drafting	

Name .....
Age..... Address.....
City..... State.....

Digitized by Google

THE
RADIO
REVIEW

A MONTHLY RECORD OF SCIENTIFIC PROGRESS IN RADIO TELEGRAPHY AND TELEPHONY

Monthly - Half-a-Crown

Single copies, post free 2s. 9d. Annual Subscription, post paid, 30/- post free.

THE RADIO REVIEW, a new monthly magazine, devoted entirely to the technical side of radio communication.

Edited by Professor G. W. O. HOWE, D.Sc., M.I.E.E., assisted by PHILIP R. COURSEY, B.Sc. A.M.I.E.E.

THE RADIO REVIEW is the Authoritative Journal of Wireless Research. Contributions from the pens of the World's leading Radio Scientists will be a special exclusive feature.

. . . . . .

Editorial and Publishing Offices
12-13, HENRIETTA STREET
LONDON, W.C. 2

SCHNOTER'S
SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit and low price. If your druggist does not carry Schnoter's, Accept No Substitutes. Sent direct upon receipt of $1.00.

Send for booklet of other styles and prices.

J. C. SCHNOTER CO.
828 SIXTH AVE. Dept. (E) N. Y. CITY

WHAT BAKELITE IS

BAKELITE is a cellulose substitute which derived its name from the inventor, Dr. L. H. Bakeland, of Yonkers, United States of America, who patented, in 1904 (Pat. No. 942699), the following process:

Equal weights of phenol (carbolic acid) and formaldehyde (formalin) are warmed together with an alkali, the latter acting as condensing agent. After cooling, the mixture forms two layers, a lower one, which is an immediate condensation product, and an upper layer, consisting of an aqueous solution. The latter is poured off, and the lower part of the mixture heated above 100 deg. C., which causes the formation of a third product, consisting of a spongy porous mass; but, as in this state, it would not be suitable for many purposes, the last phase of the process, which produces the third state of mixture, is conducted in a closed vessel (autoclave), at a temperature of 130-150 deg. C., under a pressure of from 50-100 lb. per square inch, the result of the pressure being a solid, compact, non-porous mass, very similar to the best celluloid. The specific gravity of the finished product is 1.25, the mass itself forms a material which is not elastic, but a first-class insulator of heat and electricity. The price of Bakelite is lower than best celluloid, casein and hard rubber. Of course, the above procedure covers the principal points of the process, which is actually carried out under varied conditions, the condensing agents employed are chosen from the groups of inorganic and organic acids, ammonia, ammonium carbonate, caustic alkali, alkali carbonate, calcium, stronium or calcium hydrate, anilin or pyrodin being also used.

To remove the water formed during condensation a water-soluble hygroscopic salt, such as sodium or calcium chlorid, is added during the main phase of the process.

To produce very clear or colorless condensation products of phenola and aldehyde from the condensation product, which contains the coloring matter, the latter is extracted by means of ether and other related solvents (Pat. No. 233395). The condensation process with application of solvents, is carried out as follows: Firstly, the condensation produces a liquid material (at ordinary temperature), this is soluble in alcohol, acetone or other similar solvent; secondly, further heating produces an intermediate product, which is insoluble in the above solvents, but which can be transformed into a horn-like mass by stopping the heating at a certain temperature; while, thirdly, a continued heating finally produces a mass which is not fusible. This final mass has remarkable properties; for instance, it is not attacked by boiling acids or alkaline solutions; only condensed sulphuric acid decomposes Bakelite at boiling temperature. Through treating wood, paper, or card-condensation product, these materials may be covered with a lacquer-like surface.

Bakelite is used in large quantities for manufacturing billiard balls, handles, buttons, and almost any other article which was formerly made from celluloid only and is widely employed in electrical work as an insulating substance.

LIGHT CREOSOTE OILS IN WOOD PRESERVATION

LIGHT creosote oils properly injected into wood apparently will prevent decay until the wood wears out or until it checks so badly that the untreated portions are exposed. Such is the indication of service records collected by the Forest Products Laboratory on railway ties and telegraph poles preserved with low boiling creosotes. Creosotes used in ties from 25 to 50 years ago were for the most part oils having 50 per cent or more distilling below 235°C., with a residue not to exceed 25 per cent at 315°C. The ties so treated lasted from 15 to 20 years, and failure was traceable in most cases to mechanical wear, such as rail cutting and spike killing. In no case was failure found to be the fault of the preservative.

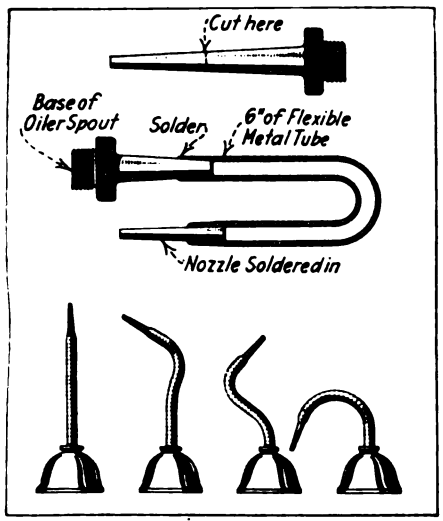
Of 1558 telegraph poles in the Montgomery-New Orleans line, which were pressure-treated with a light creosote oil, 1049 poles were still sound after 16 years. In 91 per cent of the cases of decay, the fungi had entered the wood through checks and shakes. Representative sections in the Norfolk-Washington line showed that after 17 years service, of the 1614 poles inspected, 1469 were sound, 92 decayed at the top, and 105 decayed at the ground line. The decay at the top was caused chiefly by cutting off the poles. In those decayed at the ground line, the causes of failure, as determined in 88 per cent of the cases, were checks or shakes. Here again as in the ties, the preservative outlasted the mechanical life of the wood.

Unless some other factor than protection from decay is considered important, therefore, there is apparently no need to specify high boiling oils. The important point is that any coal tar creosote which is not extremely low boiling or extremely high boiling will satisfactorily prevent decay, and in the selection of an oil, factors such as price, penetrability, and convenience in handling should receive greater consideration than moderate differences in volatility.

Digitized by Google

FLEXIBLE SPOUT OILER

THE ordinary form of hand oiler cannot be used for oiling all parts of machinery because the oil holes are sometimes placed at points inaccessible for the regular spout. Various forms of spouts may be used but even these sometimes are found wanting in reaching certain locations. A flexible spout oiler that can be easily made by any one capable of using a soldering iron



Flexible spout oiler

and hack saw is illustrated in the accompanying cut. The spout of the ordinary oil can is cut in two pieces and these pieces are soldered in a suitable length of flexible metal tubing of which various makes that are quite practical are now marketed. The new spout, which is composed of the two parts of the old spout soldered into the flexible tube can be bent into a variety of shapes as indicated, and it is possible to inject oil to points that formerly would be neglected because so hard to reach.

Magnesium is used in the manufacture of sound copper castings, because of its ability to decompose the gases formed by the copper in melt-gases formed by the copper in melting. The principal gas thus formed, carbon monoxide is attacked by the magnesium, forming two solids, carbon and magnesium oxide. By the use of magnesium, therefore, in small amounts, the production of blow-holes in the casting is eliminated.

In the Book Exodus, Moses is described as making a bitter spring potable by throwing into it the branch of a tree. This particular spring or well, it is thought, has possibly been identified and on analysis its water has been found to contain calcium sulphate in solution. If into it there were thrown branches of vegetation containing oxalates, the lime salt would be precipitated and the water would be thereby purified; this, it is thought, may have been what occurred during the days of the Pentateuch.

The foreman says

"I suppose it's because I used them myself when I was at the bench, but it does seem as though the best men in the shop have a preference for Starrett Tools.

"Of course, most of them sort of got into the habit of relying on Starrett for fine work when they were apprentices and journeymen.

"Speaking of apprentices — that little red book there, 'The Starrett Book for Machinists' Apprentices,' has saved me more time and helped more young fellows to learn how to do things right than anything else in the shop.

"When a young lad asks me how to do this or that, I usually tell him or show him, and then ask him if he has one of those books. I've noticed that as soon as he gets one of them he doesn't have half so many questions to ask.

"Starrett gets out another book, 'The Machinists' Data Book,' that's just about as big a help to the experienced machinist. It's got all the tables and formulas and so on that he ever needs, and it isn't cluttered up with a lot of engineers' stuff that he doesn't use.

"Yes, I bought one of each of the books down at the hardware store, as soon as they came out. They cost me seventy-five cents each, but they're worth it."



Starrett Tools

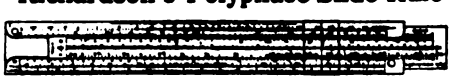


The L. S. STARRETT COMPANY
THE WORLD'S GREATEST TOOLMAKERS
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

Machinists the world over have put their faith in the accuracy of Starrett Tools for thirty-nine years. Write for illustrated Catalog No. 21 "MB."

42-989

Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 16". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $3.00.

An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO., Niles, Mich.

AMBITIOUS YOUNG MEN

WHO WANT A COLLEGE EDUCATION CAN READ OUR ANNOUNCEMENT ON PAGE 379 TO ADVANTAGE

STURDY

THAT'S WHAT YOU'LL SAY when you see this new handy Utility Chest. Built with a solid oak frame, and joints that are not dovetailed, but lock-cornered for extra strength. This chest is a sturdy keeper of tools; bang-proof, knock-proof, and weather-proof. Auto-mechanic, electrician, lineman, will find the right house for his tools in this

UNION Utility Chest

Note tray that lifts with cover, yet fits snugly when cover is closed. Strong handle, hinges, hardware.



Write for Catalog

prices and name of nearest dealer. Sold on "Satisfaction or Money-Back" guarantee. Write for special offer.

UNION TOOL CHEST CO., Inc., 34 Mill St., Rochester, N.Y.

UNION TOOL CHESTS

FOR SALE

Two cell Electro-Medical-Battery, with polished slate base and nickel-plated parts in handsome hardwood box 9 x 8 x 6 inches; contains two metal handles, foot-plate, sponge electrode, pair 3 foot cords and 32 page book of suggestions and instructions for treating various diseases with faradic currents of electricity; absolutely new. Price $10.50. Shipping weight, 12 lbs.

JOSEPH F. MATIS
316 East 89th St. New York City

Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

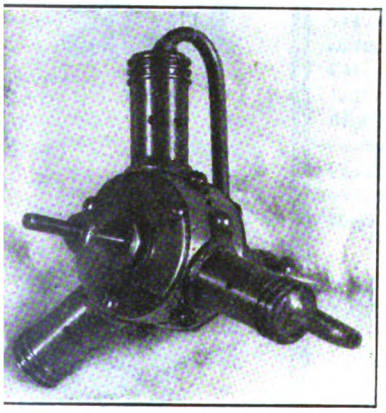
SET OF II SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

Compressed Air Motors



THE new and improved method of propelling your model aeroplane. Manufactured of the finest materials. Workmanship guaranteed. Special propellers for the above motors. Send stamp for descriptive circular of these wonderful motors. We manufacture everything for the model aeroplane builder. Give us a trial and be convinced.

HEC AEROPLANE CO.

202 East 49th St. New York City

NOW YOU CAN FLY!

A REAL AEROPLANE AT LOW COST



THE DELERAY D-5 SPORT PLANE

Wing Span 18 ft. Speed 35-65 m.p.h.

Planned by men with 4 years' experience in Designing successful U. S. Government planes. Equipped with 15 H.P. engine (practical engineering made it possible for this biplane to be flown with only 8 H.P.) Use your own motorcycle engine if you wish.

Send $6.00 for complete set of 18 large detailed blueprints, actual duplicates of our shop drawings, showing exactly how each part is made and fitted.

DELERAY AIRCRAFT WORKS

AEROPLANES ENGINES PARTS

FREEPORT, LONG ISLAND, N. Y.

Don't Scrap Aluminum Parts

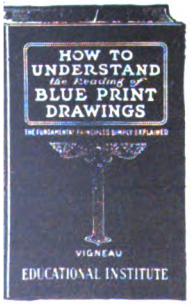
Save them with SO-LUMINUM. New, great welding solder, stronger than aluminum, perfect substitute for acetylene, welding—¼ time and cost. Use gasoline torch or soldering iron. No flux required. Booklet on request. Sample bar $1.00. Used and endorsed by United States Army and Navy, British Munitions Board and leading aeroplane and motor truck companies.

SO-LUMINUM MANUFACTURING CO.
1790 Broadway New York

UmakeM Airplanes

Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.



What Every Mechanic Should Thoroughly Know

This book points out the stumbling blocks for mechanics to avoid in acquiring a complete understanding, as well as to show you HOW TO GO AT the reading of a blue print drawing.

Every phase of the seventy subjects is gone into in detail, so that any average man can master with but little study. Every point is clearly brought out with sufficient sketches to describe each of the actual blue print drawing examples. In fact, the illustrations are practically self explanatory.

Every mechanic needs this book, be his experience in mechanics limited or long. Read the following comment from a man who passes on from 50 to 500 blue prints a day.

"I never thought there was so much to know in the reading of a blue print drawing."
WM. P. CONWAY, Planning Dept. Mgr., U. S. Rubber Co.'s Mach. Shop.

This book contains the most vital and practical information on the subject of blue print reading, and is the best and safest investment you can make. Send for a copy to-day before you forget. YOU CANNOT LOSE, YOUR MONEY REFUNDED IF NOT SATISFIED.

PRICE:—Post paid U. S., $2.00; Canada, $2.12; Foreign, $2.25.
169 pages—Size 5 x 7½ inches.
Handsomely bound in cloth 228 illustrations
54 months in the making.

EDUCATIONAL INSTITUTE, 138 Rowland Bldg., Detroit, Michigan

ADVANCED ENGINEERING

IN some of our contemporaries which aim to popularize science by detailing fanciful schemes, we find many queer things discussed with an apparent seriousness that must mislead the non-technical readers into expecting great advancement in science and engineering that really cannot take place because natural and established laws are defied. Our English contemporary, *The Aeroplane,* discusses one of these so-called discoveries in an amusing vein and the discussion may be of interest to some of our readers who have lately taken us to task and accused us of ultra-conservatism.

This accusation was made because we have not published articles on messages to Mars, negative gravity, wireless transmission of large quantities of power and other advanced engineering topics that are so far in advance that they are way ahead of the knowledge of our technical staff, who are all of the "show me" kind and apt to give more credit to an actual accomplishment of practical value than to problematical and spectacular discoveries of the future that have not yet materialized. The matter would be amusing if it were not for the fact that really serious and dependable mechanical and scientific publications are apt to be judged by those examples of radical thought and "yellow" scientific journalism that issue from the presses in such large quantities and that are considered to be representative American publications by our foreign contemporaries.

The Aeroplane, under the heading "On American Credulity" goes on to say: "In one of these curious, popular scientific magazines which America has produced in such large quantities, there is quite a long discussion on the possibilities of the electrically-driven aeroplane. This is based upon the opinions of two gentlemen, both of them sufficiently well known by name and reputation in American aviation circles to assure their ideas being taken for what they are worth. One is a not inconspicuous member of the Aero Club of America, and the other, is known to fame as the creator of one of America's most amazing achievements in the field of aeroplane construction. Both of these 'experts' agree that the electrically-driven aeroplane is a possibility.

"The scheme is that electrical generators are to be driven by petrol engines installed in the central body of the proposed aircraft. The power thus generated is to be then distributed to a number of electro-motors disposed in convenient positions about the machine, each driving an airscrew. One expert suggests that there are other obvious ways of electrically driving an aeroplane. One is to carry storage batteries

Digitized by Google

supplying power to the motors, another is to transfer electrical energy by a kind of trolley dependent from the machine and running on supply lines laid over the route. A further possibility which he suggests is that of transmitting energy by wireless to the aeroplane.

"The petrol-electric system is, however, regarded as the most practicable. The great constancy of power and the beautiful control of the screws which can thus be obtained are among the advantages claimed for this system, and it is stated that 'one thing is certain—with this arrangement of gasoline-electric propulsion we know it will work.'

"The beautiful simplicity of the idea is quite apparent when one considers that the machine, which is described, is to be provided with two petrol engines, each of 3,200 h.p., two generators, each of 3,000 h.p., and electric motors of undefined numbers, but of the same aggregate output. If we assume that America can now produce aero-engines of 3,000 h.p., each with a weight of three pounds per h.p., it seems a little unnecessary to add to that a further electrical plant of twice that output and weighing certainly not less than 25 lb. per h.p. Even American aeroplane designers have not yet succeeded in building satisfactory aeroplanes with power plants weighing over 50 lb. per h.p."

Needless to say, the curious, popular scientific magazine describing such advanced aeronautical engineering was not EVERYDAY ENGINEERING MAGAZINE.

The factories in the occupied regions of Germany along the Rhine, have been visited with a view to ascertain what the enemy did in the production of chemical products.

Rubber was made from acetone which was reduced by aluminum and hydroxyl to pinacone.. Water was removed from its molecule by distillation under pressure. The distillate was then heated to 600° C. four to six months and the resulting product was a synthetic rubber which was used for tires and other purposes.

Gas mask charcoal was made from pinewood. Small pieces were soaked for at least thirty minutes in hydrochloric acid with a little zinc chloric. They were then carbonized in a long muffle at a cherry red heat for six or eight hours. The charcoal was then washed with hydrochloric acid until only a very little zinc was left. It was then washed with water drained, dried in vacuo at 70° to 80° C. and sifted free from dust. Our readers will remember, how, during the war, fruit pits were industriously collected for making gas mask charcoal.

Let Government Tests Save You Gasoline!

Sparko-Gap Will Make Your Engine 37 Per Cent Better, Save Its Cost in Gasoline, or We Refund Your Money.

Let us prove to you, on your own car, that Sparko-Gaps make your motor 37 per cent better and save 10 to 35 per cent in gasoline. See why they end spark plug troubles and see why they were used as standard equipment on all French airplanes. Check the U. S. Government tests on your own car.

We don't want you to send us a single penny now. Just fill in and mail the attached coupon and we will send you a SPARKO-GAP for each cylinder of your car. Try them on your car for 30 days. Try them on the foulest, sootiest, oiliest spark plug you can find. Try them on a cracked plug or try them on your best plug. You be the judge. If Sparko-Gaps don't give you a smoother-running car, if they don't save half their cost in gasoline bills during the month, send them back and you won't be out one cent.

If Sparko-Gaps Do Not End Your Spark Plug Troubles—If They Do Not Make Your Motor Run Smoother, Easier, Better—If They Do Not Save 10% to 35% Gasoline, Send Them Back.

The Sparko-Gap condenses current—develops a hotter, fatter, surer spark. It sends the electric current through the spark plug in one intense spark instead of in many weaker oscillations.

The Sparko-Gap explodes 100% of gas and fires even fouled plugs. The intense spark insures 100% explosion and saves from 10% to 35% in gasoline. It stops carbon formation. It lessens the necessity for gear shifting. It fires plugs under all conditions, when fouled by oil or carbon—even when the porcelain is cracked. No miss fires—more snap—quicker pick-up.

The Sparko-Gap shows a visible spark. You can see how each cylinder is firing and so locate ignition trouble quickly. The Sparko-Gap is easy to adjust. There are no holes to bore, no attachments. All you have to do is to screw one little thumb nut on top of your spark plug. Just as if you were making a spark plug connection.

The Sparko-Gap Is the Wireless Quenched Gap

The Sparko-Gap is not a new idea, but an old idea applied in an ingenious new way, made necessary by the fierce competition of war. The Sparko-Gap principle has been used for years in wireless telegraphy to give twice the radius to sending outfits.

Professor A. Press, Professor of Electrical Engineering of Berkeley, California, watched Sparko-Gap working on U. S. subchasers, Liberty airplane engines, Liberty truck engines, and popular commercial motors in Government Laboratories at Washington. He states that the Sparko-Gap will fire plugs in conditions two hundred and fifty times as difficult as will an ordinary ignition system without them; so that plugs will fire no matter how dirty they are, and even with broken porcelains.

DON'T SEND A PENNY

Remember, you don't send a single penny now. Just mail the coupon and tell us the make of your car and the number of cylinders. Don't bother to write a check or money order now. Simply pay the postman $1.50 for each Sparko-Gap when they arrive. Then try them for 30 days on your car. If they do not make your car noticeably better, send them back and every penny you paid will be refunded. End your spark plug troubles now forever. Mail the coupon now. You can't begin too early to get more power out of your motor and more mileage out of your gas.



Dealers—take advantage of our advertising. We back you up on above offer. Send for proposition.

TRY THEM AT OUR RISK

SPARKO-GAP COMPANY
Dept. 10 54 West 39th St.
New York City

SPARKO-GAP CO.
54 W. 39th St., Dept. 10, New York City
Send me ..... Sparko-Gaps on 30 days' trial (one for each cylinder). I will pay postman $1.50 each on arrival. It is understood that if I am not more than pleased you will refund my money in full.

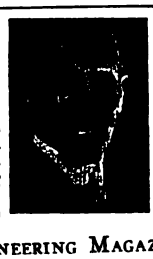
My Name .....
Street .....
City..... State.....
Name of Car.....

E. E.-7-20

Telegraph Pictures
BY ELECTRICITY

A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.

L. J. LEISHMAN CO. Dept. L, Ogden, Utah



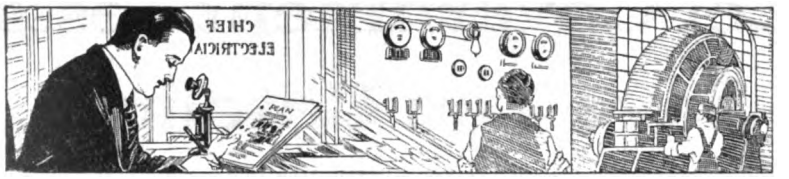
Mathematics Made Ea

The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot area, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only $1.00 postpaid. Order today before you forget.

Dept. U, L. J. LEISHMAN CO., Ogden, Utah

Digitized by Google

Become a Chief Electrician



CHIEF ELECTRICIANS ARE SCARCE, THOUSANDS ARE IN DEMAND. WHY NOT PREPARE NOW? YOU ARE CAPABLE OF EARNING

$60 to $125 a week

AS ONE OF THE LEADING CONSULTING ENGINEERS OF THE EAST I know exactly how to train men for positions of this kind. It is my SUCCESSFUL METHOD OF HOME STUDY COMBINED WITH MY OWN PERSONAL ATTENTION THAT HAS PUT HUNDREDS OF MY GRADUATES IN PROMINENT ELECTRICAL POSITIONS THROUGHOUT THE COUNTRY.

Apply immediately for my SPECIAL OFFER of this month.

H. K. BLATCHLEY & CO.: CONSULTING ENGINEERS. Liberty Building, 152 Temple St., New Haven, Conn.
Kindly send me full particulars of your Home Study Course.

Name ..... Address .....

$1.00 per Tire allowed if you bring us this Ad

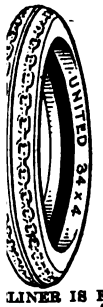
GOODYEAR

SERVICE STATION
(At Jamaica and Far Rockaway)
LET US QUOTE YOU
any tire made. We stock:—

lways	GOODYEAR
	PENNSYLVANIA
ie	GOODRICH
EST	GLOBE
	McCLAREN
	HORSE SHOE RACINE
ie	NORWALK-CORD
	MARTIN-CORD
IGHT	KELLY-SPRINGFIELD (At New York)
rice.	UNITED STATES, etc.

Supplies AT COST to tire patrons.
IT WILL PAY YOU to trade with:—
JAMAICA TIRE & RUBBER CO., INC.
West 48th Street.....New York
lside and Flushing Avenues.....Jamaica, N. Y.
Central Avenue.....Far Rockaway, N. Y.
East Main Street.....Patchogue, N. Y.
"Largest, because we serve best".

AVE MONEY!
A High Grade



INNER TUBE FREE
6000 MILES Guarantee

Economy Reconstructed Tires made by our new special process are guaranteed to give good service because the best materials are used in their construction. Our tires are guaranteed for 6,000 miles and we give a FIRST quality inner tube free with every tire ordered from us. Our tires are reinforced with extra plies of fabric making them strong so they resist punctures and blowouts.

LINER IS FURNISHED WITH EACH CASING AT NO EXTRA COST.
ESE PRICES INCLUDE CASING, RELINER AND TUBE.

0x3	$7.15	33x4	$11.00	35x4½	$13.15
2x3½	8.25	34x4	11.25	36x4½	13.50
2x3½	9.00	32x4½	11.75	36x5	14.50
1x4	10.10	33x4½	12.25	37x5	14.50
2x4	10.45	34x4½	12.90		

ite with your order whether a straight side or ncher, plain or non-skid tread. Send a deposit $2 for each casing ordered. Balance C. O. D. ject to examination. 7% discount if full amount sent with order. References furnished if desired.
UNITED ECONOMY TIRE CO.
West 48th Street New York City

makeM Club You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or your own UmakeM Club with the $5 outfit. You make Bleriot, Curtiss, Spad and other Flying Planes al Work Benches, Sewing Stands, Stationary Racks ts, Book Troughs, Arks Circus, Wagons, War Tanks n Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, , Toads, Giraffes, Ostriches, Numbers, Letters, 19 d Animals, Doll Furniture and Doll Houses. Prinsalers buy all their toys and novelties now for Christmas. Get UmakeM shop started quick and coin UmakeM Money.
PRICE, Inc., Dept. 17 UmakeMBldg., 127 5th Ave., N.Y.

WANTED

Want ads for thousands of trained Automobile Repairmen are appearing in all the papers all over the Country. New Garages and Shops are badly needed everywhere. If you are earning less than $30 a week—YOU SHOULD LEARN THIS TRADE.

You Can Earn $150 to $400 a Month

Come to this school and learn. We teach by actual practice on all kinds of cars. A few weeks time learning will fit you for a position in a garage, service station, or you can start in business for yourself. (No colored enrollments solicited.)
WRITE FOR FURTHER PARTICULARS
DO IT TODAY SEND IN COUPON

BUFFALO AUTO SCHOOL, No. E.E.I.
463-471 Connecticut St., Buffalo, N. Y.
Please send me full particulars of your complete Automobile Course.

Name..... Age.....
Street or R. F. D.....
City..... State.....

SHIP BY TRUCK

Motor Cartage.
One to Five-ton Trucks.
Hauls made to any point in United States and Canada.
Rates by hour, day or contract.

W. H. SQUIRES
1561 Woodward Avenue
Detroit, Mich.

You Can Save $50.00



By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.
$8.93 and up Parcels Post Paid
LIBERTY TOP & TIRE CO., Dept. ES, Cincinnati, O.

TESTING LUBRICATING OILS FOR ACIDS

THAT a small quantity of fatty acid in oil renders it unfit for lubricating purposes is too well known to need repeating, but how to ascertain its presence, before irreparable injury has been done is a more difficult problem. The following is a simple method of testing for acids, namely, its action upon suboxide of copper or red oxide. If the red oxide is not at hand, the copper scale or ash of the coppersmith may be employed as it contains this suboxide. Either of these substances is placed in a white glass vessel, and covered with the oil to be treated. If the latter contains a trace of acid, or any resinous acid from rosin oil, with which it may have been adulterated, the oil soon turns green and that too nearest the copper scales. A gentle heat hastens the reaction, which in the cold, requires from 15 to 30 minutes. The test is extremely delicate, and cannot result in any doubt or erorr to those who use it for the first time. An oil which is not turned green by the copper scale can unhesitatingly be pronounced absolutely free from acid. If there be but little acid present the green color is fainter, by more acid, intenser, and if rosin has been added it is bluish. The chemical reaction is this: The free vegetable and fatty acids separated the sub-oxides into oxide and metallic copper; the former then combines with the acids to form greenish blue salt that dissolves more or less in the oil and imparts its color to it. The oxide of copper does not answer as well as the sub-oxide.

TEST GAS IN TUNNELS

ONE of the problems that has developed in connection with the construction of the proposed vehicular tunnel under the Hudson River between New York and New Jersey, which will be 9000 feet long, with an estimated number of 2000 passenger cars and trucks passing through per hour during the rush periods is the amount of poisonous gas emitted by this long line of machines. This is now an unknown quantity and must be determined before the construction can be undertaken, so that provisions for proper ventilation may be made.

To carry on experiments with a view to ascertaining the amount of carbon monoxide, which is the deadly gas discharged by automobiles, that is likely to be emitted, the United States Bureau of Mines has just requested an appropriation of $100,000 from Congress. And at the same time Yale University, New Haven, Conn., will construct an experimental tunnel and cooperatively attempt to determine whether the amount of poisonous gases given off by automobiles would be detrimental to life or endanger it in a long tunnel.

Digitized by Google

GIANT ENGLISH SEAPLANE

ACCORDING to *Flugsport*, a German aviation paper, a gigantic seaplane is under construction at the Barrow, England, works of Vickers, Ltd. In its general outline the machine is a long hull flying boat, with overhanging biplane wings. Only approximate dimensions are available at this time, but the span is given as 300 ft., the overall length as 200 ft., the overall height as 42 ft., and the wing chord as 27 ft. The power plant is fitted in four independent engine nacelles between the planes, each nacelle carrying two Rolls-Royce Condor 600 hp. engines "end on" and driving a tractor and four pushers, and the total horsepower is 4,800. It is estimated that the machine will be able to fly with full load on two-thirds engine power. The framework of the boat and of the planes is entirely constructed of duralumin, while the planking of the hull is made of Consuta, a special plywood sewn with copper wire, which was developed by Messrs. Saunders, the well-known yacht builders. The boat is fitted with two decks and is extensively furnished with passenger accommodations, there being sixteen two-berth cabins and a dining room in which in case of emergency thirteen more passengers can be accommodated. With forty-five passengers, the cruising endurance of the flying boat is estimated at 1,400 statute miles. The designed full speed is 110 m.p.h.

A NEW FOKKER MACHINE

THE new Fokker machine is constructed for commercial flying purposes. The wings are made on the principle well known in Fokker's other designs, that is to say, without staywires. The wings are 60 centimeters thick in the middle and are not covered with fabric, but with three-ply wood. The wing span is 16.1 meters, the length of the machine being 11.55 meters. It travels at a speed of 170 kilometers per hour with a motor of 185 h.p.

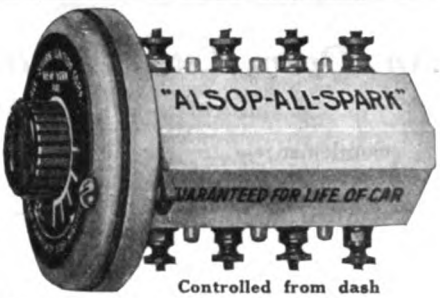
This indicates, we were told, an immense saving in gasoline and oil, and includes the advantage of light weight in the motor and also great saving in cost price as well as in use. The aeroplane itself weighs 1,200 kg. and when fully loaded 1,900 kg. With a full cargo it is calculated to reach a height of 4,000 meters in 45 minutes.

There is a closed cabin for four persons, the pilot and mechanic being comfortably seated in front of the cabin, and their seats are so arranged that small adjustments to the motor can easily be carried out while in flight. The motor is by the Bavarian Motor Works at Munich and is of the newest type. It is provided with an arrangement by which it develops its full power if desired at a height of 4,000 meters.

"ALSOP-ALL-SPARK"

Make your plugs last indefinitely

May Be Attached to Any Four-cylinder Car



Controlled from dash

THIS WONDERFUL DEVICE

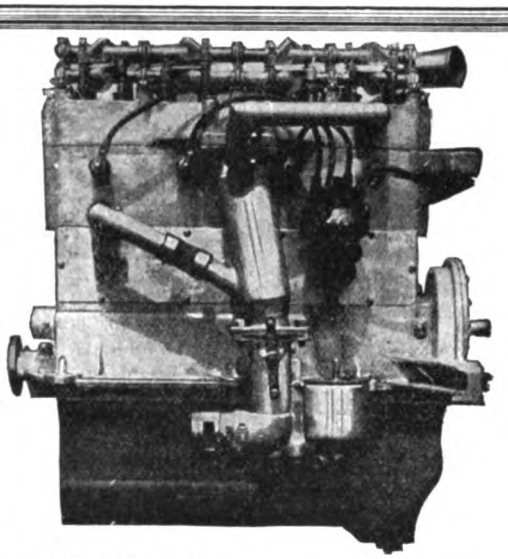
Insures a Hot Spark
Fires Old Carbon-choked *Plugs*
Increases Gasoline Mileage
Develops Greater Power
Eliminates all Spark-Plug Troubles
Puts new "Pep" *in your car*

The Installation of the "Alsop-All-Spark" increases efficiency and insures continued driving when plugs crack or become dead.

Price 4 cylinder Type with *Money Back Guarantee* $7.50

Write for descriptive literature NOW.

ALL-SPARK IGNITION CO., Inc.
13 Water Street, Dept. E, New York



"ACE" MOTORS

Are Powerful, Light, Reliable and Economical

Weight 126 Pounds — Forty B. H. P.

These motors embody all the features of engineering that an extensive series of tests proved necessary, and are the product of ripe judgment of practical airmen. The ideal power plant for the man building his own plane.

Descriptive Literature on Request.

HORACE KEANE
Aero HK Planes Inc.

Sales Office
280 Madison Ave.
New York

Factory
North Beach
Long Island

AMAZING OPPORTUNITIES in the Airplane Industry

Right now is your opportunity to get into the greatest industry the World has ever known. Thousands of new positions opening up everywhere in this attractive new field. Never before have ambitious men had such a glorious chance. Send Coupon at once—find out how our wonderful Course in Practical Aeronautics will give you the knowledge to enter this new field. Learn at home by mail during your spare time.

Prepare NOW for these positions
Aeronautical Engineer
Aeronautical Instructor
Aeronautical Contractor
Aeroplane Repairman
Aeroplane Mechanic
Aeroplane Inspector
Aeroplane Salesman
Aeroplane Assembler
Aeroplane Builder

Enormous Demand for Men—Big Pay
If you know Practical Aeronautics, some big Airplane Corporation will want you. Unheard of Salaries are being paid trained men. Act at once. The pioneers are going to reap the big rewards. Automobile history, railroad history, movie history will repeat itself in Aviation.

Special Offer NOW—Send Coupon
Send the Coupon at once for full particulars of our remarkable offer open to you now. We will also send you our big new book "Opportunities in the Airplane Industry." No obligation. Be sure to tear off and mail coupon today.

AMERICAN SCHOOL OF AVIATION
431 S. Dearborn St. Dept. 748B Chicago

FREE BOOK COUPON

American School of Aviation
431 S. Dearborn St., Chicago
Dept. 748B

Gentlemen: Please send me full particulars of your remarkable offer, also your new big book "Opportunities in the Airplane Industry." I assume no obligation.

Name.....

Address.....

Digitized by Google

An Open Letter to the Model Engineers of America

Gentlemen:—

We trust you will excuse us in writing a letter directly to you, but we feel that we have something to tell you which will be to your advantage. We know that amateurs often find a difficulty in getting supplies, as the majority of firms do not bother with these small things. We do. We are prepared to quote prices for anything you may want in carrying on your pastime of making models. We specialize in model ship fittings, castings, patterns, model boilers and boiler fittings. We also have made arrangements to supply you with all the castings in the rough or partly finished to construct the engines and boilers described in this magazine by Wm. A. Helms.

Write us what you want and we will supply you. Until the amount of business justifies a store we take orders by mail only, and guarantee a prompt delivery. Hoping for your support, we are

Sincerely yours,

THE AMERICAN MODEL SALES & MFG. CO.
601 Broadway, Telephone Spring 3337
NEW YORK CITY.

"Richards' Made"

Complete Construction Sets from which you can build successful sailing Models. Circular tells the rest. Send for it.

WM. RICHARDS
747 Tremont Ave. New York City

OH—Just What I Wanted
Real Model Racing Yachts
Sails Faster Than You Can Walk



Sport for men and boys. Construction Set—complete—30 in. long, with Rigging, Fittings and HEAVY LEAD KEEL, ready to assemble. 5 screws, 20 brads and Yacht is built. Also same Model finished ready to sail. Send 25 cents and your dealer's name and address for book "Model Yacht Sailing," just printed, giving full instructions of the Sport; How to sail, rig, nautical terms, etc., etc.

New York Model Boat & Mfg. Corporation
Dept. EM, 18 Broadway New York City

MODEL AIRPLANE ENGINES

3 Cylinder Rotary Compressed Air Engines.

⅜ in. bore, ½ in. stroke
½ in. bore, ½ in. stroke
⅝ in. bore, ½ in stroke

6 Cylinder rotary steam engines, steel cylinders, tobin bronze pistons, aluminum crank case.

½ in. bore, ½ in. stroke

Send stamp for descriptive circular.

MODEL MACHINE SHOP CO.
415 East 71st St. New York City

A Necessity for Every Shop

"The Samson No. 3 Bench Punch," with a powerful leverage of 24 to 1, is intended for work beyond the capacity of the "Samson Hand Punches," and will punch holes from ⅛ to ⅜ in. in soft metal up to 12 Gauge. Extra sets punches and dies size ⅛, 3/16, ¼, 5/16, and ⅜ in. easily inserted and removed, (maximum punching capacity 3/16 in. through 12 gauge soft metal.)



Equipped with 3-16-inch Punch and Die unless Otherwise Specified. Price $15.00 F.O.B. Factory

Catalog of Complete Line Sent on Request.

The Machine Appliance Corporation
351 Jay Street, Dept. Eng. BROOKLYN, N. Y.

MODEL ELECTRIC MOTOR YOU

can build this working model. All parts furnished complete with Blue Prints. No Extras required. $2.00. Blue Prints only 25c.

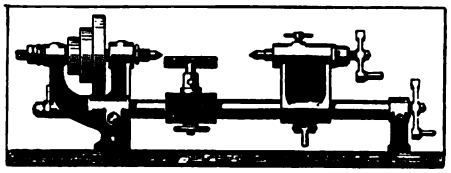
A. F. CASSEL
52 W. 130th Street, New York City

DRAFTING
Inventions and Ideas Developed!

Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.
COMPETENT DRAFTSMEN AT YOUR SERVICE

A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4589

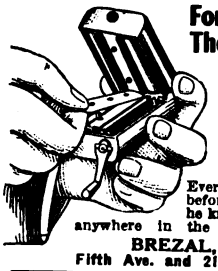
6 INCH BENCH LATHE



Model Shop Equipment

Castings or finished machine. Shop tools and supplies. Designs for Model Boats. Drawings of U. S. Destroyer. Ready for immediate shipment. Stamp for catalog.

Huhn Mfg. Co., 594 Elm St., Arlington, N. J.



For Gillette Blades Use The Big Four Stropper

A few turns and one operation gives perfect cutting edge. Makes old blades new and new blades better.

Guaranteed to give satisfaction or money refunded. Nothing to lose and everything to gain in comfort. Every blade should be stropped before using, watch the barber, he knows. Sent postpaid anywhere in the United States for $3.00

BREZAL, Inc., Distributors
Fifth Ave. and 21st St. New York City



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.

MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.

Speed Lathe $7 Complete Swing 7 ins. 24 in. metal bed Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

M. & J. SPECIALTY CO.
282 S. Parke St., Pontiac, Mich.

ALUMINUM CAN BE SOLDERED with SUPREME BRAND ALUMINUM SOLDER

FLOWS AT 500° FAHRENHEIT
REQUIRES NO FLUX

Used by General Electric Company, Worthington Pump Company, Hale & Kilburn Company, Bethlehem Shipbuilding Corp., National Lead Company, and hundreds of other manufacturers and repair shops.

Instructions for using with each bar.

Price $3.00 per Pound in Half Pound Bars.

Send Fifty Cents for 2-Ounce Sample Bar.

VANDAM SPECIALTY COMPANY
Grand Central Palace, Dept. EE, New York City

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing Lists St. Louis

Mechanical Drafting

EXPERT SERVICE—REASONABLE
INQUIRIES INVITED
E. W. HEANEY & CO.
2105 Monterey Avenue New York City
Telephone Fordham 6249

UmakeM Lathe

You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $35. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Digitized by Google



"You'll Have to Have An
Auto - Wheel to Keep Up."

It's the coaster wagon that real fellows have. Genuine Roller-Bearings make the ride smoother. The **Auto - Wheel** glides up to the finish line—leading all the others. Has steel tires and axles and a low racing body. **Auto-Wheel** wagons are well built. Not just rattle-traps, but high-grade, substantial, heavy-duty wagons. Carry 1,000 pounds. Material carefully selected, put together right.



Two Models—Take Your Pick.

Auto - Wheel Coaster — the old standard and stand-by. Just as good for coasting as for hauling.

Auto-Wheel Convertible Roadster is the newest thing in wagons. Sides can fold up or down (on durable pivots.) If you want a roadster just swing sides up. For errand wagon fold sides down to form box-wagon.

***Auto - Wheel* Owners Are Club Members.**

Write for details. Send names of three coaster dealers, mentioning which ones carry the **Auto - Wheel.** We'll put you on the mailing list of **Auto - Wheel** "*Spokesman.*" Tells about our big PRIZE CONTESTS.

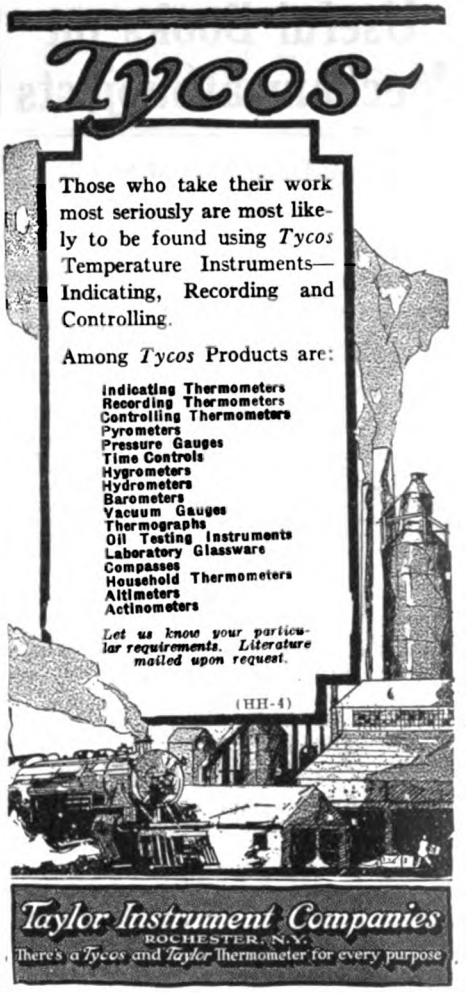
The Buffalo Sled Co.,
159 Schenck St., N. Tonawanda, N.Y.
In Canada: Preston, Ont.

A SIX-CYLINDER AIR MOTOR

(*Continued from page* 314)

the pistons are to the top, the more effective travel or stroke is obtained. Care should be taken that the pistons do not hit the cylinder tops, as the engine will not rotate and the light connecting rods may be bent. The front plate of the crank case is machined from steel or brass and carries a flange by which the propeller is driven. This engine will swing a twenty-inch diameter two-blade screw, having a pitch of approximately 30 to 36 inches without any difficulty and operates well on an average air pressure of about one hundred pounds. Obviously, the more air pressure supplied, the higher the rate of revolutions and the greater the power output will be. The motor will work on any air pressure that the usual type of airplane model air reservoir or tank will carry. A simple collar with a small set screw is used to keep the taper valve seat tight.

After assembly, the engine should be run on a lathe or drill press, by holding the cylinders from turning and rotating the crankshaft by catching it in a chuck, supplying plenty of oil and lapping in so that all parts will be a good fit before the engine is used. This running-in process makes for an easy running and well fitted engine and one that will require a minimum consumption of air.



Are You Going to Give Up a College Education

BECAUSE YOU CAN'T AFFORD IT?

Will you allow yourself to go through life handicapped by the lack of technical education, knowing that you can never attain the success that would have been yours if you had gone to college?

NO!

If you have the stuff in you of which success is made you need not think of the cost of going to college, for EVERYDAY ENGINEERING MAGAZINE will pay your expenses at any University, College, Trade School or Correspondence School in the United States.

Everyday Engineering Will Finance Your Education

in return for all or a portion of your spare time. It may seem too good to be true, but it is no less a fact—Four years at college with all the opportunities of learning, with the social life, which, in itself, is of tremendous importance in the life of every man.

To make arrangements for starting this coming fall, write immediately to the "Circulation Department", EVERYDAY ENGINEERING MAGAZINE, stating the name of the University to which you want to go, the course you are desirous of taking and the approximate cost for the scholastic year.

Here is your chance. It is up to you to take this opportunity now.

EVERYDAY ENGINEERING MAGAZINE
2 West 45th Street New York City, N. Y.

Digitized by Google

Useful Books on Mechanical Subjects

Electro-Deposition of Metals

By George Langbein and William T. Brannt

The new eighth edition of this volume, which has been completely revised, considerably enlarged and entirely reset, is now ready. It is a complete and comprehensive treatise, written from a scientific as well as practical standpoint and especially intended for the practical workman, wherein he can find advice and information regarding the objects to be plated while in the bath as well as before and after electroplating. This volume is the foremost book on the subject in the English language and covers electro-plating and galvanoplastic operations, the deposition of metals by the contact and immersion processes, the coloring of metals, lacquering, and the methods of grinding and polishing as well as descriptions of the voltaic cells, dynamo-electric machines, thermopiles, and of the materials and processes used in every department of the art. Particular attention has been paid to all important innovations, and it has been endeavored to include all of the latest practical methods of plating, as well as the most recent machinery and apparatus. It is a ready book of reference and a practical guide to the workshop.

Octavo, 875 Pages, 185 Illustrations.

Price $7.50

Complete Practical Machinist

By Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations

Price $3.00

Metal Worker's Handy-Book of Receipts and Processes

By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations

Price $3.00

Send for our new 48-page descriptive catalogue mailed free on request.

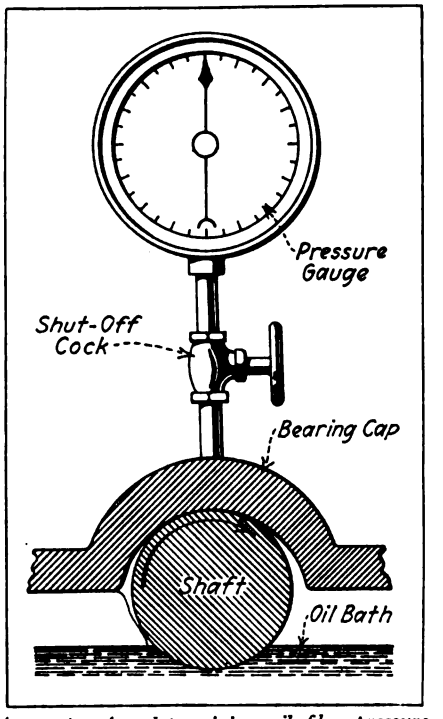
HENRY CAREY BAIRD & CO., Inc.

Publishers of Mechanical and Industrial Books

2 West 45th Street, New York, N. Y.

DETERMINING OIL FILM PRESSURE

CLAIMS have been made that under the heavy demands on journals and the necessity of keeping them in cool running condition, a properly compounded grease is safer in operation than by the use of oil, no matter how carefully the latter may be applied. From the experiments of Beauchamp Tower, a British engineer, the "film of oil" theory was established. The instant that this film is broken and metal



Apparatus for determining oil film pressure

touched metal, all laws of lubrication failed. Mr. Tower's experiments also show that there is a best lubricant for every class of service, ranging from the heavy oils and greases, with high viscosity or "body" for great pressures, and low velocity of rubbing, to the light spindle oils for low pressures and high velocities. Good judgment based on experience is the best guide in the selection of the proper oil for each service.

The results of some of Mr. Tower's experiments are interesting. In the accompanying drawing is shown a simple device showing the pressure on the oil or grease film in a journal box. A hole was drilled in the cap of the box for the purpose of applying oil at that point. It was found that oil would not enter there, and a bath was applied below the box, inserting a wood plug in the hole. But this was always forced out by the oil. Mr. Tower then connected a pressure gauge and found that while the pressure on the journal was 100 lbs. per square inch, the pressure gauge recorded an oil pressure of over 200 lbs. per square inch. Apparently the journal with oil adhering to its surface serves as a pump constantly lifting oil to the top. The adhesion of the oil to the surface made it possible for the pressure at the center to reach this very high point. The importance to be attached to this is that journal boxes should be constructed so as to admit of the pumping of the lubricant up the side to the top. It is readily concluded that if an ample supply of lubricant can be maintained between rubbing surfaces of fluid pressure twice as great as the unit pressure on the journal, there need be no concern as to the failure of the film separating the metals.

STUDY OF ENGINE TESTS

THE National Advisory Committee for Aeronautics, Washington, has just issued Report No. 46, "A Study of Airplane Engine Tests." It embodies deductions drawn from results of many tests made upon one engine in the altitude library of the Bureau of Standards.

Three major variables are considered; namely, speed, altitude and power, as well as other variables, such as best distribution, friction losses, carburetion, etc.

The work shows that:

Power varies approximately with the density of the air, decreasing with altitude. The heat supplied in the fuel should be proportioned to the density of the air, up to nearly 15,000 feet altitude, above this altitude a richer mixture should be supplied. The thermal efficiency based on brake power is a variable, but when based on the indicated power it is nearly a constant for all speeds and altitudes. The sensible heat in the exhaust varies somewhat, but is closely related to the heat rejected on the theoretical (Otto) cycle. The pounds of fuel per B. H.P. per hour is constant up to nearly 15,000 feet altitude, but increases at the higher altitudes as a richer mixture is required. When fuel consumption is based on B. H.P. it steadily rises with decrease of density owing to the effect of a nearly constant friction loss at a given speed.

In the production of nitric acid from Chile saltpetre, acid sodium sulphate has been a waste product. Recent experiments in melting with silica and other substances used by the glass-maker have resulted in the production of a clear greenish glass with a saving of over one-half the sulphur in the salt. If charcoal is added, some of the sulphur may be recovered as such, being reduced from the sulphate. It has long seemed as if silica, which may be common sand, could be used as an acid to expel other acids from their combinations. At high temperatures practically no acid can resist it.

Digitized by Google



Motor Boats and Boat Motors. Design, Construction, Operation and Repair. By Victor W. Pagé, M. S. A. E. and A. Clark Leitch, N. A. 524 pages, 6 in. by 9 in. 372 illustrations. The Norman W. Henley Publishing Company, New York City.

This is a brand new book on motor boats and should be of value to everyone interested in boats or engines. It considers every phase of motor boating, as it considers all details of modern hulls and marine motors, deals exhaustively with boat design and construction, design and installation of all types of marine engines and gives expert advice on boat and engine maintenance and repair. Not only is boat construction fully treated, but every needed dimension is given for building from complete yet simple plans, and construction is considered step by step. Everything from the selection of the lumber and laying out the boat molds to the finish of the completed craft is outlined in detail. The boats described have been built by the author and the plans are right. The book has also a special chapter on seaplanes and flying boats and includes complete working drawings for boat builders, giving full instructions for building boats ranging from a general utility 16-foot model to a 25-foot raised cabin cruiser from tested designs. It is divided into two parts and is practically two books in one binding. Part 1 deals with the hull and fittings. Part 2, the Power Plant and its auxiliaries. It is the most complete book on motor boating we have examined to date.

The Electrician's Handy Book. By T. O'Conor Sloane, Ph. D. 823 pages. 593 illustrations. Flexible cloth binding. 6¼ in. by 4½ in. Published by the Norman W. Henley Publishing Co., New York.

The Electrician's Handy Book has rapidly won its place in electrical literature and has already had a large clientele of readers. We note with interest this new edition which, while including the original matter of the book, has by extensive additions been made thoroughly up to date. It has filled a unique place in the literature of the science and the additions with their numerous illustrations operate to maintain its very high standard. The entire field of electricity is covered by the text, and the numerous illustrations, by their great clearness, facilitate its clear descriptions of electrical theory, operations and apparatus.

The book has a very full table of contents and is thoroughly indexed. Its very clear and systematic paragraphing make quick reference very easy.



NEW MOTORS FACTORY GUARANTEED ALL SIZES PROMPT DELIVERY

Charging Generators Suitable for all lighting, Battery Charging and Power Requirements.

8 v., 10 amp.	$19.50
15 v., 10 amp	$26.50
40 v, 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110 v, 18 amp.	$116.50
40 v., 50 amp.	$116.50
110 v, 26 amp.	$156.50
110 v, 50 amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors 2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., Complete with base and pulley.

½ H.P.	$46.50
1 H.P.	$66.50
2 H.P.	$86.50
3 H.P.	$98.50
5 H.P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors 110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H. P.	$58.50
1 H. P.	$82.50
2 H. P.	$124.50
3 H. P.	$142.50
5 H. P.	$218.50

Single Phase Motors 110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P. repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL ¼ H.P. 110 volts A.C., 60 c S. P., 1750 R.P.M. Complete, cord, plug and pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each Reg. Val. $34.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

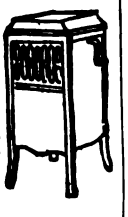
Discover Your Talents

What Are You Best Fitted For?

Personal, Mental and Vocational analysis, by Dr. S. S. George, M.A., Ph.D., former U. S. Army expert. Will help you know your mind and what you are best fitted for. Complete course of tests and analysis, with 1,500 vocations classified, will be mailed to you on approval. Send $3.00 for the course postpaid. If it is not satisfactory return it in five days and we will refund your money. Address

The Vocational Guidance Institute
2285 Broadway, New York City

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.25 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices. Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 44M, E. 13th St., N. Y.,U.S.A

UmakeM Outfit No. 3 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 3 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Earn $35 to $100 a Week

BECOME A PROFESSIONAL PHOTOGRAPHER





Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:

MOTION PICTURE—COMMERCIAL—PORTRAITURE

Cameras and Materials furnished free

Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.

N. Y. INSTITUTE OF PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.

YOU CAN MAKE BIG PROFITS Charging Auto Storage Batteries

$100 to $300 Profit Every Month

Start Now making BIG PROFITS. HB Equipment most dependable on the market—no repairs, no burn-outs, no expensive renewals—pays biggest profits with least expense—economical to operate, never wears out.

It costs only 10c to 15c each to charge batteries the HB way—customer pays 75c to $2.00. You get those profits!

with an HB Battery Charger

An HB Battery Charger for Every Size Battery Business



Small Cash Payment Puts Any HB Charger In Your Garage—Choose the Size You Need

Mark a cross (X) on picture of HB Charger you need—then tear out and mail this ad. All you need is the small cash payment—you have almost a year to pay balance on easy monthly terms. Your HB Profits will do it—easily. Sold on 10 days trial under HB Absolute Money-Back Guarantee. You run no risk. Write TODAY for information.

HOBART BROTHERS COMPANY
Box EE-77 TROY, OHIO
Successful Manufacturers Since 1893

$110 A Month To Start As Railway Traffic Inspector



ONLY THREE MONTHS spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad-minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today, and they're on the road to still further advancement, so write immediately for Booklet D 48 before you turn this page.

WE ARRANGE FOR A POSITION

Standard Business Training Institute, Buffalo N.Y.

Digitized by Google

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.



PATENTS

Before disclosing your invention to anyone, send for blank form, "Evidence of Conception," to be signed and witnessed. Form and information concerning patents FREE.

LANCASTER AND ALLWINE
225 Ouray Building, Washington, D.C.
Originators of the form "Evidence of Conception"

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney
"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost.
Offices
364 University St. Montreal, Canada
920 F St., N. W. Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today
TALBERT & TALBERT 4850 TALBERT BLDG., Washington, D.C.

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

WILLIAM VOGEL
INVENTIONS DEVELOPED
MODELS, EXPERIMENTS
Absolute Secrecy Guaranteed
CONSULTATION
Phone Barclay 9134 96 Warren Street
New York City

BOOK REVIEW

PROSPECTOR'S FIELD BOOK AND GUIDE. By H. S. Osborn. Ninth Edition. Revised and enlarged by M. W. Von Bernewitz. 400 pages, 4⅝ by 7⅛ inches. Pocket-book style. Illustrated. Henry Carey Baird & Co., Inc., New York.

Some idea of the scope of the ninth edition may be gained from the fact that a spirited introduction emphasizes the necessity of prospectors receiving some technical training. The chapter on preliminary instruction covers the fundamentals of a study of the earth's crust. Then follow discussions on practical minerology, crystallography, the value of the blowpipe in prospecting, surveying and chemical tests in the field. Separate chapters are given to the precious and base metals, also to the non-metallic minerals. A general rearrangement has been made, and the metals or minerals found in association are considered together.

The chapter on the non-ferrous or alloy group of minerals is entirely new, being the best information available. The section on oil has been expanded, while the subject of oil-shale is new. A new and little known, yet successful method of prospecting for gold, is included, while surficial indications for copper receive full attention. The chapter on gems in the previous edition has been rewritten and condensed on that subject, but to it has been added matters concerning gemstones used for industrial purposes, such as abrasives. A general chapter covers many useful minerals and salts, the old matter being amplified and brought up to date.

An important guide and suggestive aid throughout the new book are the many brief descriptions of ore deposits of all minerals occurring in scattered parts of the world. These have been abstracted carefully, and tell how certain minerals may be expected to be found. No other prospector's book contains this class of information. Another special feature is the lists of outfits, prices and manipulation of the apparatus. In the appendix will be found numbers of useful tables, an explanation of the unit system of buying and selling ores, and a complete glossary of mining and minerological terms.

The conclusion has been reached that copper is an advantageous constituent of steel. Two samples are cited. One contained 0.86 per cent. of copper and the other .030 per cent. copper. The first sample is better under all conditions with a higher yield-point, higher ultimate stress and greater reduction on area with a slightly lower value for elongation. Under the Brinell and Shore tests and the Charpy impact test the sample with the larger percentage of copper was the harder. In its general effects copper in steel is comparable to nickel which has been used so much in the last few decades of metallurgical practice.

PRINCE ALBERT *the national joy smoke*
Our exclusive patented process cuts out bite and parch.

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 76-page book on Stammering and Stuttering. "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 910 Bogue Bldg., Indianapolis

THE Wireless World
The Official Organ of the Wireless Society of London

Commencing with April 3d, will be published fortnightly in order to adequately deal with the increasing amount of Wireless Experimental and Research Work.

Full of Practical hints and useful information for Wireless Amateurs.

Extensive reports of the Wireless Societies of Great Britain.

Annual Subscription 17s, Post Free
Single Copies 9d, Post Free

To be entirely up-to-date in your knowledge of Wireless you must be a subscriber to The Wireless World.

To the Publisher,
The Wireless World,
12-13 Henrietta St.,
London, WC2, England.
Please enter me as a subscriber to the Wireless World for the
period ..... to .....
for which I enclose .....
Name .....
Address .....
Please write distinctly.

Digitized by Google

BURGESS ELECTRICAL HAND-BOOK

(called THE BURGESS BLUE BOOK, originally in blue-print form)

SHORT CUTS AND TIME SAVERS

Prepared in pocket size especially for practical men and those taking up the study of electricity. **Contains drawings and diagrams of electrical machinery—over 200 formulas for calculation and problems worked out showing how formulas are used.** From the personal note book of Yorke Burgess while on all different kinds of electrical work covering a period of nearly a quarter of a century.

Electrical laws, formulas, methods of calculation, etc. Simplified and made easy to understand and remember. Easy to apply in practical work. **Many valuable stunts not to be found in any other book.** Of value to any electrical man, whether Technical Graduate, Electrical Engineer, Student or Practical Man.

Electricians all over the world are sending for this book. **The most complete and valuable book of its kind published.** Nothing else like it. If you have never seen this book it is impossible for you to realize what you have missed.

Price $1.00

Send dollar bill, money order or check. You take no chance—money back ANY TIME if not satisfactory.

THE BURGESS COMPANY
Consulting Electrical Engineers
YORKE BURGESS, *President*
Engineering Division (Department 108) 750 E. 42nd Street,
CHICAGO, ILLINOIS, U. S. A.

Professional Assistance and Consultation

We solicit the patronage of inventors and will give prompt, confidential service in the perfection of ideas. Complete drawings and plans prepared. Specialists in steam and gas engine appliances.

Correspondence Invited.

L t Us Know Your Problem

Bell & Hoyt
366 Madison Ave. New York, N. Y.

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX €087B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

TWO GOOD BOOKS

Model Engineering

By Henry Greenly
407 pages, 809 illustrations, cloth
Price $3 postpaid

Model Making

By Raymond Francis Yates
400 pages, 301 illustrations, cloth
Price $3 postpaid

A postcard puts you on our mailing list.

SWANSON BROS.
Technical Book Service
186 No. La Salle St., Chicago, Ill.

ATTENTION! PRACTICAL BOOKS FOR PRACTICAL MEN

Get our set of 18 Books on Machine Shop Practice. Contents: Glazing, Mathematical Tables, Shop Arithmetic for the Machinist, Drawing, Screw Cutting, Screws and Bolts, Milling Machine Tables, Strength of Materials and other information. Machine work. Price **$5.25** per set prepaid.
One set of 9 Books on Electricity. Contents: Dynamos, Motors, Electric Railways, Transmission of Power, Electric Lighting, Telegraph and Telephone, Electro Plating, Armature and Magnet Winding, Wiring Diagrams, etc. Price per set **$5.00** prepaid.
Automobile Guide. Price **$1.60.**
Dykes Automobile and Gasoline Engine Encyclopedia. Price **$6.40.**
Power Wagon Reference Book for 1920 and Power Wagon Magazine, both for **$5.00.**
Storage Batteries Book **75c.**
Automobile Road Maps of every state in the Union, **35c** each state.
Send money orders or stamps.
UNION TECHNICAL BOOK CO.
4020 McPherson Avenue, St. Louis, Mo., U. S. A.

EASY to LEARN at HOME

ELECTRICITY

TAUGHT BY A PRACTICAL MAN

This Home Study Course, based on the years of practical experience of Yorke Burgess, who gives personal attention to each student, has placed hundreds of men and boys in better positions. Beginners get employment after taking the Burgess course a short while—over 85% of students now engaged in electrical work.

For BEGINNERS and EXPERIENCED MEN

What You Should Learn and The Way You Should Learn It

Why the Burgess method is best for you—Read what L. E. Walkins, E. E. M. E., of Brockton, Mass., one of the foremost Electrical Engineers in the U. S. and a pioneer in electric railway work, writes of the Burgess school: "It is indeed good that there has been established a school of Electricity on so practical lines Free From The Frills of the general run of correspondence schools."

You **TAKE NO CHANCE**—so confident are we of your success that **YOUR PAYMENTS CEASE IF YOU ARE NOT SATISFIED—EASY TO LEARN—EASY TO PAY FOR.** Apparatus, instruments, materials, etc., are included in the course. Mr. Burgess has just issued **a new 48 page book, "ELECTRICITY"** that every person interested in electricity or employed in any branch of electrical work should have. Contains valuable information and scores of letters from men and boys who are making a success by the Burgess method.

ELECTRICITY

TAUGHT BY A PRACTICAL MAN

SEND for this Remarkable Book N-8
IT COSTS YOU NOTHING
BURGESS ELECTRICAL SCHOOL
YORKE BURGESS, Supt.
151 E. 42nd St., Chicago, Illinois

Barometrical Determination of Heights

A practical method of barometrical levelling and hypsometry. By F. J. B. Cordeiro. Second edition, revised and enlarged, 6 x 4 in., limp cloth, 50 cents.

Buchanan's Tables of Squares

Containing the square of every foot, inch, and sixteenth of an inch between one-sixteenth of an inch and fifty feet. These tables will be found to be of great value to all classes of Engineers, $1.25.

French Measure and English Equivalents

By John Brook. Giving equivalents in inches and decimals of an inch and inches and fractions of an inch (to the nearest 64th + or —) or from 1 to 1000 millimetres, and 1 to 100 metres, and table of fractional parts of an inch with corresponding decimals. 80 pages, 4 x 3 ins., limp cloth, 40 cents, net.

Metrical Tables

By Sir Guilford G. Molesworth.
Fourth Edition, Revised and Enlarged
VIII + 95 pages, 5 x 3 in., limp cloth, 75 cents, net.

SPON & CHAMBERLAIN
120E Liberty St. New York

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

HAVE YOU ANYTHING TO BUY, SELL OR EXCHANGE?

Automobile owners, mechanics, model makers, motor boat owners, radio and electrical experimenters and students read these classified columns every month, looking for advertisements of things they need. Are you telling them what you have? The cost is but 7c a word; about 7 words per line. Advertisements should reach us by the first of the month to insure proper classification.

Agents Wanted

MAKE $30.00 NEXT SATURDAY. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Mich.

AGENTS MAKING $200 WEEKLY selling Bull Dog Inner Tires. Double life of tires, eliminate blowout and punctures. Big repeater. Wonderful opportunity to establish independent, permanent, growing business. Write at once. Eastern Auto Specialty Co., Dept. S, Utica, N. Y.

WANTED—Men with Ford cars to work home territory or travel; earn $10 to $25 daily. Write for particulars. Barrett Motor Starter Mfg. Co., 1777 Broadway, New York City.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscantine, Iowa.

STORAGE BATTERIES FOR AUTOMOBILES. We furnish all parts and Moulds for making them. Sample Plate 40c, Foreign Countries 50c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Aviation

CONSULTING AERONAUTICAL AND AUTOMOTIVE Engineers. Inventions analyzed and developed—Designs prepared. Tests. Expert advice. Van Muffling & Marx, City College, New York.

Books

BOOKS DELIVERED FREE. Write today for Illustrated Guide to the Latest Books. Wesley Mills Co., Dept. A, 500 Fifth Avenue, New York, N. Y.

Business Opportunities

FREE information regarding large earnings, Raising Canaries for pastime. Birdland, Lynnhaven, Virginia.

SUBSTANTIAL Manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $1,500 necessary. Will allow expenses to Baltimore as explained. Address, Treasurer, 416 N. Howard St., Baltimore, Md.

WILL YOU HELP—financially—to place the best Lock-Nut on the market? (Cheap, needs little additional machinery to manufacture, simple and positive.) How many shares at $1.00 each will you buy, subject to when, as and if issued? Rolph J. Lackner, 136 West 49th St., N. Y.

AMBITIOUS MEN—Grasp this opportunity to make money. You can make $5.00 to $10.00 every day in your spare time at home. Not a cheap scheme, agency or soliciting proposition, but substantial business plans. Investigate this today. Address, Business, Box 175, Fredonia, N. Y.

START a business of your own. 24 plans, $1.00. Joel Tilberg, Proctor, Vermont.

Cameras

SEND favorite negative and 50 cents for a beautifully mounted enlargement, guaranteed to please you or your money refunded by return mail. Western Portrait Co., 2118 Kendall St., Chicago, Ill.

Chemicals

EXPERIMENTAL LABORATORIES, fully equipped—$11.00 to $100.00. Payment Plan or Cash. Descriptions and actual photographs free. Write Dept. E-27. Lions Scientific Institute, "Laboratory Outfitters," Mt. Oliver, Pittsburgh, Pa.

Electrical

INSTANTANEOUS Hot Water Heater, attachable any faucet, valuable hospitals, physicians, and dentists' offices, barbers, and home use. Retail $60. Dealers $45. Victor O. Ford Company, 250 West 54th St., New York.

Ford Owners

FORDS RUN 34 MILES per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days' trial. Air-Friction Carburetor Company, 600 Madison St., Dayton, Ohio.

FORD SPEED-POWER EQUIPMENT stocked; 4 Speed Forward Auxiliary Transmissions, Doubles Pulling power, increases speed 40 or 20%; 16 Valve Overhead Cylinder-head; speed carburetors; camshaft, piston rings; light pistons, crankshaft counterbalances; high tension magnetos; underslung fixtures; speed power bevel gears; foot accelerators; steering wheels; wirewheels; disc wheels; metal wheel discs; Ford Fire Chemical Hook and Ladder; 15"-30" Double Universal Wheelbase Extension; 1½-2 ton Side Spring Additional Frame Work Units; Complete Line 1½-5 ton Shaft-Chain Drive Units; Racing Body; Complete Racing Cars $500.-$1750. B. V. Ford Speed-Power Equipment Manufacturers, 250 West 54th St., New York.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 238-230 Gordon Ave., Syracuse, N. Y.

For Sale

PAINTS: Before you buy paint, secure list heavybodied dampresisting high grade oil paints: brick, cement, stucco, wood: low prices, prompt shipments, careful attention, orders large or small. The many repeat orders received due to quality, service and fair dealing speak for themselves. Dept. 51, Martinek Paint Co., 405 Lexington Ave., N. Y. C.

THE REGULATION POLICE WHISTLE is the highest quality and loudest sounding whistle made. Can be heard four blocks and instantly attracts every policeman within that distance. Sent postpaid on receipt of 50c. (Special prices to Police Departments). Sharpe Mfg. Co., Paterson, N. J.

POLICE KEYS are the best and most convenient for household use. Used by 20,000 pleased customers. Assortment of four different sizes sent postpaid on receipt of 40c. Stamps accepted. Sharpe Mfg. Co., Paterson, N. J.

FOR SALE—Flying Boat without motor $1950.00 f.o.b. or with an 80 H.P. "Roberts" $2400.00. R. L. Wells, General Delivery, Cleveland, Ohio.

MOTOR BOAT POWER PLANT COMPLETE — Four Cylinder, Fifteen H.P. Motor; Rear Starter; Magneto and Carburetor; Clutch and Reverse Gear; Enclosed Type; Spicer Universal Joint. Must sacrifice. Practically New. Price $100.00 F.O.B. New York. Box 10, Everyday Engineering Magazine.

CALIFORNIA FARMS FOR SALE. Write for list. E. R. Waite, Shawnee, Oklahoma.

Guinea Pigs

WANTED 5,000 baby guinea pigs 3 to 4 weeks old 60c each. Who will raise them for us? Breeding stock supplied at moderate prices. Western Reserve Animal Industries, Drawer B, Station E, Cleveland, Ohio.

Help Wanted

FIREMEN, BRAKEMEN, BAGGAGEMEN, $140-$200. Colored Porters by Railroads everywhere. Experience unnecessary. 893 Ry. Bureau, East St. Louis, Ills.

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

Instruction

INSTRUCTION. Drafting; Practical Courses; Instruction free; Small Material cost. Write Cincinnati Industrial Training School, 2235 Kemper Lane, Cincinnati, Ohio.

Inventors

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

Male Help Wanted

SALESMEN—City or Traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association. Dept. 157-H, Chicago, Ill.

DETECTIVES EARN BIG MONEY. Travel, unusual Opportunity. Write Johnson's Detective Correspondence School, Desk 17, 232 Sheldon Ave., Grand Rapids, Mich.

DETECTIVES EARN BIG MONEY. Excellent opportunity. Travel. Experience unnecessary. We train you. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

RAILWAY TRAFFIC INSPECTORS earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM-36. Standard Business Training Institute, Buffalo, N. Y.

Miscellaneous

MULTIGRAPHS, Addressographs, Duplicators, Sealers, Folders, Less than half price. Guaranteed one year. Pruitt Company, 112-D, North La Salle, Chicago, Ill.

SALES LETTERS written by Jacobus, The Man who takes the Doubts out of Advertising. $3.50 each. Three $10.00. Jacobus Advertising Service, 1073 Sanford Ave., Irvington, N. J.

WANT Goodell Pratt Lathe, with Sawtable. Pray, 102 Heath, Somerville, Mass.

Motion Picture Plays & Supplies

$25-$300 PAID ANYONE for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530, St. Louis, Mo.

PHOTOPLAYS WANTED. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175A-10 and 175A-12, Chicago, Ill.

Motorcycles

USED AND REBUILT Indians, Excelsiors, Harleys, Overhauled and tested by experts. Guaranteed and shipped on approval. We save you big money. We furnish Bank References. Send Stamp for Free List. Floyd Clymer, Dept. 3, "Largest Motorcycle Dealer in Western America," Denver, Colorado.

$25.00 UP, GUARANTEED REBUILT MOTORCYCLES. Henderson, Excelsior, Indian, Harley-Davidson. Bicycles, $5.00 up. Tires and accessories at wholesale. Illustrated bulletin A free. Ash Motor Corporation, 162 N. Clinton Ave., Rochester, N. Y.

Opportunities

AUTOMOBILE OWNERS' FRIEND, labor, money saver $1 guaranteed. Kautch Sales Co., Stockton, Cal.

Patents

PATENTS — Herbert Jenner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York. 625 F Street, Washington; Tower Building, Chicago; Hobart Bldg., 582 Market Street, San Francisco, Calif.

PATENTS In all matters pertaining to invention consult National Institute of Inventors. 118 Fulton St., New York City, having three thousand members. Booklet free.

PATENT WHAT YOU INVENT. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" Free. Franklin H. Hough, 510 Loan & Trust Bldg., Washington, D. C.

DON'T lose your rights to patent protection. Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster and Allwine, 237 Ouray Building, Washington, D. C. Originators of Form of "Evidence of Conception."

"INVENTORS RECORD" AND "BULLETIN" sent without charge. My free blank form for disclosing your invention simplifies procedure. Send sketch or description for preliminary advice. Wm. H. Mulligan, Registered Attorney, 394 Woodward Building, Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers, Washington, D. C.

PATENTS—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years' actual experience; full information upon request. B. P. Fishburne, 322 McGill Bldg., Washington, D. C.

Phonographs

BUILD YOUR OWN PHONOGRAPH—Big saving. We furnish parts and cabinets. Write today for free instructions. Associated Phonograph Supply Co., Dept. V, Cincinnati, Ohio.

Photo Developing

MAIL US 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 283 Bell Ave., Roanoke, Va.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stammering

ST-STU-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonald, 103 Potomac Bank Building, Washington, D. C.

Stamps

APPROVAL 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

HAVE YOU SEEN THE STAMP HERALD? Finest monthly stamp paper published. Subscription 50c a year. 3 months trial for 10c. Stamp Herald Publishing Co., Dept. E, Indianapolis, Ind.

STAMPS FREE—60 all different for the names of two collectors and 2c postage. 30 Sweden stamps 10c. 20 Denmark stamps 10c. Toledo Stamp Co., Toledo, Ohio, U. S. A.

Telegraphy

TELEGRAPHY (both Morse and Wireless) and Railway accounting taught quickly. Tremendous demand. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalogue free. Dodge's Institute, P St., Valparaiso, Indiana.

Toys

AMERICAN MADE TOYS NEEDED. Homeworkers on small scale and Manufacturers on large scale wanted to manufacture Toy Soldiers, Army, Navy, Machine Guns, Cannons, War Ships, Indians, Cow-boys, Wild Animals, Whistlers and other toys and novelties. Greatest chance for Industrial people to have an independent business. Enormous demand gives an unlimited field and great future all over the United States, Canada and foreign countries. Experience or tools not necessary. Hundred and more made complete per hour. Casting forms, complete outfit from $3.00 up. We buy these goods all year paying fixed prices. For painted foods we offer attractive prices. Contracts made with reliable parties. We have connections all over the United States and goods made with these Casting forms are badly needed by all wholesale and retail dealers on account of the scarcity in these lines. Greatest opportunity are offered manufacturers of American Made Toys. A strictly business proposition and no one need apply unless he means business. In this case write for booklet and information, furnished free. Toy Soldier Mfg. Co., 32 Union Square, New York City.

Typewriter Ribbons

TYPEWRITER RIBBONS, all typewriters, 50c. Abbit Typewriter Company, 38 East 23rd St., New York.

Watches

EXPERT WATCH REPAIRING, prices moderate. Include return postage when sending watches. Workmanship guaranteed. Henry Dietrich, Watchmaker, Hamler, Ohio.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¾" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotny Electric, Charlotte, N. C.

Digitized by Google

CONTENTS

VOL. 9 AUGUST, 1920 NO. 5

HEAT TREATING ALLOY STEELS—PART 4..... 391
By Victor W. Pagé, M.S.A.E.
ELECTRONS AND THE CONSTITUTION OF THE CHEMICAL ATOM—PART 2..... 394
By Prof. T. O'Conor Sloane
INDUSTRIAL NIAGARA..... 396
By Raymond Francis Yates
SPARK TEST FOR STEEL..... 400
COMMON CAUSES OF AUTOMOBILE NOISES—PART 2..... 402
By Victor W. Pagé, M.S.A.E.
SHOP PRACTICE..... 405
Increasing Range of Milling Machine—Flanging Copper Tubes—Resistance of Steel to Cutting—Device for Small Drills—Extemporized Air Compressor.
MODEL STEAM ENGINE AND BOILER CONSTRUCTION—PART 2..... 407
By Wm. A. Helms
A Double-Acting Oscillating Engine—Stationary Boiler.
EVERYDAY MOTORIST..... 411
A New Lapping Compound—A Quenched Gap as a Spark Intensifier—Simple Spring Oiler—A Bushing Extractor—Testing Inner Tubes of Automobile Tires—Extension Pads for Ford Pedals—Clogged Muffler.
HOW THE AUTOMATIC TELEPHONE WORKS.... 413
By Kenneth Alton
A FOUR-CYLINDER AIR MOTOR FOR MODEL AIRPLANE..... 416
By Clifford A. Butterworth
USEFUL AND INTERESTING INVENTIONS..... 418
Scheme for Air Cooling—Stump Sawing Machine—New English Valve Designs—New Fuel Feed Device—Two-Piece Piston.
ELECTRICAL PROGRESS DIGEST..... 420
Determination of Minute Length Changes in Bridge Members—Electric Lighting Increases Efficiency of Laying Hens—Hand Instrument for Measuring Angles—Electricity Applied to Agriculture in Germany—Losses in Car Generators.
THE PROCESS OF NICKEL PLATING..... 422
By L. M. Blakey
CHEMICAL NOTES, RECIPES AND FORMULAS.... 423
HOW TO GET MORE MILEAGE..... 424
By Victor W. Pagé, M.S.A.E.
AEROMARINE AIR YACHT..... 426
SIMPLE KITE PHOTOGRAPHY..... 427
By L. B. Robbins
COMMUTATION AND WHAT IT MEANS TO A MOTOR..... 428
By N. M. Ferris
HOW TO MAKE A HORIZONTAL SUN DIAL..... 430
THE UTILITOR GARDEN TRACTOR..... 431
AVIATION BRIEFS..... 432
Fishing from a Blimp—A French Aviette—Record Parachute Jump—Completely Enclosed Airplane Fuselage for High Altitude Flights—Experimental Multiplane.
MANUAL ARTS AND CRAFTS..... 434
By Chas. E. Muller, M.A.E.
Electric Boudoir Lamp—Magazine or Dictionary Stand—A Simple Balance—How to Make a Small Lift Truck.
EVERYDAY SCIENCE NOTES..... 438
By Prof. T. O'Conor Sloane
THE DESIGN AND USE OF LOOP ANTENNAS..... 440
By M. B. Sleeper
EQUIPMENT FOR THE RADIO STATION..... 442
By Stuart D. Dimond and John A. Hall
THE RADIO DEPARTMENT..... 444
A NEW DEVELOPMENT IN TUNING INDUCTANCES 446

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street New York City

A Dependable, Instructive Digest of Current Mechanical, Scientific, Automotive and Radio Progress.

Managing Editor VICTOR W. PAGÉ
Science Editor PROF. T. O'CONOR SLOANE
Radio Editor M. B. SLEEPER

Contributing Editors

L. M. CLEMENT *Radio Engineering*
CHAS. E. MULLER *Manual Arts and Crafts*

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Office
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, INC.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechanics Co., Inc.

What Is Engineering?

WE are frequently called upon to define the functions of an engineer, and to explain the term "ENGINEERING" by outlining its scope and its limitations. The report submitted by one of the committees of the American Society of Civil Engineers gives definitions that are worthy of general adoption because they answer the questions so often asked.

ENGINEERING is the science and art of directing the great sources of power in Nature to the use and convenience of man. Engineering is an art and a science. It is a science in so far as physical laws are its base, and an art in so far as in the application of these laws the things designed and constructed develop the spirit of progress, the creation of wealth, and the well-being of all peoples. Engineering is generally divided into four divisions: civil, mechanical, electrical and mining. The practice of engineering requires knowledge of physical laws, forces, and the materials of Nature. The professional engineer is one who by reason of special training, education and experience is qualified to design and direct the construction of engineering work in one or more of the major divisions of engineering.

ENGINEERING is the creative science and art of applying economically the materials and forces of Nature to the use and convenience of man. Engineering is the science of industrial effort, and the science and art of applying this effort for the welfare of the public. An engineer is one versed in the science and art of industrial effort made for the purpose of public welfare.

NONE of these definitions state that an engineer must be trained only in a special technical school or institute, or that a successful engineer must have a degree from some seat of learning. Engineering can be learned in the school of practical experience, but the great value of preliminary education is that the student becomes familiar with what has been done, and why, without the inevitable waste of time that always accompanies an education obtained solely by experience.

THE engineering world demands that anyone who wishes to practice in any of the branches of this profession must combine a good theoretical knowledge of basic principles with a practical appreciation of how things are done. The former can be obtained by study, the latter only by doing. The engineer taught in both schools is the one who succeeds best, and who accomplishes great things.

Digitized by Google

Useful Books on Mechanical Subjects

Electro-Deposition of Metals

By George Langbein and William T. Brannt

The new eighth edition of this volume, which has been completely revised, considerably enlarged and entirely reset, is now ready. It is a complete and comprehensive treatise, written from a scientific as well as practical standpoint and especially intended for the practical workman, wherein he can find advice and information regarding the objects to be plated while in the bath as well as before and after electroplating. This volume is the foremost book on the subject in the English language and covers electro-plating and galvanoplastic operations, the deposition of metals by the contact and immersion processes, the coloring of metals, lacquering, and the methods of grinding and polishing as well as descriptions of the voltaic cells, dynamo-electric machines, thermopiles, and of the materials and processes used in every department of the art. Particular attention has been paid to all important innovations, and it has been endeavored to include all of the latest practical methods of plating, as well as the most recent machinery and apparatus. It is a ready book of reference and a practical guide to the workshop.

Octavo, 875 Pages, 185 Illustrations.

Price $7.50

Complete Practical Machinist

By Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations

Price $3.00

Metal Worker's Handy-Book of Receipts and Processes

By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations

Price $3.00

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.

Publishers of Mechanical and Industrial Books

2 West 45th Street, New York, N. Y.

LEARN DRAFTING

At Home—In Spare Time

as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed. by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.



Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.



Draftsmen Get $35 to $100 a Week



Draftsmen are needed in greater numbers, and receive better salaries than ever before.

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.



How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING

Roy C. Claflin, President

Dept. 1152, 14th & T Sts., N. W., Washington, D.C.

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1152, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below: (Mechanical Drafting, or Machine Drafting, is the foundation course and is complete in itself.)

Architectural Drafting....	Ship Drafting.....
Automobile Drafting.....	Statistical Drafting.....
Electrical Drafting.....	Radio Drafting.....
Aeroplane Drafting.....	Automotive Drafting.....
Special Machinery Drafting	Hydrographic Drafting....
Sheet Metal Drafting.....	Machine Design.....
Structural Drafting.....	Tool Design.....
Highway Drafting.....	Shop Mathematics.....
Patent Drafting.....	Builders' Course.....
Topographical Drafting....	

Name .....

Age..... Address.....

City..... State.....

Digitized by Google

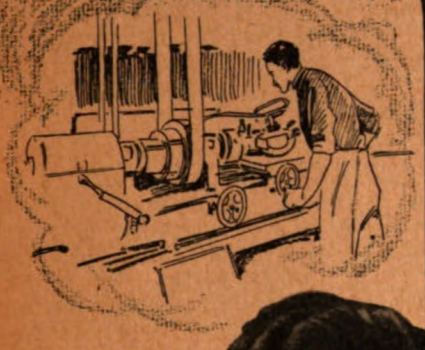


LEARN WIRELESS

At Home Quickly and Easily

WIRELESS is the hinge upon which swing the doors to success. It is the very foundation of the road which leads to many professions vast in scope, big in responsibility, satisfying in progress and salary.

A trained Wireless Operator with initiative and ambition can easily fulfill his ideals for a successful future; one including a position filled with vital enterprise, adventure, and financial success.



Attractive Work—Alluring Salaries

Radio offers interesting work in pleasant environment, besides substantial salaries. Radio Operators' salaries start at $125 a month with all living expenses—board, lodging, laundry, etc. —paid. When totalled and added to salary, it means $200 or more a month, at the very start. Advancement to higher positions with bigger pay is readily accomplished.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, wireless offers unequalled opportunities. On shipboard you are rated as an officer, living and eating with the officers, and mingling with the passengers. All without one cent's expense to you! Land Wireless positions are just as attractive if you prefer them.



Send for Free Booklet

Our booklet "Wireless The Opportunity of Today" contains much interesting and valuable information. We have helped hundreds of ambitious men and women; the booklet explains how we did it, and how we can give you a thorough Wireless training, in your spare time, at home, by mail, and help you secure a worthwhile position.

NATIONAL RADIO INSTITUTE
Dept. 263 14th & U Sts., N.W.
WASHINGTON, D. C.

Send This Coupon Today

NATIONAL RADIO INSTITUTE
Dept. 263, 14th & U Sts., N. W., Washington, D. C.

Send me your FREE book, "Wireless the Opportunity of Today." Tell me about your Home Study Course in Wireless Telegraphy and Telephony—the free post graduate course and your Special Instrument offer.

Name .....

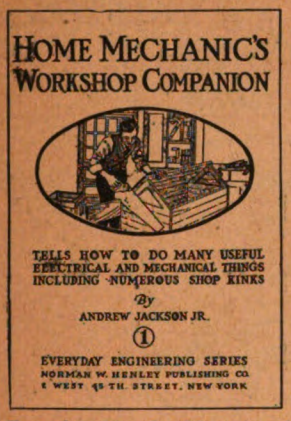
Age..... Address.....

City..... State.....

Digitized by Google

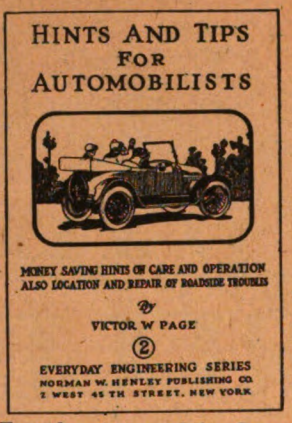
A SPECIAL OFFER TO OUR READERS

ANY ONE OF THESE BOOKS WILL BE SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION WHEN SENT DIRECT TO US AND NOT THROUGH AN AGENT



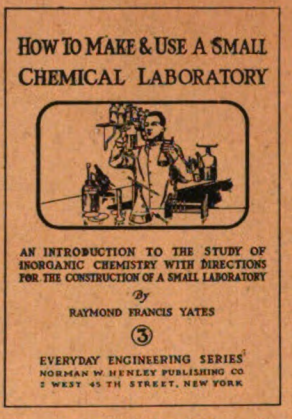
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.



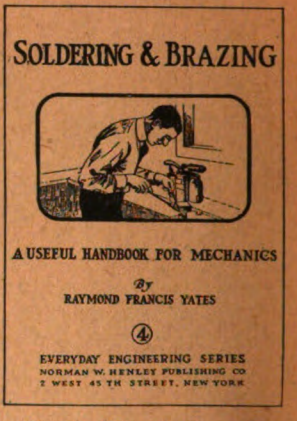
For the Automobile Owner or Driver

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints.



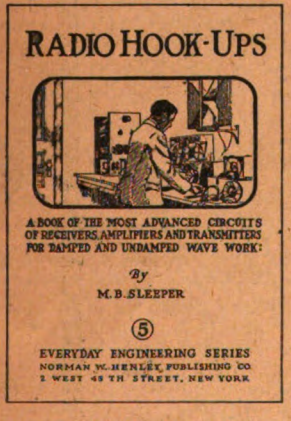
For the Student Chemist and Experimenter

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.



For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work.



For the Radio Experimenter and Amateur

In this book, the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuit diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details.

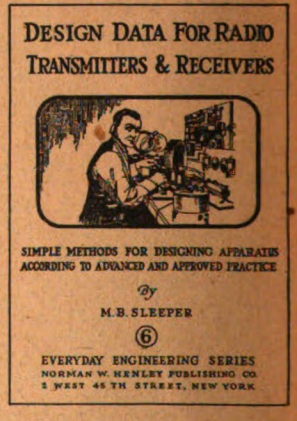
ALL of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest.

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOUR OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

Fill Out the Special Blank Below
Check Off the Title Desired and Mail with Your Remittance

Special Circular Describing These Books Sent on Request

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man —the Mechanic and the Radio Experimenter.



For the Radio Engineer and Student

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45TH STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for ..... years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the ..... issue. I enclose $....., and
(Date of issue)
according to your special offer send me copy of book checked off.

Name .....

Street .....

City .....

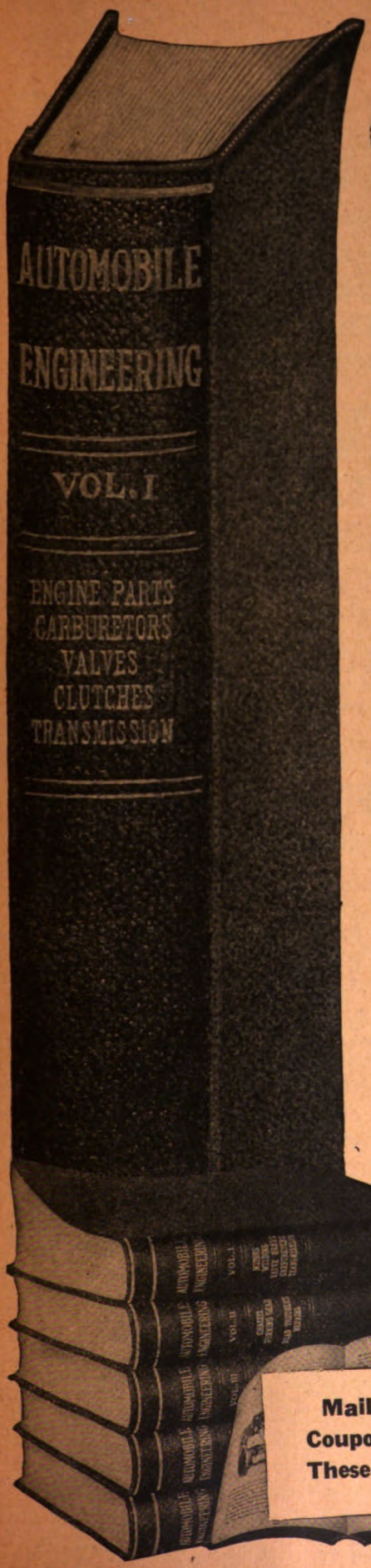
State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS
Check off title desired here

1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google



NAME	POSITION	SALARY
John	AUTOMOBILE ENGINEER	$125 A WEEK
	REPAIR MAN	$50 A WEEK
	CHAUFFEUR	$30 A WEEK

PUT YOUR NAME ON THIS PAY-ROLL

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

AUTO BOOKS

6 Volumes Shipped Free

Now ready for you—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,600 pages and 2,300 illustrations, tables and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination.

PARTIAL LIST OF CONTENTS

- More than 100 blue prints of wiring diagrams
- Explosion Motors
- Motor Construction and Repair
- Carburetors and settings
- Valves, Cooling
- Lubrication
- Fly-wheels
- Clutch
- Transmission
- Final Drive
- Steering Frames
- Tires
- Vulcanizing
- Ignition
- Starting and Lighting Systems
- Shop Kinks
- Commercial Garage
- Design and Equipment
- Electrics
- Storage Batteries
- Care and Repair of Motorcycles
- Commercial Trucks
- Glossary

ONLY 7cts A DAY

Not a cent to pay in advance. First you see the books in your own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2.80 in seven days and $2 a month until the special introductory price of $24.80 has been paid. (Regular Price $36.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This great bargain offer must soon be withdrawn.

SEND NO MONEY NOW

Don't take our word for it. See the books without cost. There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—Just the coupon.**

American Technical Society, Dept. A35c Chicago, Ill.

Dept. A35c
American Technical Society
Chicago, Illinois.

Please send me the 6-volume set, Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $2 a month until $24.80 has been paid. Then you send me a receipt showing that the $36.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the seven days' trial I will return them at your expense.

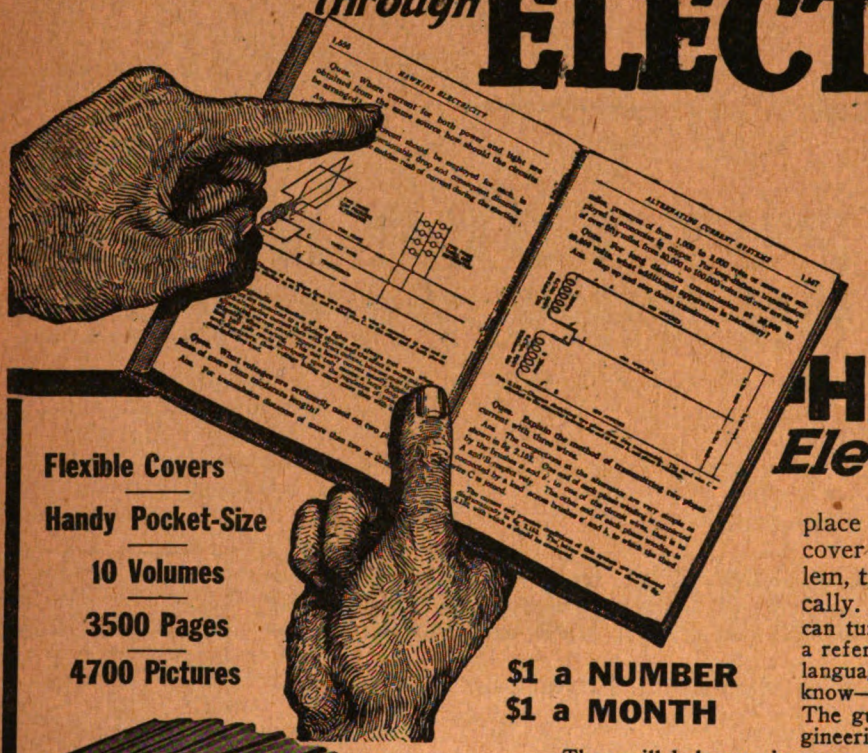
Name .....

Address .....

Reference .....

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

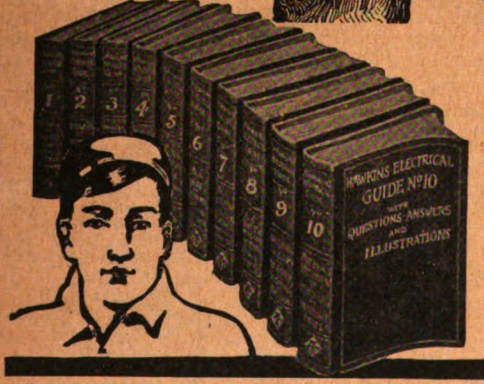
3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers: losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent
Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Menard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved
The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.
The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.
Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry
The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins,
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....
Occupation .....
Employed by .....
Residence .....
Reference ..... August

SEND NO MONEY - USE THE COUPON

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 9 AUGUST, 1920 NUMBER 5

Heat Treating Alloy Steels

A Series of Simplified Articles Detailing the Various Methods of Heat Treating Modern Alloy Steels. This Installment Explains the Methods of Making Microscopic and Chemical Analysis in Determining Carbon Content of Steel

By Victor W. Page, M. S. A. E.

PART IV.

IT will be apparent to the reader that in a series of this nature it is not possible to cover the broad field of the metallurgy of iron and steel but before dealing with the heat treatment of alloy steels it will be well to describe briefly the influence of various percentages of carbon on the steel and also to explain how it is possible to determine the chemical composition of the steel by microscopic analysis which is done as shown in Fig. 1 and chemical analysis which is carried on by means of either of the combustion trains shown at Figs. 2 and 3.

The combustion method is a very good way of determining the carbon content by chemical means. Different tests are necessary to detect other alloying elements, such as nickel, chromium, etc. Steel is a generic term applied to a large variety of iron alloys which range from wrought iron, which is nearly carbonless at one extreme and cast iron, which is very high in carbon at the other extreme. Steel differs from either wrought or cast iron in that its nature may be changed by heat treatment and various internal structural modifications will take place either upon the application or abstraction of heat. Metal that contains less than .03% of carbon is not known as steel but is termed wrought iron or ingot iron, while a metal that has over 1.80% of carbon is cast iron. It will then be apparent that the material we know as steel, ranges, as far as its proportions of carbon are concerned, within the limits mentioned above.

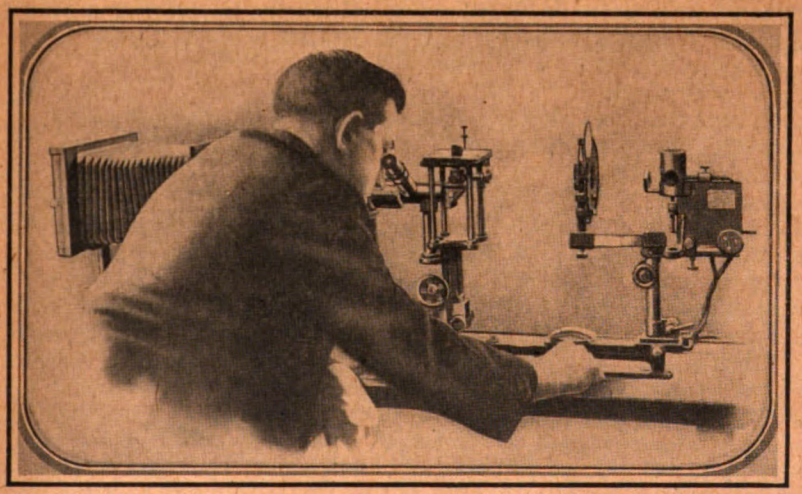


Fig. 1—Method of examining steel specimens under the microscope to determine micro-constituents

Microscopic Analysis of Steel

The use of the microscope in determining the amount of carbon and other alloying elements in iron and steel is of comparatively recent development. The pioneer work was done by Dr. Clifton Sorby, about fifty years ago, and it is due to the researches of this scientist that we know of the microstructure of steel. At the present time thirty different micro-constituents of steel are known. The micro-structure, which is produced by various heat treatments, enables one to determine very accurately if the heat has improved the metal or if it has damaged it as regards to strength, endurance, and other physical characteristics.

Before a piece of iron or steel can be examined under the microscope a small piece must be cut off the bar, then this must be ground to an absolutely level surface after which the piece must be polished so as to remove all scratches. This polishing process is followed by etching the steel with various kinds of acid, depending upon the micro-constituent that is to be looked for and finally the small piece is mounted on a glass slide or in a special holder so it may be easily manipulated for inspection under the microscope.

It is not necessary to go into details regarding the polishing process, suffice it to say that this must be very carefully done, the piece being ground on a fine emery wheel and then polished by successive stages in which a start is made by using a piece of medium coarse emery cloth on an absolutely flat surface and then worked down by using finer grades of cloth successively and performing the final polishing operation by holding the specimen against a revolving block covered with a damp canvas cloth charged with a fine polishing medium such as crocus, tripoli powder or rouge.

After the piece has been polished it is ready for etching. This is done by using various etching fluids, the one best adapted for general use being a saturated solution of picric acid in alcohol. The etching operation consists of moving the polished surface of the specimen in the acid for a period of time depending upon the nature of the material tested. This can only be determined by experience. The usual time for a plain carbon steel is about thirty seconds. If deeper etching is desired it may be necessary to immerse the polished surface for a longer period.

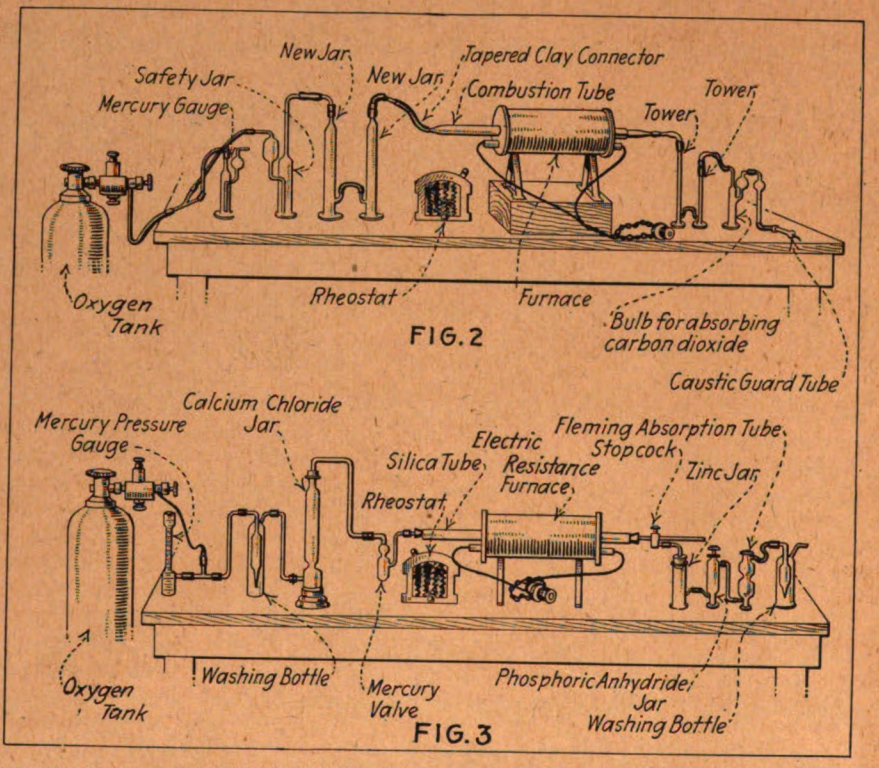
Digitized by Google

During the etching process, the lines of demarcation between the various crystals are intensified as these cannot be detected on the polished surface unless it is etched.

Care must be taken that the scratches made by the abrasive do not run always in the same direction when polishing.

After the etching process, the crystals of which the metal is composed are more sharply defined and are apparently bounded by walls. The etched specimen is illuminated by a powerful and concentrated light which does not illuminate the walls or spaces between the crystal but yet brings out the surface so that when viewed through the microscope, the illuminated crystals are marked out by black lines. The effect of increasing the carbon content of iron is to produce gradually augmenting areas of a compound known as pearlite, and when the proportion of carbon is about .90%, all of the ferrite or pure iron has been replaced by this new substance, known as pearlite. If the carbon proportions are augmented further, some of the pearlite is in turn replaced by another constituent known as cementite, and this material outlines the pearlite which tends to arrange itself into a triangular form.

The accompanying illustrations at Fig. 4, which are reproduced from the *Scientific American*, show clearly the appearance of pure iron after various percentages of carbon have been added to it. In a future installment, actual reproduction of photo-micrographs will be shown so that the reader will readily understand how the name pearlite was given on account of the appearance of that material which is similar to mother of pearl under strong illumination. It is possible to detect other elements in steel and impurities in iron by the microscope, for example: sulphur and manganese forms manganous sulphide, which shows up a dove gray under the microscope.



Figs. 2 and 3—Typical combustion trains for determining carbon content of steel by chemical analysis

Composition of Simple Carbon Steel

Steel is composed of pure iron or variety of iron carbide (Fe_3C, containing 6.06% carbon, 93.04% iron) together with various impurities in solution. A certain amount of the carbide will dissolve in iron and when that definite amount is exceeded there will be precipitated free carbide which is known as cementite. As previously stated the point of complete saturation is reached at .90% carbon in simple carbon steels and at that point if the steel is in a soft or annealed condition the structure shows no ferrite of cementite but the mixture of pearlite.

The changes in the structure of steel and the action of the iron and carbon it contains may be stated about as follows: To start with we have pure variety of iron, then by adding a little carbon we add a little cementite. At this point we have neither free cementite nor toally free ferrite, but a partial mixture of both known as pearlite and so on up to the point where sufficient carbon has been added so there is complete mixture of cementite, and iron and there is no free ferrite or cementite and only pearlite is shown.

When the carbon content exceeds .90% we have the pearlite stage and some excess of cementite. If th carbon should reach 6.06% we would have only cementite in the mixture, but it is not available commercially as either cast-iron or steel. The carbon content of a steel may be estimated by the metallurgist trained in this work by the relative percentage of the micro-constituents. As has been previously pointed out, if .90% steel will show all pearlite, one having half of that amount or .45% will show half ferrite and half pearlite, while a steel of 1.50% carbon will show .90% pearlite and .10% cementite. The micro-constituents of annealed simple carbon steel containing various percentages of carbon can be readily approximated, by the simple chart presented at Fig. 5, showing ferrite, pearlite and cementite.

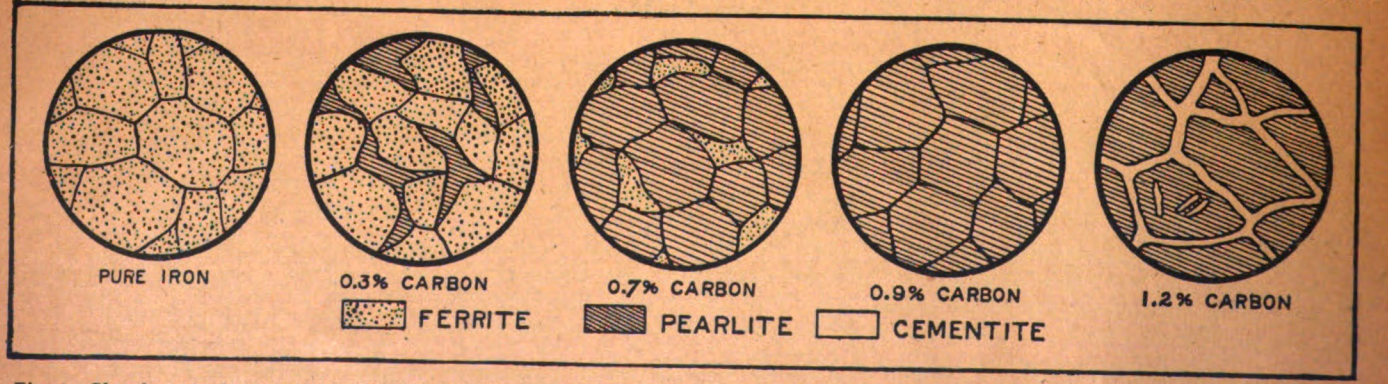


Fig. 4—Sketches of photo-micrographs showing how various percentages of carbon change the structure of steel when examined under a powerful microscope

Digitized by Google

Chemical Analysis of Steel

Having explained in a simple way how it is possible to determine the carbon content of steels by micro-analysis, an attempt will be made to show how the carbon content of steel is determined by the chemist using analytic methods. It is believed that the reader who is interested in the subject of heat treatment will be better able to understand the discussions which are to follow, if he has some idea of how it is possible for the chemist to determine accurately how much carbon or other alloying elements are in combination with the iron to form steel.

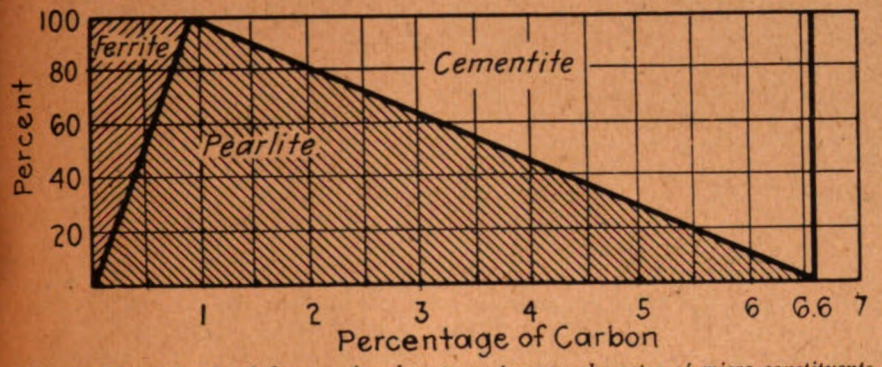


Fig. 5—Chart showing influence of carbon percentage on character of micro-constituents of annealed steel

The arrangement of chemical appliances at Fig. 2 shows a combustion apparatus designed by C. N. Johnson, and supplied by the Scientific Materials Company. It is used for determining the amount of carbon in iron or steel by direct combustion and it is stated that the elimination of all rubber stoppers reduces the liability of gas leaks. The electric furnace is of the resistance type and can be supplied for either 110 or 220 volt circuits. It can be used with either alternating or direct current. The mercury gauge is used to detect gas loss and stoppages in the apparatus. The next is a safety jar which is filled with a potassium hydrate solution. Then we have a new jar, one-half of which is filled with anhydrous calcium chloride and the other half with granulated soda lime. The next new jar is provided for lump caustic potash.

The combustion tube, which is inside of the furnace, is made of vitrified clay and is provided with taper connectors for the rubber sleeves which join one end of the combustion tube to the new jar and the other end to the tower. The rheostat is used for the regulation of the furnace temperature. The first tower is used for granulated zinc, the second tower is used for phosphoric anhydride. The bulb for absorbing the carbon dioxide gas, which is produced by burning out the carbon from the steel specimen in the combustion tube in the presence of oxygen, is used for weighing and it is from this that the amount of carbon contained in the steel is determined.

The steel is divided into very fine chips or coarse filings and is placed in a small shallow "boat" or tray of clay and then put into a combustion tube. Various chemicals used in the train of apparatus are for removing impurities and moisture from the oxygen gas and also from the carbon dioxide gas given off by the combustion of the carbon contained in the steel.

The outfit shown at Fig. 3 is known as a Fleming combustion apparatus, and while it operates on practically the same principle as Johnson's combustion train shown at Fig. 2, it differs from it in some respects. It is stated that only five minutes are required to make a combustion test and that a feature of the absorption tube is that there is no possibility of the CO_2 or moisture escaping even though the oxygen current passes through the combustion tube at the rate of 600 cubic centimeters per minute. The apparatus consists of a mercury pressure gauge to detect leaks by falling pressure and stoppage by rising pressure. Next is a washing bottle, then a calcium chloride jar which is joined to a mercury valve. The combustion tube is of silica and varies from twenty-four to thirty inches long and from three-fourths of an inch to seven-eighths of an inch inside diameter. The furnace is the same type as shown at Fig. 2, as is the current regulating rheostat. The remainder of the apparatus performs the same functions as in the outfit illustrated above it.

It is not within the province of this series to go into the methods used for carbon determination because this can be found in detail in text books devoted to the subject. The reason for presenting these combustion trains in this article is to make clear to the reader how it is possible to test the steel and determine its composition as relates to alloying elements accurately by chemical analysis and the type of apparatus that can be employed for that purpose. The chemical test can be checked up by a microscopic analysis and there is no longer any guess work in determining the amount of carbon or any of the alloying elements ordinarily used in connection with iron and steel manufacture. In the next installment the various critical points in plain carbon steels will be described and the effect of heat treating steel at points other than those indicated to be best will be considered.

(*To be Continued*)

UNUSUAL MONOPLANE DESIGN

RATHER radical ideas on airplane design are embodied in a machine under construction by the Stout Engineering Laboratories from designs of William B. Stout, and reported in *Automotive Industries*. It is called the Stout bat-wing monoplane and its chief characteristic is that all the machinery, trussing, etc., is in the wing. The engine is set into the leading edge, the passengers are enclosed between the surfaces of the wing and every part exposed to the air is designed to lift. Central part of wing is thick and of long chord, the tips are thin and narrow. For this reason and on account of the peculiar trussing inside, all formed of plywood, the plane is said to be exceptionally light. Not only the frame, but the surface of the wing, as well, is of strong, waterproof veneer, the surfacing being only 0.05 inch thick and three-ply.

Each wing is supported on either side by nine spars, and two of which are said to be strong enough to support the ship should the others be shot away. The longest spars, with a spread of 20 feet, weigh only 7½ pounds and supported in test over a ton per pair without breakage. The radiators pull into the wings when cold altitudes are reached, and the heat from them is utilized to warm the passengers and pilot. In the large type even the landing gear is pulled into the wing when the ship is off the ground.

A new ship of this type being laid down has a span of 100 feet, a wing depth of 7 feet at the center, and has within it a compartment for mail, bombs or passengers, as the case may be, this cabin being 30 feet long, 6 feet high and 8 feet wide.

COMPOUNDS OF LEAD

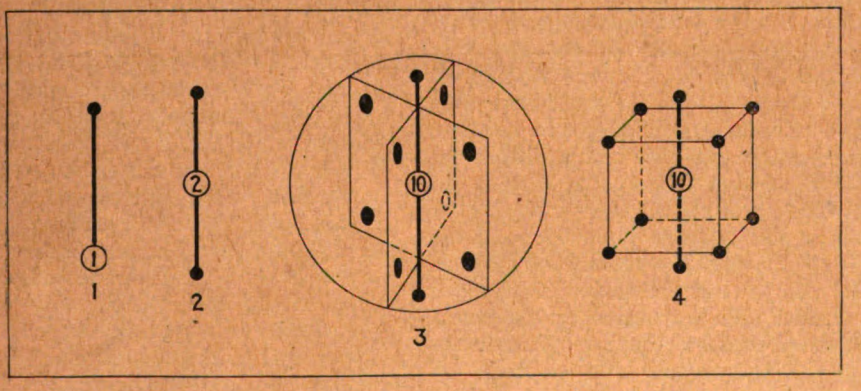
Red lead, litharge, and white lead are all compounds of lead. Litharge and red lead are oxides of lead, except that the red lead contains more oxygen than the litharge. A still higher oxide of lead called the peroxide is brown. White lead is a basic carbonate of lead. It will be appreciated, therefore, that the compounds of lead are quite varied in color.

Digitized by Google

Electrons and the Constitution of the Chemical Atom

By Prof. T. O'Conor Sloane

IT is fair to say that the constitution of the atom is still unsettled and is a subject for theorizing and investigation. Perhaps the best conception of it as it is now generally accepted is to start with the hydrogen atom. All atoms are supposed to be made up of a nucleus which is charged with positive electricity and holds within the limits of the atom one or more electrons charged with negative electricity. It is something like the solar system in which the sun would represent the nucleus and the planets the electrons. The electron carries a charge of negative electricity. Every electron carries precisely the same charge, so that we here have in nature a fundamental unit of electric quantity. The positive charge of the nucleus of an atom is equal to the sum of the charges of the electrons of that atom. Returning now to our hydrogen atom



we must think of it as consisting of a nucleus with a unit positive charge and a single electron with a unit negative charge. This makes a one sided structure. There is no balance or equilibrium about it, therefore it cannot exist alone, but must combine with another atom so that the vacant space, as we may term it, shall be taken care of. We find, therefore, that hydrogen has very high chemical affinities. Now suppose that another electron is added to the atom and that another positive charge is added to the nucleus. Here we have a perfectly balanced atom; it is like a balance-beam with equal weights at each end. This atom takes care of itself, it combines with nothing and cannot be forced into any combination. Chemically speaking it is found to be absolutely neutral and without any affinity. It cannot enter into any chemical compound. This substance is helium. It is a very light gas and exists in considerable quantities under the earth's surface. A very convenient way to think of an atom is to figure it as a sphere with the nucleus in the center.

In the case of helium we may place an electron at the North and South Poles. We now may think of the surface of this sphere as divided into eight equilateral spherical triangles whose bases are 90° in angular measurement and lie upon the equator and the apex of each of which is at the North or South Pole. Now in addition to the North and South Pole electrons, place an electron in the center of each of these triangles and we will have eight additional symmetrical points indicated on the sphere. Such points may be picked out easily on a terrestial globe. The atom we have just described would have ten electrons and the nucleus would possess ten unit charges of positive electricity. This atom would be in perfect balance and would be perfectly symmetrical. It would combine with nothing, as there is no vacant place upon it for another atom to attach itself, and this describes the atom of the element neon, a second element without any affinity whatever.

If we examine the list of elements we will find that from hydrogen to neon inclusive there are precisely ten elements taking them in the order of their atomic weights. We shall give later the list of the elements in their order, one set of figures expressing their numerical position as well as the number of electrons in the atom of each element, while the other row of figures expresses their atomic weight. Suppose now that we add eight more electrons to our atom. These we may suppose to lie in a sphere concentric with the other and they involve the possession by it of eight more unit charges of positive electricity by the nucleus. Again we have perfect equilibrium. This is the atom of argon, another element absolutely without affinity. The seventeenth of the elements in numerical order is sodium and argon is the eighteenth. Between hydrogen and argon there come in sixteen elements in numerical order, giving a total of eighteen, including sodium and argon; the numerical order of each element expresses its number of electrons. If we double the electrons of the argon atom we double of course the positive charges in the nucleus and we will have a 36 electron atom, also perfectly balanced and incapable of combining with anything. This is the 36th element in the numerical order and is called krypton. Between argon and krypton come in thirty-four elements one for each additional electron, so as to make an even series of numbers. Next adding eighteen electrons to krypton we get xenon with fifty-four electrons, and finally by adding thirty-two electrons to the fifty-four xenon we get the niton atom with eighty-six electrons. These are the six perfectly balanced atoms which can combine with nothing. Approximately the half of the atomic weight of an element gives the number of the electrons of its atom in the series. There are a very few vacant spaces counting each space as if we had discovered the element to fit it. Assuming the missing elements to exist we find there is a total of ninety-two elements. It will be evident that there is a relation of the number eight to atomic properties. As long ago as 1864 Newlands had the idea of chemical octaves and the number eight appears in the modern table of atoms very definitely.

The valency of an element indicates the number of vacant electron spaces in its atom. This is a general way of putting it and from the popular standpoint it is perhaps as good as any. We have seen that the hydrogen atom has one vacant place where an electron might fit. Hydrogen, therefore, has only a valeney of one or is a monad element. The element oxygen has eight electrons in its atom. We have seen that a ten electron atom is perfectly balanced and neutral; if we subtract eight from ten we have two, so that oxygen is an element whose atom is two electrons out of balance and is therefore a dyad or of twofold valeney. We may go right through the list in this way and find that the vacant electron spaces correspond very

Digitized by Google

closely to the old time bonds, which latter are still used in chemical formula.

Thus if an atom of oxygen combined with hydrogen one atom of hydrogen would take care of each vacant space. A molecule would be formed containing two atoms of hydrogen and one of oxygen, which would be properly expressed by the formula H^2O, and that is, as our readers know, the formula of water.

But the most interesting thing about the electron theory of the constitution of atoms is that we have an almost complete list of elements found by chemists and physicists successively increasing in atomic weight by almost even additions, so as to lead to the conclusion that starting with single electron hydrogen, then with two electron helium, we can go right down the list, each element having one more electron than its predecessor. Thus the numerical position of an element in this list tells us the number of electrons which it contains and tells us the charge of its nucleus.

We have said that the atom is comparable in structure to the planetary system with the sun to represent the nucleus. Whether the electrons have independent motion within the limits of the atom, and if so what such motion is, we do not know.

Various illustrations have been given of the relations of nucleus and electrons. One authority says that if an atom were ten meters in diameter the electron would not exceed one-tenth of a millimeter in diameter. This is one one-hundred-thousandths of ten meters. On this conception the atom is principally empty space, and its mass which gives it weight and inertia is taken as concentrated in the nucleus and this leads to a very extraordinary conclusion. If it were possible to fill a cubic inch with a nuclei of gold atoms in close contact with each other the weight would exceed three million tons.

The absolute size of an atom is roughly estimated from various considerations, among others by observing the interference colors of a soap bubble film. Its thickness can be calculated. When it is on the point of breaking and the film on the top is at its thinnest, showing black, it is taken as being approximately a molecule in thickness. The color of gold films deposited on glass, which also may be made extremely thin and the thickness of the oil films floating on water all give an idea of the possible size of a molecule. A crude way to get at this figure is by the use of the microscope, to determine the smallest quantity of dye that can be seen by man. From these and other considerations one conclusion reached is that the diameter of a molecule is less than a millionth of a millimeter.

If a molecule is composed of the smallest number of atoms compatible with its valency we may get from the above some idea of the size of an atom.

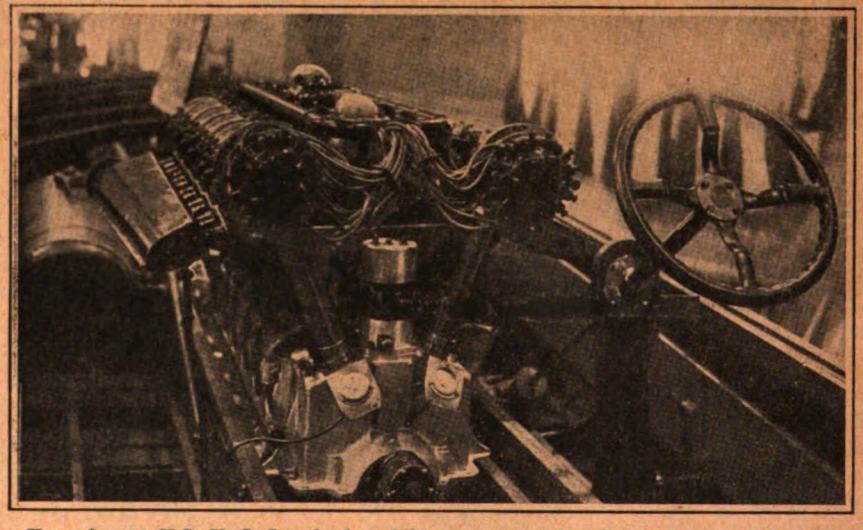
An electron is defined as a corpuscule of electricity. The possession of the property of producing self induction is taken as showing that electricity possesses inertia or mass. It is taken as almost certain that the mass of an electron is entirely due to its charge of electricity. This brings us to the electric theory of matter, which states that all matter is composed of electricity coming pretty close to the old doctrine of subjective ideality, and bring us perilously near the point where the words of Milton apply, and we will "find no end in wandering mazes lost."

We have no exact knowledge of the constitution of the nucleus. We know that it is the seat of intense force, so intense that chemical methods cannot affect it. In radio-active emission electrons are detached from the atom forming beta and alpha particles; the latter are found to be helium gas, the first of the six saturated or neutral elements, with atomic weight of four. This is taken as indicating a grouping of positive electrons in the nucleus in groups of two.

gine is effected by means of compressed air. As the boat in question, together with other similar boats, has been entered for most of the coming season's motor boat races, it may be confidently expected that the above-mentioned speed will be still further improved upon. The accompanying illustration shows how our own Liberty engine has been installed in a very fast motor boat of American design that made speeds in the neighborhood of one mile per minute in its trials. American racing craft fitted with two Liberty motors have attained speeds of over 75 miles per hour.

SYNTHETIC FUEL OIL

It is reported from Germany that wartime experiments showed that the distillation of lignite at a high temperature gave a liquid coal tar which contained certain ingredients suitable as a substitutte for gasoline, kerosene, and lubricating oils. Through a new process benzine and kerosene can be obtained from liquid coal tar, which has been distilled from lignite at a lower temperature, and all industries using lignite are urged to set up facilites for generating this liquid coal tar and thus secure synthetic products to supply the lack of the natural products. It is interesting to remark that at this time when there is a shortage of fats in central Europe, German newspapers are advertising a liquid soap containing a percentage of alcohol for shaving purposes. This is undoubtedly a by-product.



How the 400 H.P. U. S. Standard or Liberty motor is installed in a speed boat hull

AIRPLANE ENGINES FOR RACING BOATS

THE new motor boat built by M. Despujols in Paris, which succeeded in attaining a speed of 75 miles per hour, is fitted with a Sunbeam-Coatalen engine of the "Matabele" type, suitably modified for use in motor boats. For motor boat purposes the engine is fitted with an exhaust manifold of special design, which acts as an efficient water-cooling arrangement. The engine is mounted on special resilient mountings and the drive is through a flexible coupling to a gear box by which the speed of the propeller is geared up to 3,000 r.p.m. The starting of the en-

Bismuth subnitrate has been a favorite medicine for treatment of stomach troubles. During the early part of the war all scources of bismuth became exhausted and now it is said that kaolin, the pure white clay used in making fine porcelain, can act as a substitute and has been demonstrated to be efficacious in the treatment of stomach complaints. It certainly will be an innocent medicine operating by its porosity, as it is quite insoluble in the gastric juices.

Digitized by Google

Industrial Niagara

How a Small Part of the Energy of the River Producing This Great Waterfall Is Made To Do Useful Work

By Raymond Francis Yates

As we view the titanic waterfall of Niagara we are inspired by its terrible thunder, entranced by its omnipotence. We are indeed under a spell—the spell of some inconceivable yet ever-existing spirit—the "Spirit of Niagara." It toys with the soul strings of the most mundane observer, and the strongest minded are powerless to withstand its aesthetic appeal. We look into the awful depths below and watch the crystal waters, as if beckoned by some unseen force, glide off the apex and leap into the terrible abyss. In the stream below the waters again become peaceful and move with a sluggish current on down the gorge with growing calmness to again be churned into turbulence by the witchery of the rapids below.



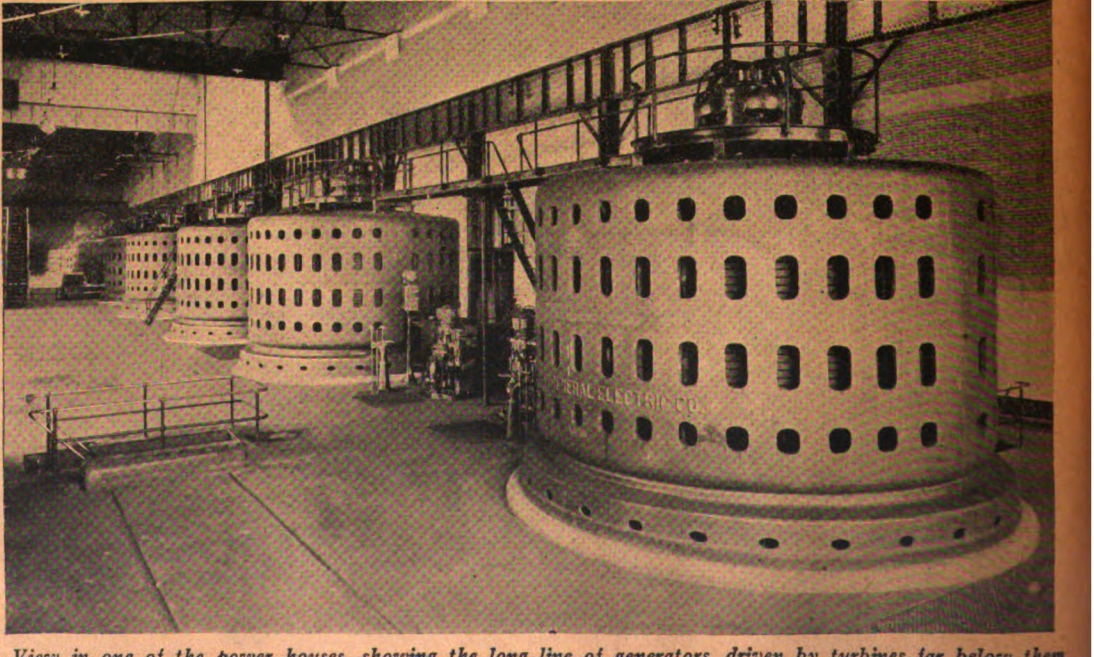
Niagara Falls, one of Nature's marvels, is being harnessed by man and some of its titanic power diverted to useful work

Back in the dim past, the illiterate red man gazed at this mighty waterfall. He thought not of its immeasurable power. He cared not for its grandeur, for in it he saw a spirit—he felt the "Spirit of Niagara." To satisfy his superstition the fairest maiden in the tribe, in a flower-bedecked canoe was willingly sacrificed to the "Great Spirit." The red man's wigwam has vanished. Vanished is the smoke from his campfire, for now, in ever-changing measures, the smoke of a hundred industries mingles with the mist of the mighty waterfall. Gone are the red man's pathways where now wind great highways of traffic. This mighty waterfall has run relentlessly for countless centuries. But when the white man came he invaded the realm of the "God of Waters" and wrested the secret from him; bade the waters to dash and roar to a purpose.

Birth of the Project

It was in the year 1852 that the first power project in Niagara Falls saw its birth in the starting of the Hydraulic Canal. The canal which now plays a very momentous part in the Niagara power development extends from the upper river to the banks of the lower river, which gives its water the same drop as the falls. With the digging of the canal the Niagara Falls Hydraulic Power Company was incorporated. At the outbreak of the Civil War, operations on the canal and power equipment were suspended, and for years the water gushed over the cliff unused. In 1877, new life was put into the movement and four years later the first electrical energy ever furnished by the waters of Niagara was generated. From that period the canal has been enlarged and deepened many times, for the men associated with the movement realized that the harnessing of Niagara was no longer a venture but a reality.

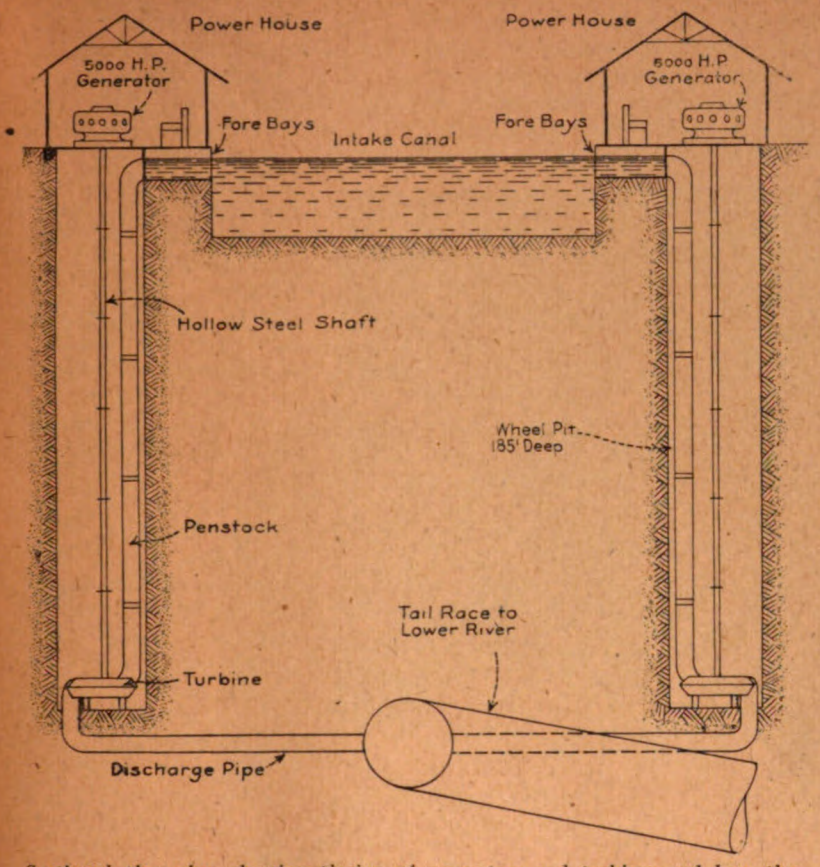
The two generating stations of the Hydraulic Power Company stand huddled in the shadow of the towering cliff within the roar of the mighty Niagara itself. It is from these two sturdy structures of stone and steel that nearly 200,000 electrical horsepower is launched, by a network of wires, to meet the needs of the many industries all of which contribute to make Niagara Falls a potent factor in the commercial world. Many patrons of the Hydraulic Power Company are situated on the bank directly above the generating stations, and, being so close, it is possible for the company to supply the different industries with power that is fitted to their needs without the use of an elaborate transmitting system.



View in one of the power houses, showing the long line of generators driven by turbines far below them

Digitized by Google

A few years ago the Hydraulic Power Company installed 13,000 H.P. units and it was then thought that this was the limit of engineering. In fact, it was at that time. The penstocks feeding turbines were but nine feet in diameter and a solid column of water this diameter was passing through the penstocks at a speed of three miles per minute.



Sectional plan view showing placing of generators and turbines and how the penstocks supply water from the intake canal to the water wheels below

The latest units to be installed by this company have a capacity of 37,500 H.P.; nearly three times as large as their forerunners. The penstocks feeding these gigantic turbines are fourteen feet in diameter.

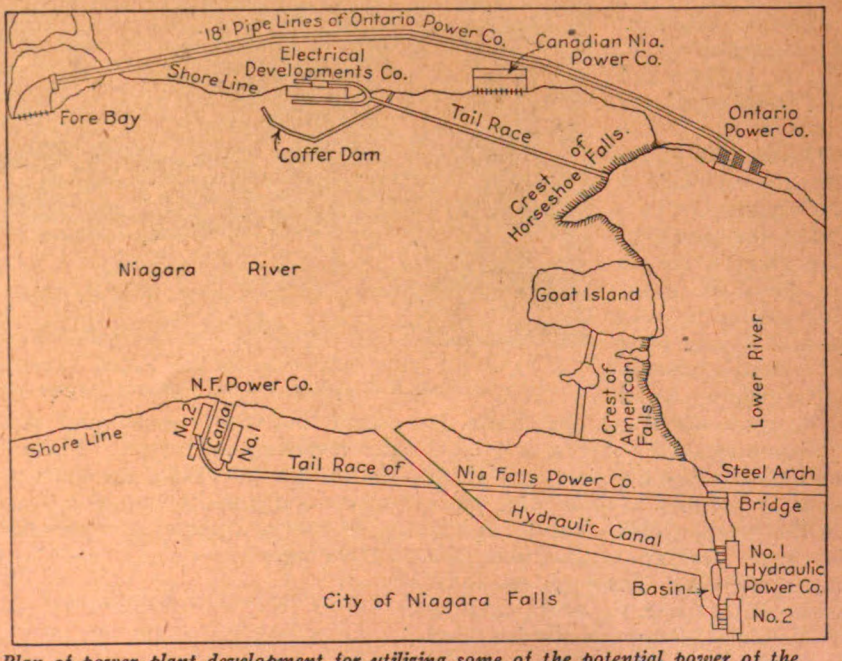
How Power is Utilized

Situated on the upper river about a mile above the falls are two power houses owned by the Niagara Falls Power Company, and which, if judged by the engineering problems that were met with in their construction, are two of the greatest man-made wonders of the age—veritable castles of volts and amperes. They stand out rather boldly with the slowly moving river in the background, and as the setting sun casts its rays on the crystal waters, our thoughts are for an instant returned to the humble red man—to think these modern creations of science stand on his very hunting grounds.

The water from which these stations operate is drawn from the river by a short intake canal. From the canal the water passes into the power houses located on each side of the canal and thence on to the penstocks. The penstocks, which are seven feet in diameter, extend vertically for 180 feet below the surface into a long, narrow pit over which the building stands. At the end of each penstock is adjusted a large turbine with a long, vertical, steel shaft which is connected to the generators in the station above. After the water has imparted its energy at a pressure of 55 pounds to the square inch to the turbine, it is discharged into a large tunnel which carries it off under the city of Niagara Falls for a distance of 7,000 feet, where it discharges into the lower river almost directly under the famous Steel Arch Bridge. This tunnel is 18 feet in diameter and the largest of its kind in the world.

In Power House No. 1 of the Niagara Falls Power Company, which was the first to be built, are ten generators of the revolving field type, each with its respective turbine and connecting shaft. These machines have a capacity of 5,000 horsepower each and generate alternating current of 2,200 volts, two-phase, twenty-five cycles running at 250 revolutions per minute. At the side of each generator is located a governor which automatically operates the large valves on the turbines below and thereby controlls the amount of water flowing through the turbines. This keeps the generators running at a very uniform speed, which is imperative. The total weight of the revolving parts of each machine is about 240,000 pounds.

This would naturally make the problem of lubrication a difficult one. It is accomplished in a very unique manner. At the extreme end of each shaft is fastened a large metal disc which is enclosed in a compartment of the turbine wheel case. Into this compartment water is forced at a great pressure upward against the disc. This method avoids hot bearings and reduces friction to a minimum. A few feet beneath the generators is placed another large bearing. This is a thrust bearing and consists mainly of two discs, one stationary and the other connected to the shaft. Between these two discs oil is forced



Plan of power plant development for utilizing some of the potential power of the Niagara River on both American and Canadian sides of the falls

Digitized by Google

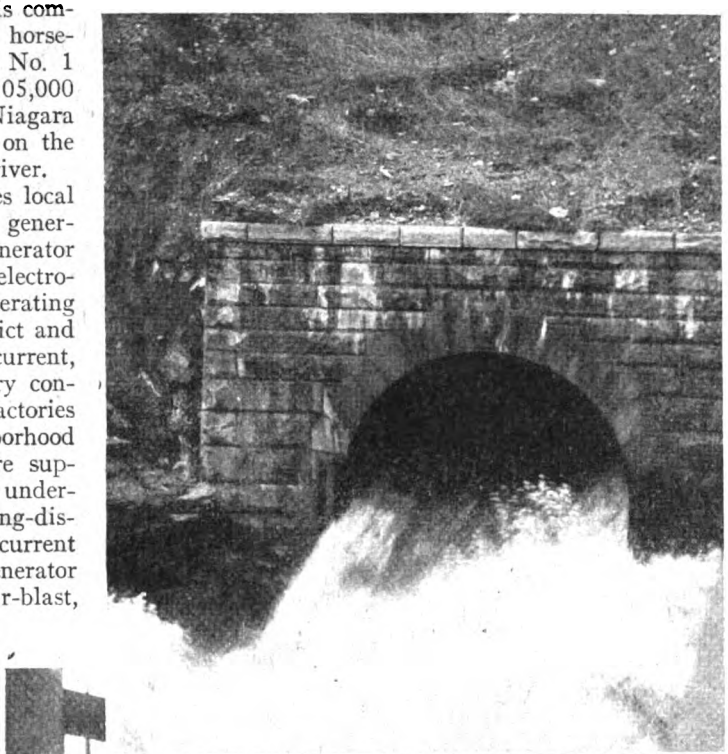
under a very heavy pressure.

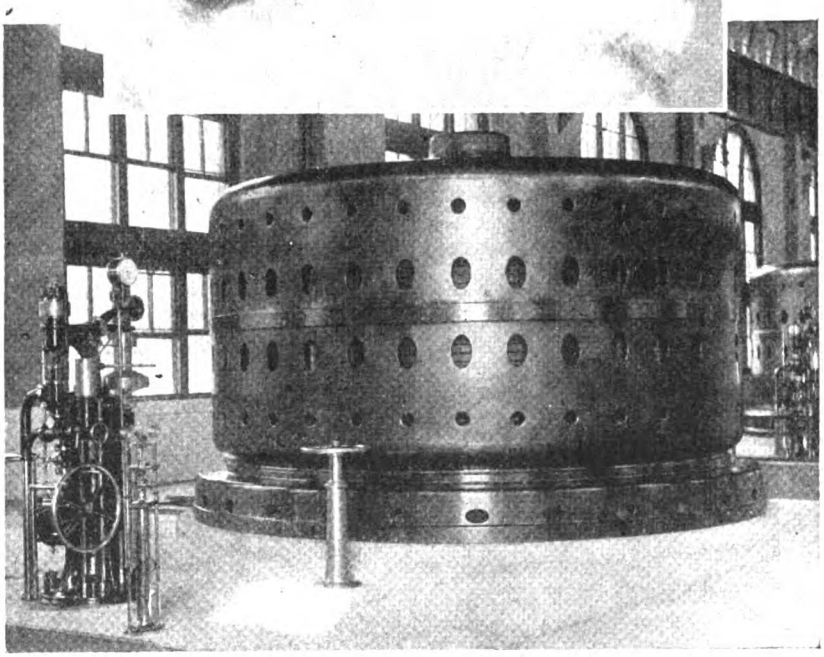
Power House No. 2 of the Niagara Falls Power Company, which was completed in 1904, is very similar to Power House No. 1. The main difference is in the last five machines which are of the internal field construction. The capacities of these machines are the same as those of the revolving field type. There are eleven generators in this plant which makes the total output 55,000 horsepower. This combined with the 50,000 horsepower of Power House No. 1 makes an output of 105,000 horsepower for the Niagara Falls Power Company on the American side of the river.

The company supplies local service directly from the generator bus-bars at generator cycle and voltage. The electro-chemical processes operating in the upper river district and calling for direct current, operate their own rotary converter stations. The factories in the immediate neighborhood of the power house are supplied by a system of underground cables. For long-distance transmission the current is taken from the generator bus-bars and fed to air-blast, step-up transformers. It leaves the transformers at 22,000 volts and is distributed by a three-phase system overhead to Buffalo, Tonawanda and Lockport.

Companies generating power on the Canadian side of the river are: Canadian Niagara Power Company, the Electrical Development Company of Ontario and the Ontario Power Company.

The Ontario Power Company employs a novel system for converting the power of Niagara. This is probably one of the most interesting and carefully planned hydro-electric systems in use today. About a mile above the Horse Shoe Falls, at the beginning of the rapids, is a large forebay and screen house through which the water passes into three large pipes that lead to the power house located in the gorge directly across from the American Falls. These pipes, which measure 6,200 feet in length and 18 feet in diameter, are the largest used for hydro-electric purposes in the world. At the top of the cliff, directly above the generating station, the pipes are each divided into eight smaller penstocks. Six of these are 9 feet in diameter and two are 30 inches in diameter. Just before the larger penstocks enter the twin wheel turbines which they drive, they are divided into two separate branches, one for each wheel of the turbine. The wheels of the turbine revolve on a horizontal shaft which is directly connected to a 10,000 horsepower generating unit of the revolving field type. These machines run at 187½ revolutions per minute and produce alternating current of 25 cycles, 3-phase, at a potential of 12,000 volts.





The upper view shows one of the tail race outlets. The lower illustration is that of a 5,000 H.P. generator and its driving turbine control apparatus

Power Obtained Limited

As a result of the International treaty, the Burton Act, between the United States and Great Britain not more than 350,000 horsepower can be generated on the American side of the river. In other words, not more than 20,000 cubic feet of water can be used per second. At the present time only 15,600 cubic feet is being used. The companies on the Canadian side are, however, granted 36,000 feet per second. Of the power generated from this, 160,000 horsepower may be brought into the United States.

The above is only a puny fraction of the amount of power it would be possible to produce from the waters of Niagara. The flow in the river is approximately 222,000 cubic feet per second. This great amount of water falling 300 feet in five miles, as it does, would theoretically be equivalent to 7,500,000 horsepower!

Niagara was America's greatest industrial ally in the world war. It was an absolute necessity to the development and maintenance of our war machine. It was responsible for the whirr of a myriad of wheels and nearly every industrial establishment in the country was dependent upon it to a greater or less extent. Every great battleship in our navy that cut its way through the blue waters of the sea, every shell that whistled through the air from her guns, every torpedo that rushed to its mark, every submarine that glided unseen beneath the surface, and every airplane that soared aloft carried with it one or more products made possible by Niagara.

Niagara as One of the Allies

Without steel, modern warfare as we understand it, would be impossible, as we could have no battleships, artillery, shells, submarines, railroads, automobiles or warplanes. Steel is no longer a simple mixture of iron and carbon. The great armor-piercing shells of today would pass through such steel with ease. Modern steel is extremely hard, resistant and tough. This is made possible by the addition of certain alloys that alter the physical properties of steel, making it more tenacious. Niagara and its abundant hydro-electric power, through the medium of the wonderful

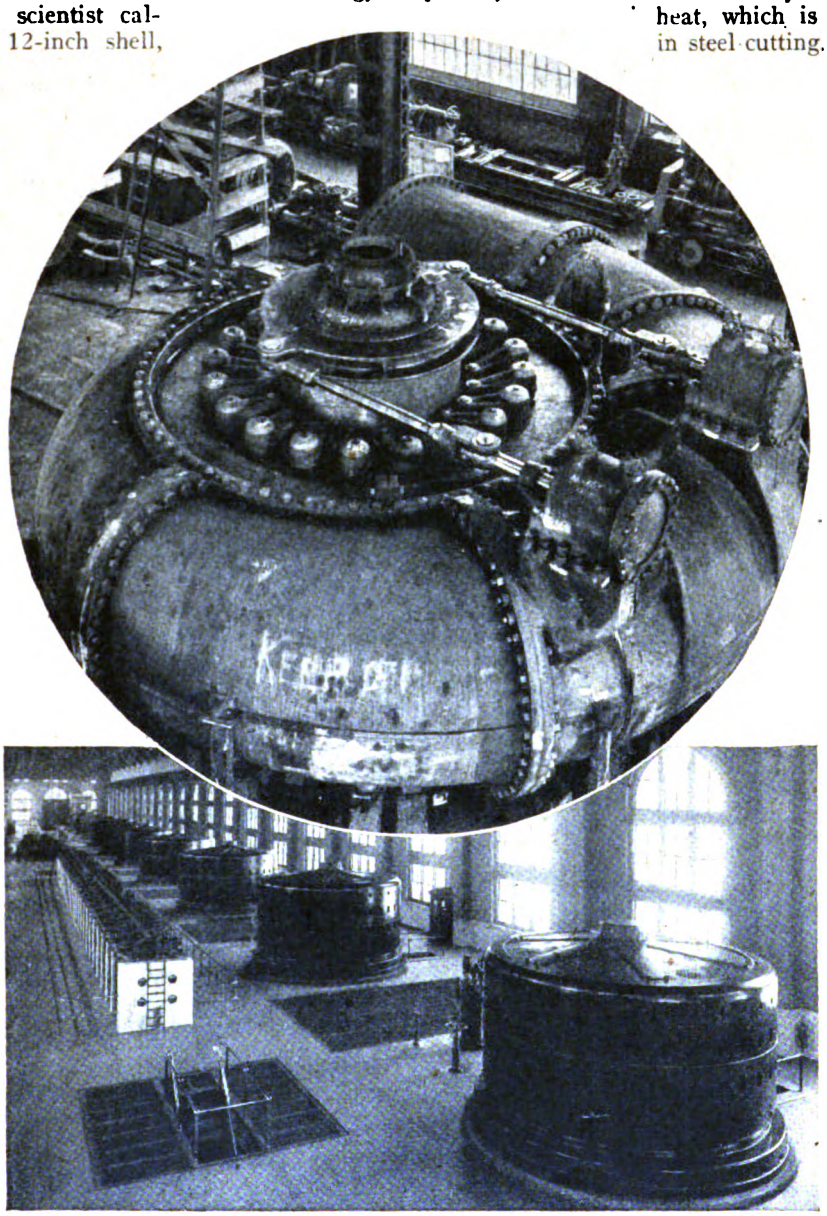
Digitized by Google

electric furnace, is providing ferro-alloys for 85 percent of the 28,000,000 tons of basic open-hearth steel produced annually in the United States. Ferro-silicon is very necessary in the production of certain grades of steel and Niagara at present supplies the entire demand of America. Every battleship in our navy has many tons of ferro-chromium in its armor, as this is the essential hardening element in the manufacture of armor-plate as well as armor-piercing projectiles.

A prominent English scientist calculated that a modern 12-inch shell, with a velocity of 1,700 feet per second, has twice the striking force of an express train traveling 45 miles per hour, yet the shell has but 1/8000 the bulk of the train. Such shells pass through the 12-inch armor-plate of a battleship with ease. This is made possible by the extreme hardness of the steel in the nose of the shell. When the metallurgist was called upon to produce steel with such wonderful hardness, he accomplished it only by the use of ferro-chromium. America's entire supply of this invaluable product is produced within the fiery radiance of Niagara's electric furnaces.

Production of Ferro-Silicon

A few years ago, metallic silicon was a rare element. Today it is a common commercial article of inestimable value to the steel industry. Tons and tons of this material are produced annually in the furnaces at Niagara. Ferro-silicon, which is produced by the chemical union of iron and silicon within the high heat of the electric furnace, is practically indispensable in the production of high-grade castings by eliminating blow holes. It is said that the greatly increased use of steel as building material during the past twenty years is chiefly due to ferro-silicon, which insures complete deoxidation of the steel. This important alloy also enters into the production of sound iron castings. Silicon is also used in the manufacture of a special steel known as silicon-steel, and this product is invaluable to the electrical industry. Silicon-steel is used in all alternating-current apparatus and it has figured greatly in the development and perfection of such apparatus during the past fifteen years. It has entirely replaced transformer iron in the manufacture of electrical transformers. Silicon-steel saves many millions of dollars annually in the United States through the conservation of our electrical energy, especially in alternating current transformer stations.



One of the gigantic turbines that is placed down in the wheel pits is shown above the row of generators that are driven by duplicates of this power producing unit

It can be said with absolute confidence that Niagara is the backbone of the steel industry of the United States. A cessation of the production of ferro-silicon alone would result in nothing less than a calamity to the steel industry of America. The War Department's specifications for shell steel in munition contracts called for 0.20 to 0.30 percent silicon, with a corresponding percentage of ferro-chromium. If Niagara could not supply these vital products, we would be at the mercy of the world, for without them we would have no hard steel, and without hard steel we would have no navy or coast defense. Carbon steel is no longer used in metal cutting, as it is not hard enough and cannot cut if it becomes heated. The ferro-alloy steels have entirely replaced carbon-steel cutting tools, not only because of their superior hardness and cutting power, but because they can stand up under red heat, which is essential for fast work in steel cutting.

In passing through the large Government munition plants we can see 16-inch guns being turned to diameter in the great lathes while the ferro-alloy cutting tool is peeling off curls of steel that are red hot as they fall. In fact, the point of the tool itself is at red heat, but it continues to cut just as efficiently as if it were cool. Ferro-alloy cutting tools have tripled the output of every machine shop in the country!

Abrasives an Important Product

Of all the valuable products of Niagara's electric frunaces, the artificial abrasives, aloxite, carborundum, alundum and crystallon probably enter into our daily life most intimately, as they form an indispensable part in every manufacturing establishment in the land—in the world in fact. These modern artificial abrasives, with their unprecedented hardness and wonderful cutting power, are largely responsible for the present-day automobile in its great perfection and moderate cost. Modern machines and instruments are intricate and delicate, and the lathe, with its steel cutting tool, can no longer be relied upon to work with sufficient accuracy. The grinding wheel has superseded the steel cutting tool and is capable of great accuracy—an accuracy figured in the five-thousandths of an inch. In the tannery we find it buffing leather; in the stone-working industry we find it

(*Continued on page* 470)

Digitized by Google

Spark Test For Steel

IT is rather difficult to determine the exact nature of a bar of steel unless microscopic or chemical tests are made to give some index to its chemical composition and the nature of the alloying elements used. John F. Keller, in a paper read before the Indiana Section of the S. A. E., describes some interesting tests by which some approximation of the nature of the steel may be determined.

If a piece of steel is touched with some pressure to an emery wheel revolving at high speed it will throw off a great number of sparks, characteristic of the combustible elements in the metal. If we could distinguish the different sparks by their quantity or characteristics as caused by the different elements in the metal, we might be able to identify with a reasonable degree of accuracy iron or steel that throws a characteristic spark.

Much time and money has been spent in attempting to photograph the sparks from different metals, but we have been unable to get anything worth while; therefore, we have resorted to the pen (Figs. A to H, inclusive) in order to furnish an illustration of the sparks from different steels. While it is not absolutely correct, nevertheless, it will furnish some idea of what to look for.

In making spark tests the following conditions are essential: (1) Clean-cutting emery wheel running at a speed of about 7,000 feet per minute; (2) enough pressure on the wheel to throw a few sparks only.

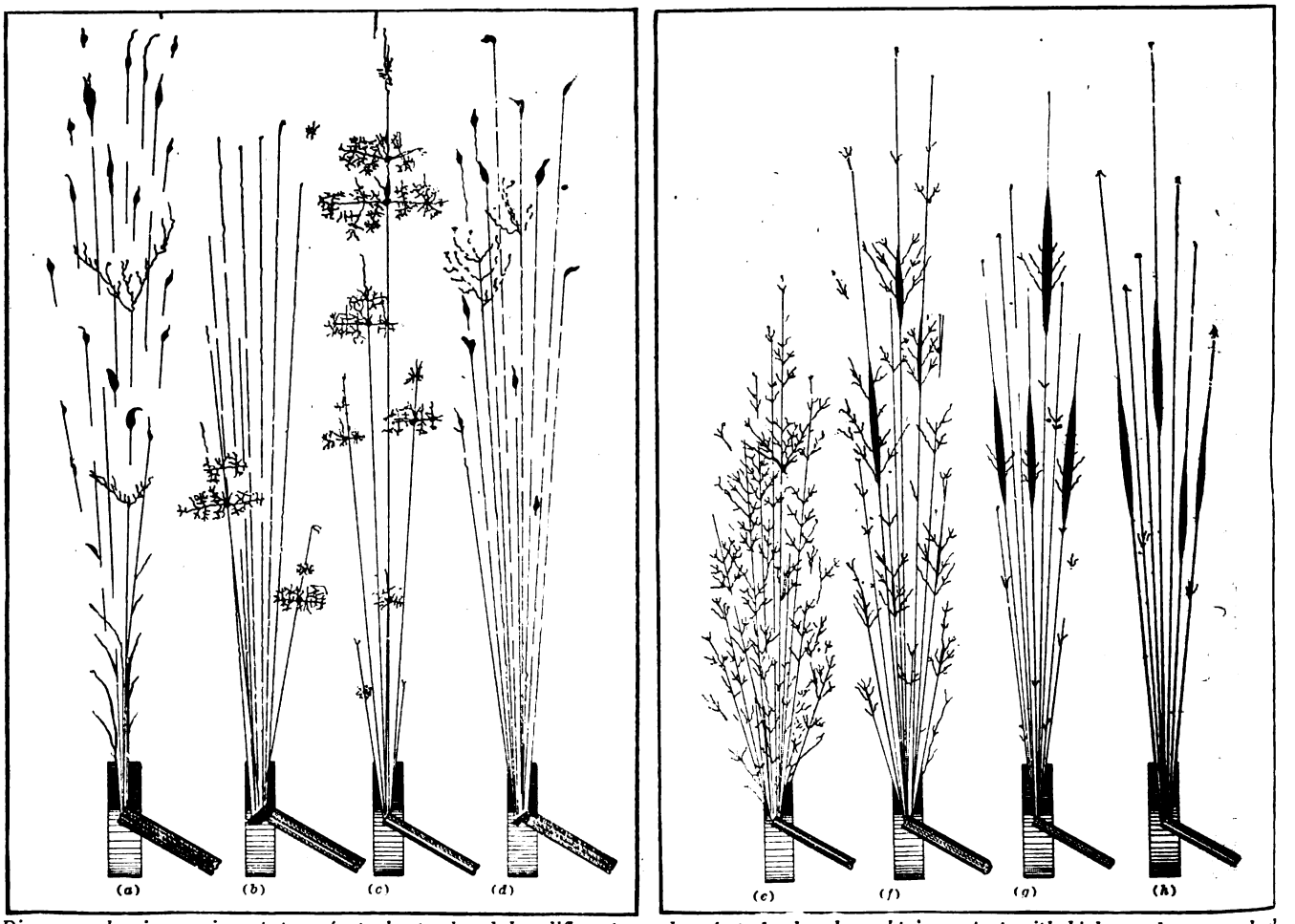
Suppose a piece of wrought iron (a) almost free from carbon is held against an emery wheel revolving at high speed; the small heated particles thrown from the wheel will follow a straight line, which becomes broader and more luminous some distance from its source of heat. If the particles are not all consumed, they fall to the floor, just as do those from the meteorite or shooting star. The broadening of the streak of light is probably due to the action of the oxygen of the air, requiring some time to act. All commercial iron contains a small percentage of carbon; this will be indicated by a branching or forking of the luminous streak.

In the manufacture of steel, carbon is added to iron; therefore, if we touch a piece of mild steel (b) that contains a small percentage of carbon, the effect is at once noted by a division or forking of the luminous streak. This is probably due to the presence of carbon, which is acted upon by the maximum heat of the iron spark; this burns explosively, causing several breaks in the original heavy line.

With increase of carbon from 0.50 to 0.85 per cent, the iron spark lines (c) diminish, becoming less conspicuous in proportion to the increase of carbon content; the forking of the luminous streak occurs much more frequently, being subdivided by re-explosions from the smaller particles. The lower the percentage of carbon, the less will be the forking of the heavy lines of light and the farther the sparks will be thrown from their source of heat.

In the higher grades of carbon tool steel (d) the iron lines are practically eliminated with increase of the explosions and subdivisions, causing a beautiful display of figures. This is probably due to the iron and carbon becoming united in such a manner that they are easily attacked by the oxygen of the air. Hence the danger of burning carbon tool steel on the emery wheel and in the fire. It would be well to state here that the higher the percentage of carbon, the more profuse are the explosions, and the shorter is the distance from the sparks to the source of heat.

The spark shown at (e) is thrown from high-speed steel. Practically all



Diagrams showing various types of sparks produced by different grades of steel when brought in contact with high speed emery wheel

Digitized by Google

high-speed steel contains, in addition to carbon, other alloying elements, chiefly tungsten and chromium. This steel contains about 65 per cent carbon, but the particles show no trace of a carbon spark whatever. It is probable that the alloying are so thoroughly combined with the carbon that they prevent its explosion or burning. The metal being much more refractive than carbon steel, will endure high temperature without scaling or burning, and the temper is not drawn so easily as in carbon steel. Considerable pressure on the emery wheel is required to ignite a spark. Its color is a dark yellow owing to the chromium and tungsten. The spark follows a straight line similar to iron, except that the broad streak of light is more abrupt, with an occasional branching spark that is probably due to manganese.

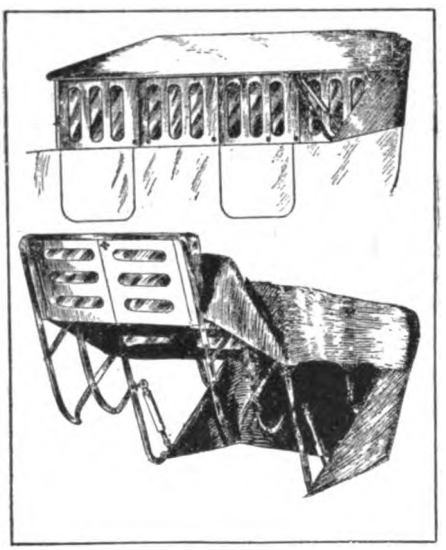
At (f) is represented a manganese spark. This differs widely from the carbon spark in that it seems to explode at right angles to the direction in which it is moving. Each spark is divided and sub-divided into a number of reexplosions which are very distinct. An illustration of this spark can be found in cast iron high in manganese; the spark from manganese steel is not so distinct, yet to the trained eye it is easily recognized by its branching appearance, as indicated at (e) and (h). This is probably due to the manganese and other elements becoming so united or combined as to prevent the free explosion of the manganese.

The spark thrown from the oil grade of "Mushett" steel (not the modern high speed) is shown at (g). This steel usually contains about 16 to 17 per cent tungsten, about 2 per cent carbon and 2 per cent manganese. A remarkable fact is that it shows no trace of a carbon spark and only an occasional manganese spark. This steel is easy to detect owing to the fact that it requires considerable pressure on the wheel. The particles follow a broken line, and the color is a very dark red with an occasional manganese spark. The old "Mushett" steel is not in general use since the introduction of the modern high-speed steels, but we found a great quantity of it among old tools not in service, especially in old-established factories. The steel companies are glad to have such material at this time, owing to its high percentage of tungsten.

At (h) is represented the spark thrown from a special steel manufactured especially for magnets and, therefore, known as magnet steel. This is similar to the spark from high-speed steel, except that it is of a lighter color with a more profuse quantity of abrupt luminous explosions and an occasional branching manganese spark. The explosions, however, occur at a shorter distance from the source of heat than do those of high-speed steel. We find by this test that many of the permanent magnets in service today are made from carbon steel rather than from the more expensive magnet stock.

NEW ENGLISH SIDE CURTAINS

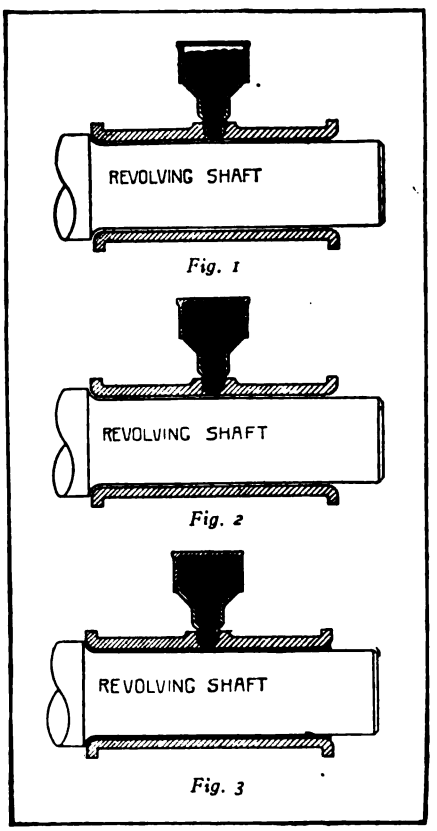
IN really bad weather, the ordinary Cape cart hood offers little protection unless side curtains are fitted. The usual drawbacks to side curtains are the difficulty of fitting them and the problem of storing them when not in use. To overcome these difficulties, Mr. F. H. Hall, of Claverdon, Warwick, England, has designed and patented side curtains which are permanently attached to the hood when not in use. The top edges of the curtains are preferably sewn to the sides of the hood, and the bottom edges fasten to the body in the ordinary way when the curtains are in use. When the side curtains are not required, the fasteners on the body are released and the curtains swung up to the roof of the hood and buttoned there. The curtains may be swung up on to the outside of the hood, but are preferably kept on the inside. When the hood is put down, the curtains fold up with the hood, and, being of thin material, do not make the hood bulky, the same hood envelope being employed. By splitting the curtain into four sections, a separate section is left over each door, and thus does not interfere with the ease of exit or entrance. In this country, curtains that are part of the top are common, these sliding along wires strung from one top bow to the other and are carried at the back of the top in special pockets when not in use. The English idea is not as sightly because the curtains are visible in the top when not in use but it has the advantage of permitting almost instant use of the curtains in case a sudden shower comes up.



New English side curtains

SCREWING DOWN GREASE CUPS

THERE is a right and wrong way of doing even such a simple thing as screwing down a grease cup. A very common mistake is made in filling grease cups by not squeezing the grease down in the top of the cup. When the cup is not properly filled, the first few turns do not force the grease into the bearings but simply compress it in the grease cup. Figure 1 shows grease cup not properly filled. The first few turns will not send the grease into the bearing—but will compress it into the cup. No part of the bearing is lubricated. Because of this fact the man may think he has done his part and greased the bearings when in reality he has not. Figure 2 shows another thing that happens when the grease cup is carelessly used. The bearing is only partially supplied with grease. The illustration at Figure 3 shows the right way to handle the grease cup. Screw the top down until the bearing is well filled or until it can be plainly seen that the grease has reached both ends of the bearing.



Screwing down grease cups.

The United States Bureau of Standards has been investigating the mixing of concrete. Cement and water were mixed for a long period, 15 to 30 minutes, and to this mixture were added the sand and stone constituents of the concrete. The usual way is to mix all the constituents together for a few minutes and then to put the mixture in place. It was found that there was no advantage by this preliminary mixing of cement and water.

Digitized by Google

Common Causes of Automobile Noises

A Simplified Exposition for the Man Who Runs His Own Car Describing What Various Noises in an Automobile Are Due To and How To Eliminate Them

By Victor W. Pagé, M. S. A. E.

PART 2

Wear in Front Axle Parts

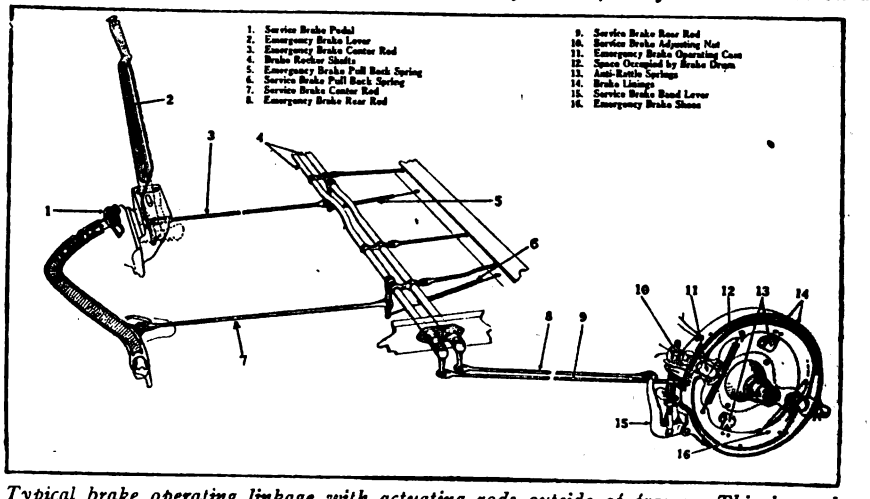
The points to inspect in the front axle after that member has been jacked up so that the weight of the car is off of the wheels, are: first, make sure that the wheels are properly adjusted. If the front wheel bearings are insufficiently tight, the wheel will move back and forth on the steering spindle and this will not only cause noise because of loose bearings, but will also result in the entire front end of the car vibrating and any looseness in various link joints will result in rattling. The amount of play between the steering knuckle and the steering knuckle bolt should also be noted and if this is more than a few thousandths of an inch, the movement will produce rattling.

There are a number of joints in the tie-rod and drag link that will cause rattling as soon as they are worn. The tie-rod, which is the member that is parallel with the front axle and that joins the steering arms of the steering knuckles together, has two joints, one on each steering arm. The drag link, which is the part that usually runs parallel with the frame member and which joins the steering arm at the lower end of the steering gear with the arm on the steering knuckle, also has two joints, and as these four joints are exposed to dirt and dust in most cars, as well as being subjected to considerable strain, it is not unusual to find that most of the rattling at the front end is due to wear on these points. On most cars the drag link members have ball ends so that a certain amount of take-up is possible for wear. This is not true of the tie-rods of most cars, which have points somewhat limited in bearing surface and which can only be adjusted by the substitution of new bushings and new bolts.

One of the most prolific sources of noise is a dry spring. The leaves of which these are composed should move relative to one another all the time that the car is in use, so that if there is considerable rust or lack of oil between the springs, noise due to the rubbing of dry metals will be evidenced. Properly lubricated springs not only make for noiseless operation, but also contribute materially to the easy riding qualities of a car.

How to Lubricate Springs

The best method of lubricating a spring is to remove it from the car and to take it apart. This enables one to clean off the rust deposits with emery cloth or sandpaper and also makes it possible to insure that grease can be put on the working surfaces of the leaves before they are reassembled. There is a trick in connection with taking a spring apart that the average car owner might not know. This is to hold the spring parts together with a heavy C clamp while the bolt or rivet that passes through all of the leaves to hold them together is removed.



Typical brake operating linkage with actuating rods outside of frame. This is used on some Overland models

This C clamp is also used on reassembling to bring all parts of the spring back together before the bolt or rivet is reinserted. A graphite grease is much better than oil for use between spring leaves as it will fill minute spaces in the surface of the metal. Even if the oil finally works out, the graphite remaining between the leaves is an excellent lubricator.

A quick method of lubricating springs is to pry the leaves apart with a screw driver or a special tool made for that purpose and insert oil or graphite in the space provided in this way. This does not insure as thorough distribution of lubrication as the method previously described and does not remove the rust. It is sometimes possible to clean out the space between the spring leaves by spreading the leaves apart and allowing kerosene to penetrate the space. This kerosene can be applied with a squirt gun or a hand oil can. Some repair men use a mixture of paraffine wax and graphite for spring lubrication but this can only be applied properly when the springs are taken apart and the leaf surfaces well cleaned of all rust.

Spring Shackles and Bolts

The spring shackles and spring shackle bolts are also common offenders against quiet operation. Any lost motion in the spring shackle will result in rattling. The lubrication of these shackle bolts and spring eyes is apt to be neglected because of the inaccessible position of the grease cups. In any event, they are not screwed down with the regularity that is required to prevent abnormal depreciation.

The majority of car owners do not take the trouble to lubricate the car properly until it begins to be noisy, at which time it is really too late as the damage has been done. The only remedy for worn spring shackles and shackle bolts is replacement with new ones. Whenever depreciation in the front or rear axle is found, the point should be made clear that looseness will not develop unless the various parts are relieved of their share of the car weight. If this is done, parts that appear to be tight when examined with the weight of the car holding them together will be found to be quite loose as soon as the car weight is lifted off. It is only when operating on smooth roads that these parts are uniformly loaded as when running on rough roads, the car frame and load is con-

Digitized by Google

stantly shifted by being thrown upward every time the wheels pass over an obstruction or go down into a hole and it is under these conditions that the noise is more apparent.

Brake Linkage

The linkage and rod connections operating the brakes have a multitude of minor joints that must receive oil regularly and as these are under the body for the most part, in the majority of cases they receive no oil. This condition has been met by designers of up-to-date cars by using oilless bushings at each rod end. Where ordinary bearings are used, neglect of all these bearing points will result in lost motion. All the while that the car is in operation, these rods rattle up and down and while each one may only make a little noise, they contribute to a considerable rattle in the aggregate. This lost motion may be minimized by using coil or scissors springs to keep the rod end parts together.

Another point about the car that is seldom suspected when tracing noise is the muffler. This should not only be tight at the brackets which hold it to the car frame but it should be removed and cleaned out occasionally as well as tested to make sure that none of the partitions or baffle plates in the interior have been loosened or detached from the muffler shell by a back fire or charge exploding in the interior. The exhaust connections at both the muffler end and at the end of the exhaust manifold of the engine should be looked after, as a broken gasket or packing at either of these points will cause the exhaust gas to escape and as it is under considerable pressure it will cause a sharp, hissing noise.

Cars that are provided with radius rods are apt to be noisy because these rods are lubricated at the points where they are attached to the frame and axle and these bearings, being difficult to reach, are apt to be neglected. If the car is a Hotchkiss drive form, which is the name given to that transmission system where radius rods are eliminated and where all braking and driving stresses are taken through the rear springs, it would be found that the bolts and shackles of the spring members will wear out much quicker than in those types of cars where no torque or radius rods are used to take some of the stresses.

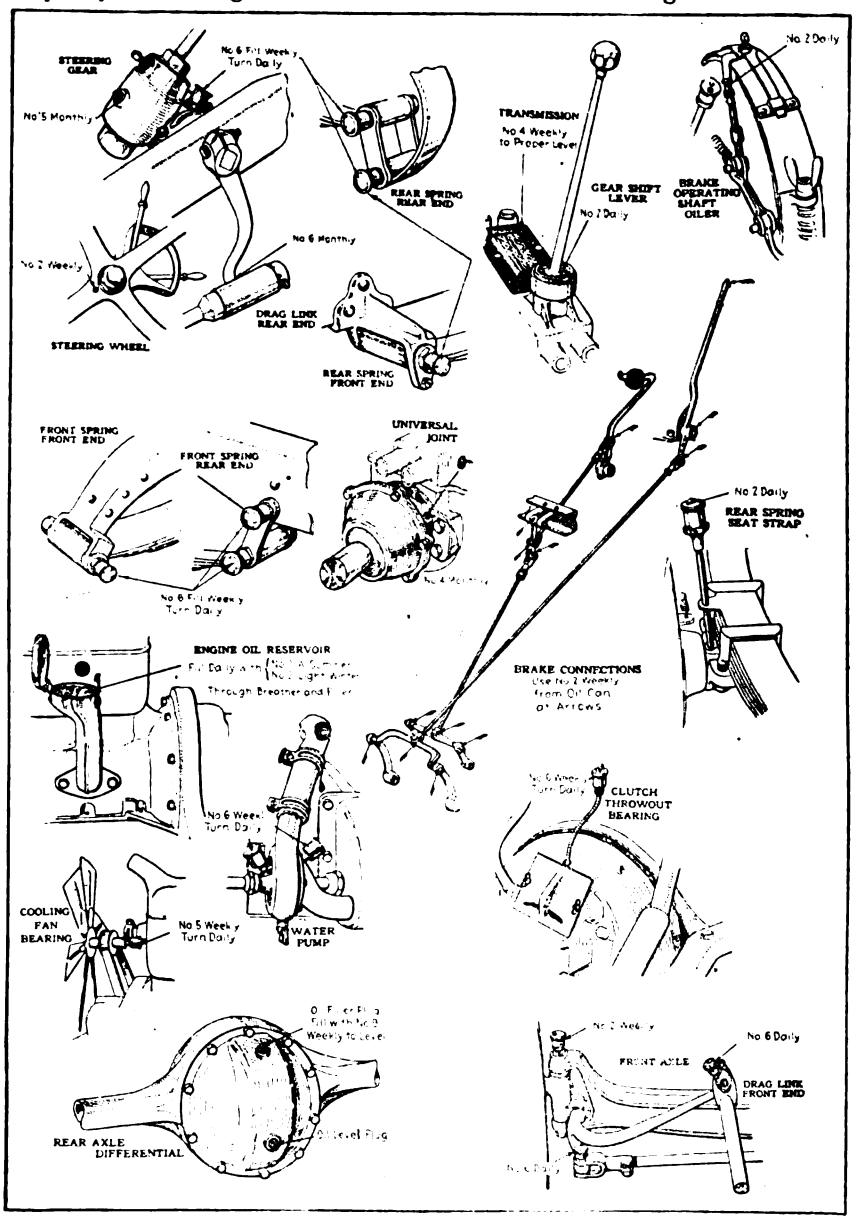
Control System Parts

There are various points in the control system that may cause noisy operation. A steering column sometimes becomes loose in the bracket by which it is guided at the cowl or dash-board and will cause a rattling noise. If the steering post interior is not oiled regularly, there will be a squeaking noise every time the wheel is turned. The clutch and brake pedals may be so loose on their bearings that they will rattle and may also be loose enough so that they even hit the floor boards at the lower end of the slot in which they are operated when they are not in use, thus causing considerable rattling noise. The emergency brake lever and gear shift lever sometimes are loose enough so that they hit against the floor boards and it is not unusual to find an emergency brake handle latch rod loose enough so that it makes an annoying little rattle.

Auxiliary Body Parts

A poorly fitted engine bonnet or hood will cause both a squeaking and rattling noise, if the hood side retention clamps do not hold the hood firmly in place, which sometimes happens when the small springs lose their tension or break. Even when the clamps are in place, a certain degree of motion is possible for the hood sides. If the hood rubs on either the radiator or cowl of the body, a squeak will result, whereas, if the hood can move up and down, a rattling noise will be the result. The squeaks due to this cause may be prevented by putting rubbing strips of raw hide or webbing on the lower ledges of both radiator and cowl. Most cars are provided with material of this nature which is in the form of a lacing which is threaded back and forth through holes punched in the hood supporting ledges. If for any reason, this lacing should break, it is a simple matter to insert a new piece.

The windshield glass is sometimes loose enough in its frame so that it will move constantly, though very slightly, all the time that the car is in motion. If the movement is slight, a squeak results, whereas, if more movement takes place, the glass hitting the metal sides will cause a high-pitched rattle. This can be prevented by re-packing the

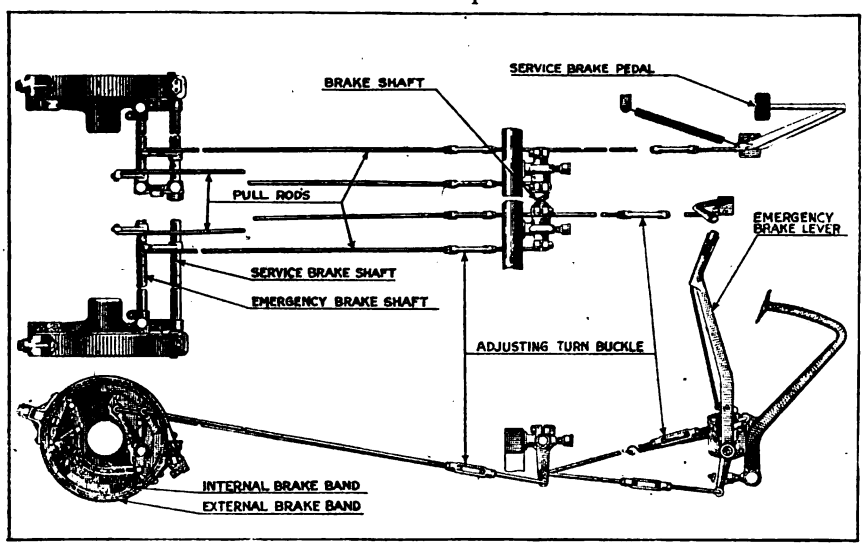


Oil is one of the best preventatives of noise. The illustrations above depict the points needing lubrication on the Dodge Bros. car. No. 2 is cylinder oil. No. 4—Transmission compound. No. 5—Light cup grease. No. 6—Heavy cup grease. No. 9—Differential or gearcase compound

Digitized by Google

windshield frame so that the glass will be a tight fit therein.

Loose registration number plates are also a common cause of trouble. In many cars, the plates are fitted directly to the carrying brackets and as they are of thin metal, and are usually supported only at one end or the top, it will be apparent that considerable noise will be caused by the other end striking the metal parts attached to them. A simple way to prevent this trouble is to make sure that the plate is held between leather or rubber washers and to pack the metal part of the supporting bracket where the plate hits with ordinary friction tape, using enough to make sure that the noise will be deadened. If the car is provided with shock absorbers, it is well to note that any loosening in the parts themselves or in the brackets by which these are attached to the frame, will be instantly audible.



Buick brake operating linkage using turnbuckle adjustment and brake rods inside of the frame

Wheels and Wheel Lugs

One of the most annoying squeaks and one that is the hardest to locate by the motorist is due to poorly-fitting, rim retention lugs. There are twenty-four of these on the average automobile, six being used on each wheel and looseness of any one will cause a constantly, re-occurring squeaking noise every time the wheel turns. It is sometimes impossible to prevent this squeaking even if the lugs are screwed in as tightly as possible. This is because the wedge portion of the lugs has worn and the only remedy is to use new lugs that will have wedges of the proper size to take up the space between the rim carrying the tire and that of the felloe of the wheel.

Wood wheels sometimes squeak if the spokes become small and are not a good fit between the hub flanges. This is a rare case and is produced by the wood drying out or the flanges bedding into the spoke butts. It can sometimes be cured by soaking the wheel with water so as to swell the wood and then tightening the nuts that hold the flanges together. Poorly adjusted and worn brake bands, especially those used on external brakes cannot fail to produce a rattling noise by striking the brake drums and care should be taken that the brakes are always properly adjusted.

If the brakes squeak when applied, it is because the brake lining has become impregnated with particles of sand and grit and these get into the brake lining and of course cause a loud squeak as they bear on the metal drum. The only real remedy is to remove the brake bands and clean off the lining so that all of this noise making material will be removed. A temporary expedient is to put a few drops of oil on the brake drum, but this should not be done carelessly because if too much oil is applied the brakes will slip.

In conclusion, it may be stated that knocking and rattling noises are usually caused by considerable lost motion between two parts which should be firmly held together. Squeaking sounds are generally produced by limited movement of dry parts against each other. In most cases a knocking or rattling may be taken care of by tightening the retention means, while squeaks may be eliminated by the liberal use of properly applied lubricants or by various rubbing strips and packings of soundproof material, such as wood, leather or rubber.

Zinc, it is found, can be reduced from its oxide by carbon in an atmosphere of nitrogen. A temperature from 762° to 1100° C. is required. The easier and more general reduction by carbon monoxide requires only 350° C. and the production of the carbon monoxide from carbon and dioxide requires a temperature of 450° C.

PRODUCER GAS FOR VEHICLES

SOLID fuels offer the only method whereby the high price of liquid fuels can be countered. An English engineer gives the distillation of coal in the process of making coal gas as an example and goes on to say that 1 ton of coal would propel a 5-ton steam wagon about 160 miles, the fuel then being completely destroyed. If subjected to distillation the 1 ton of coal would give 13,000 cubic feet of coal gas, and taking 250 cubic feet of this gas as equal to 1 gallon of gasoline, this would propel a 5-ton internal-combustion-engined vehicle 312 miles. But after allowing for the fuel use for the retort about 10 hundreweight of coke would still remain, and at 3 pounds of coke per mile, a 5-ton producer gas vehicle would run a further 373 miles on this, or a total of 685 road miles, as against 160 miles on 1 ton of coal burned directly.

A SIMPLE HORSE POWER FORMULA

ONE of the automotive publications describes simple horse power formulas that are remarkably simple and that are claimed to have a low limit of error. In fact, they are sufficiently accurate for making approximate calculations when comparing one engine to another quickly. The formulas are:

$$\frac{H.P. = B^2 S}{3} = \text{for four cylinders.}$$

$$\frac{H.P. = B^2 S}{2} = \text{for six cylinders.}$$

$$\frac{H.P. = B^2 S}{1.5} = \text{for eight cylinders.}$$

$$H.P. = B^2 S = \text{for twelve cylinders.}$$

The formula is not intended to be used for extremely high speed engines or for engines having special power producing elements such as multiple valves, special timing and refinements of that nature. In the above formulas, initial B is the bore of the cylinder in inches and S the stroke of the piston in inches. Care should be taken in each case to use the proper divisor, depending upon the number of cylinders.

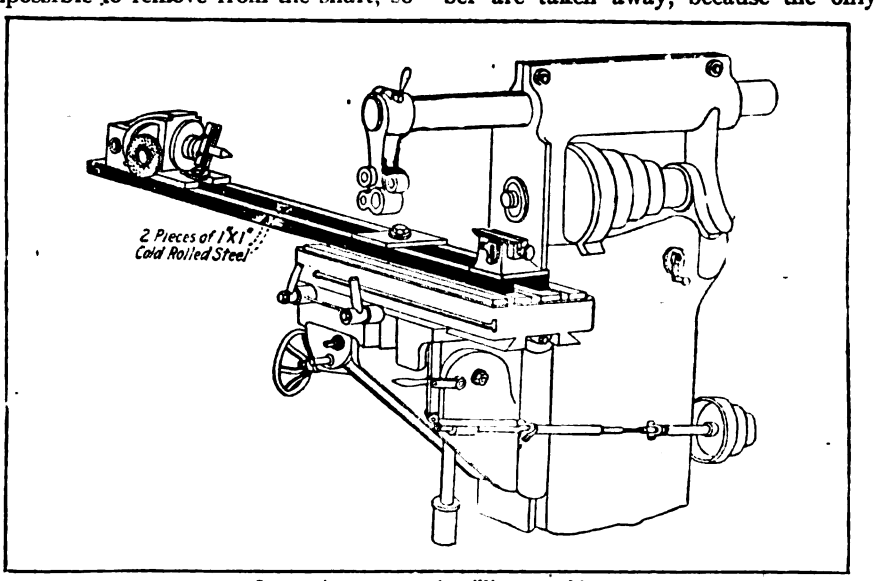
"Keep the motor cool" is not a good tractor maxim, if kerosene fuel is used. Both the motor and radiator water should be kept hot because the fuel, which is thicker than distillate, needs much heat for good combustion; needs also more needle valve opening, though too rich a mixture means carbon, as with lighter fuels. The trick is to start with gasoline and continue with it till the engine is thoroughly warmed for smooth, economical running with kerosene or distillate.

Digitized by Google

SHOP PRACTICE

INCREASING RANGE OF MILLING MACHINE

A VERY useful kink for the machinist was described in a recent issue of the *American Machinist* by O. F. Kuhlman, and is illustrated herewith: Recently there came to his shop the job of repairing a shaft and pinion, the object being to use the same shaft but to make a new pinion smaller in diameter. The old pinion was next to impossible to remove from the shaft, so



Increasing range of milling machine

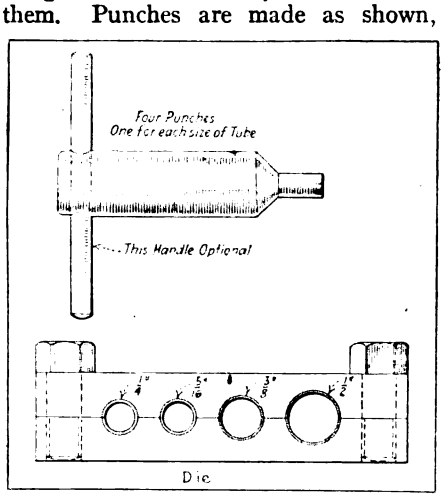
he decided to turn it down while in place, to the new blank diameter and cut the teeth without removing it. There was no milling machine available to handle a shaft 6 ft. long, so a Brown & Sharpe miller was rigged as shown in the sketch by putting long steel parallels on the platen, and attaching the index centers to them. Two blocks are set into the T-slot to keep the parallels in line.

FLANGING COPPER TUBES

IN automobile practice and in motor boats, the fuel supply and oil lines are usually made of copper tubing and the joints where the tubing is attached to the fittings are generally of the simple tapering flange form. In this construction the flat end of the tube fits against a suitable tapered piece which is the male member while the female member or nut, screws against the flange and keeps it steady.

It is not difficult to make a simple fixture for flanging various sizes of tubing ordinarily used, if the suggestion given in the accompanying illustration is followed. Two flat pieces of steel or iron are clamped together with a strip of sheet steel or brass about 1/32nd inch thick between them. The four holes should be drilled and countersunk for the various sizes of tubing the fixture is intended to handle. In the most popular sizes the range of size is ¼ inch, 5/16 inch, ⅜ inch, and ½ inch. The two parts may be held together by suitable bolts.

After the holes are drilled, the small pieces that are left of the spacer member are taken away, because the only function of these is to insure enough clearance between the tube clamps while drilling so that the tubes to be flanged will be securely held between them. Punches are made as shown,



Simple device for flanging copper tubes

these having a pilot member which is the size of the inside diameter of the tube. The large portion of the punch has a 45 degree shoulder or bevel so that as the punch is driven into the tube after it is properly clamped between the jaw pieces, the tube will be flared out to correspond to the bevel on the shoulder of the punch. The rod inserted in the end of the punch is to facilitate its removal and to steady it while it is being driven into the tube. The smaller diameter or pilot member of the punch is to be a good fit in the inside of the tube so that the tube will not be closed in when the vise jaws are clamped around it. It is a very simple matter to make flanges on tubing with this device and this can be done in any ordinary form of vise.

The clamp bolts are loosened so that the tube can be inserted, allowing enough to project above the surface to insure that the flanged portion will be of sufficient length. After the clamp bolts are tightened and the tubes securely held between the vise jaws, the device is placed in a vise to hold the tube and the suitable sized punch is driven down the required distance to form the flange.

Hard brass tubing should be annealed before an attempt is made to form a flange on it as it is apt to give trouble by cracking at the ends unless this precaution is taken. Ordinary grades of copper tubes such as used on fuel and oil lines are soft enough so that flanges can be easily formed without annealing.

RESISTANCE OF STEEL TO CUTTING

AT a recent meeting of the Academy of Sciences in Paris, a memorandum was presented from M. Ch. Fremont giving some interesting explanations regarding the phenomena attendant upon the cutting of metals, as follows: For example, a steel having a tensile strength of 107,000 lbs. per sq. in., when calculated according to the conventional rule universally used, that is to say by dividing the maximum stress by the original section, will wear away and dull the cutting tool quite rapidly, when another steel having a tensile strength of 166,000 lbs. per sq. in. can be cut easily and will not wear the faces of the tool. The explanation of the paradoxical phenomenon is to be found by measuring the final resistance obtained in a tensile test of the two steels.

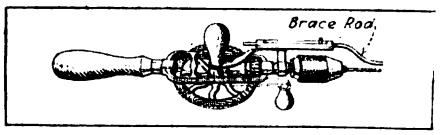
By "final resistance" is meant that which is obtained by dividing the resistance of the test piece at the moment of rupture by the actual section at the point of fracture, that is to say, the reduced section of the test piece. This

Digitized by Google

final resistance or stress is less than the maximum stress which just preceded it, but the final resistance per square inch, on the other hand, is higher than the resistance is ordinarily calculated, because the actual reduced section at the point of fracture is less than that of the original section.

DEVICE FOR SMALL DRILLS

WHEN using an ordinary hand or precision drill in connection with small drills, it is very difficult to drill a hole without breaking the drill several times unless great care is taken in the operation. The simple fitting shown in accompanying illustration may be made by any man handy with tools and is a tool that will make it possible to drill holes in hard material with small twist drills without breaking them from the pressure needed to insure penetration of the drill point. The device is a simple clamp which has a slot at its upper end in which the steadying handle of the drill press is inserted. At the lower end, a screw clamp fitting is mounted that just fits above the chuck. A rod that slides in a sleeve or bearing member is attached to the clamp, the movement of this rod being controlled by a stiff spring within the sleeve.



Steadying device for small drills

It will be evident that a tool of this nature will prevent the drill from breaking because it will be difficult to press too hard on the drill press and the vibration that is evident with a tool of this kind when using small drills is prevented and another cause of breakage is eliminated.

EXTEMPORIZED AIR COMPRESSOR

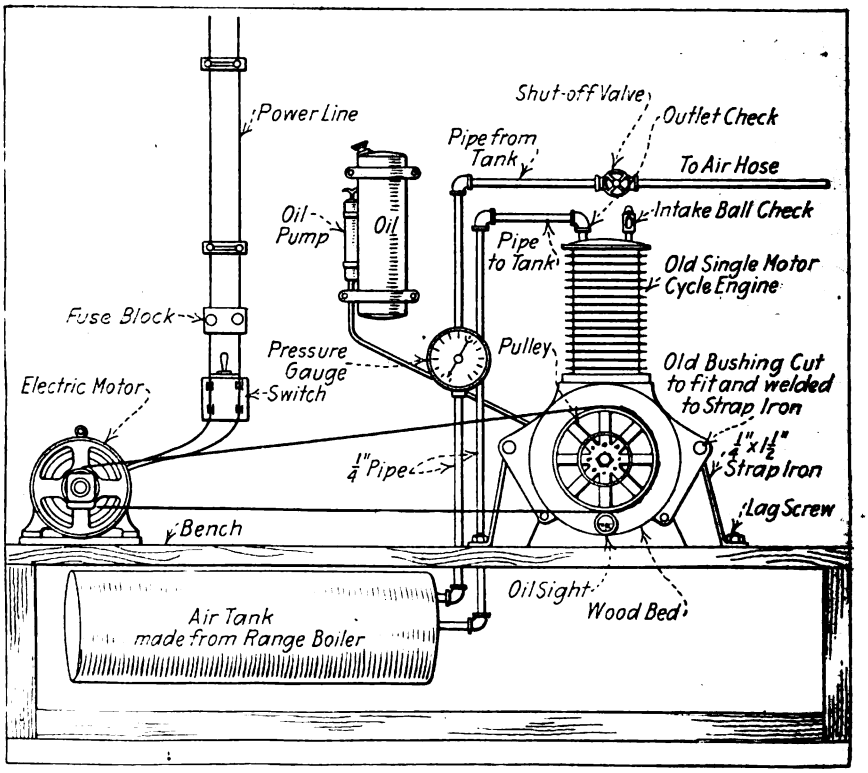
ONE of our readers, Mr. William B. Hunt of Montgomery, Alabama, sent in the accompanying sketch showing how he has extemporized a motorcycle engine that had outlived its usefulness for its legitimate purpose, as an air compressor. While all details are clearly shown in the drawing, a few words of description may be of value to those of our readers who would like to make up a similar outfit. The engine was a single cylinder type about two horsepower and formerly served as the propelling mechanism of an Indian motorcycle. It is attached to a wood bed, which is bolted to a work bench and braced by ¼ inch by 1 inch strap iron extending from the motor support plates to the bench. A new head was made from a piece of solid stock tapped with two holes, one of which receives the intake ball check fitting, the other the outlet ball check fitting from which the pipe extends to the air tank under the bench. The air in the tank was directed to the air hose by another length of pipe in which a gauge was placed to indicate the pressure in the tank. A shut-off valve was interposed between the gauge and the air hose coupling.

When it is necessary to blow up a tire, this shut-off valve is opened, allowing the air to flow through from the tank to the air hose. Even if an automatic coupling is fitted at the air hose, it is advisable to use the shut-off valve because this will prevent air leaking through at the joints in the air pipe or hose. The same oil pump and oil tank that served to lubricate the motor when it was installed in the cycle frame also serves to supply lubrication to the engine in its new role. This as attached to the wall in a convenient place. A few strokes of the pump will supply sufficient oil for a extended period of operation. The oil level is clearly shown in the oil sight glass on the bottom of the motor crank case. The pump is driven by any suitable means at a speed of about 300 r. p. m.

If an electric motor is used for power as indicated in the sketch, it should be provided with an automatic, or other adjustable belt tension device and should be fitted with a small enough pulley so it can be run up to speed without driving the air compressor too fast. It will be evident that the air compressor may be driven from a line shaft.

Mr. Hunt states that the [illegible] a new solid head reduced the compression space sufficiently so that an adequate working pressure is provided to blow up most sizes of automobile and motorcycle types. When air is pumped in this way, it is advisable that a filtering device to be interposed in the air line to remove any oil that may be present and that would tend to deteriorate the rubber of tire tubes. If the piston rings are carefully fitted to the cylinder, then very little oil will go by the piston and it may not be necessary to supply the filtering fitting.

The inclusion of such a filter is recommended by many manufacturers of commercial tire inflating outfits, so it would seem that it would be a valuable addition to the scheme suggested by our correspondent. The suggestion illustrated should be easily followed by any mechanical man and will supply quantities of air for experimental work or tire inflation purposes. A special fitting is necessary to carry the driving pulley on the engine crank shaft, this being turned from a piece of steel or brass and adapted to fit the end of the shaft instead of the driving sprocket or the clutch assembly ordinarily attached at that point.



Details of an extemporized air compressor outfit made from an old single cylinder motorcycle engine and a range boiler

Medallions, coins and the like can be cast from the following alloy which will reproduce all of the very finest details: Tin 3 parts, lead 13 parts and bismuth 6 parts. Another which is more suitable for certain work contains less lead but more bismuth, as follows: Tin 6 parts, lead 8 parts, bismuth 14 parts.

Digitized by Google

Simple Model Steam Engine and Boiler Construction

By Wm. A. Helms

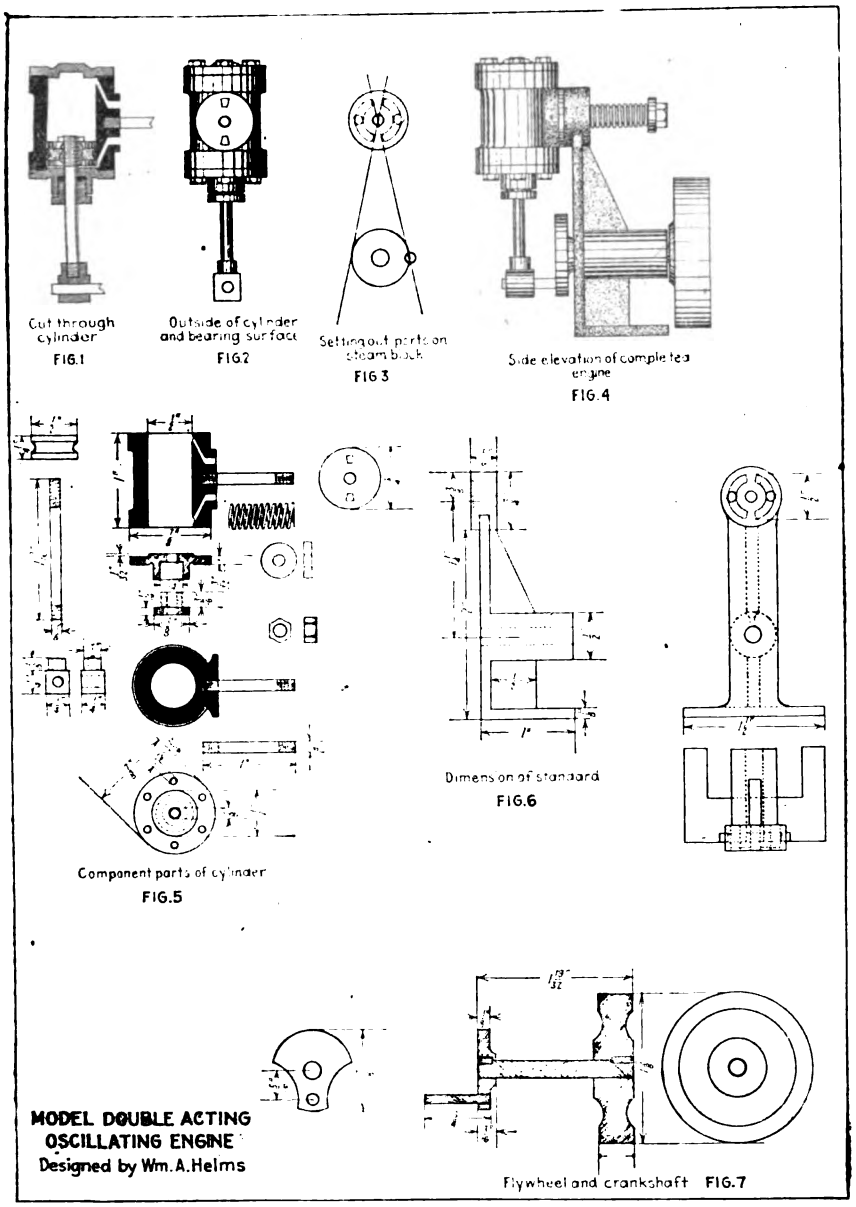
PART II

A DOUBLE-ACTING ENGINE

IN the first article I have described the single acting oscillating engine and have started the construction of a boiler suitable to run those engines. I conclude the latter in this article, as it is also employed to generate the steam for the double acting engine described in this instalment.

We come now to the double acting oscillating cylinder. It requires only a little more than half the momentum of the single acting, as the only dead points are those when the piston is at the extreme ends of the stroke. The double acting engines have therefore almost twice as much power for the same size of cylinder as the single acting ones and are less likely to stop at reduced speed. This type of engine economizes space and weight. They are especially adapted for propelling small power boats. The entire machine is built low which is an important factor in small boats. It is important to use a rather heavy flywheel, as experiments have shown that it is required on an engine which has the constant drag of a propeller to overcome.

The dimensions of the cylinder described here are 5/8 in. stroke by 1/2 in. bore (see Figs. 1 and 5). As is usual on engines of that kind it is made out of a brass casting. The length without covers is 1 in., allowing 1/4 in. for the thickness of piston, 1/32 in. for each of the spigots of the cover, and the same distance left vacant at each end. The diameter of the cylinder over the flanges is 7/8 in. One of the most difficult jobs to be accomplished by a model engineer is the boring and facing of the cylinder of a model engine, as accurate work is required to make a successful running model. This is especially the case with beginners. As there are several ways of doing it I will describe the method I believe to be the easiest. In describing this I presume the model engineer to be in possession of a lathe, and drilling machine. A shaper would also be very useful, but is not necessary as the surface work can be finished on a lathe.



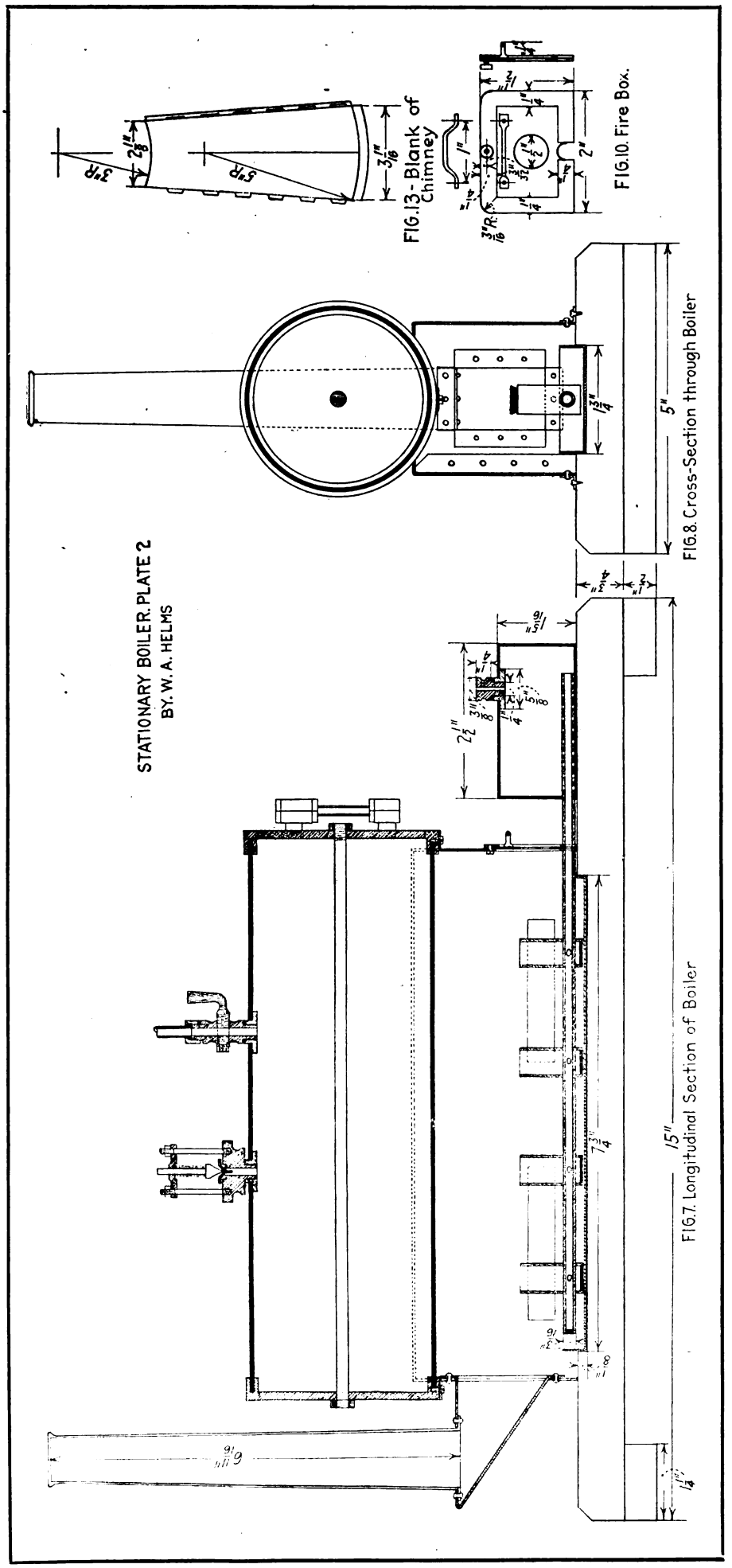
Machining Cylinder Casting

We take the casting and start with the bore. To do this, we clamp the casting on the saddle of the lathe and use a boring bar. The cylinder flanges being round are easily faced by using a chuck. The bearing surface on the cylinder is faced by using a small and accurate angle plate. It is fastened to the face plate and on this is placed the cylinder, which is securely held by a clamp. In order that the facing tool can finish the face level, it is necessary to first drill the hole for the cylinder-trunnion (see Figs. 4 and 6). The utmost care should be used in setting up the cylinder on the angle plate and I recommend using a piece of smooth and thin paper between the angle plate and cylinder and other touching parts, so as to keep the finished parts from being burred. Then drill the steam ports and drill and tap the flanges for the bolts which hold the cylinder covers. The latter are fastened to the cylinder by six hexagon headed bolts of 1/10 in. diameter. The cover on the bottom side of the cylinder is equipped with a stuffing box for the piston rod. The gland is screwed direct into the boss of the cylinder cover (see Figs. 1 and 5). The boss is filled with lamp cotton and compressed by the gland so as to make a steam tight fitting for the piston rod.

Piston and Piston Rod.

The piston rod is made out of a piece of 1/8 in. steel rod, truly centered to make sure that it is perfectly straight. A thread is cut on both ends, one to fit into the piston and the other into the cross head. A small lock nut

Digitized by Google



is employed to fasten the piston securely to the piston rod. The cross head is simply screwed into the lower end. The piston itself is turned out of a solid brass bar or out of a casting, and is provided with a groove for the packing to make a steam tight fitting with the cylinder wall.

The cross head is turned out of a ¼ in. square brass rod. In the drawing it is shown in one piece, but it is better to cut the head horizontally to the diameter of the crankpin and secure the cap with two screws. This is done to obtain a good bearing for the crankpin, as the double acting cylinder exerts the same strain at both the up and down movement of the piston.

Crankshaft and Flywheel

The crankpin is made out of ⅛ in. steel rod and is riveted into the balanced crank arm (see Fig. 7). The latter is fitted into the crankshaft by a small set screw. The crankshaft is turned out of a 3/16 in. steel rod and is fitted into the bearing of the standard. It has been previously bored and carefully riemed with a 3/16 in. expansion riemer, parallel to the trunnion bearing in the steam block and vertical to the center line of the cylinder (see Fig. 6). A small hole should be drilled for the lubrication of the crankshaft. The bearing is a long one to insure a smooth running engine and keep the crankshaft from troublesome vibration.

The flywheel is turned out of a casting either iron or brass. The latter is preferred as it is softer and makes a better finish. It has a diameter of ⅝ in. and is 5/16 in. wide on the rim. It is secured to the crankshaft with a small set screw.

The bearing surface on the steam block of the standard (Fig. 6) must be made perfectly level and at right angles to the boring of the crankshaft and trunnion bearing. This is done in the lathe by fastening the standard to the face plate, using the trunnion bearing to center it. At the same time cut the circular grooves, which form the steam and exhaust posts respectively.

Engine Action Explained

The action of a double acting oscillating cylinder is easily explained by a close study of the drawings. The steam block, which forms part of the standard contains two ports, drilled from the back, one to receive the steam pipe, the other the exhaust pipe. These ports run into the circular grooves. When the cylinder is placed in position and fastened to the standard with the aid of the trunnion, as illustrated in Fig. 4, and the cylinder is in vertical position the port holes of the cylinder are opposite the solid parts of the steam block. As soon as the steam enters the groove, the cylinder is moved and steam

Digitized by Google

enters the port of the cylinder and presses against the piston. By the same motion the other port opens into the second groove and discharges the used steam. Reaching a vertical position the steam ports are closed once more and

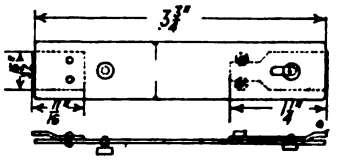


FIG. 11. Inspection Door

the momentum of the flywheel carries it over the dead center and the position of the ports is reversed. In this way the steam is admitted alternately at both ends of the cylinder.

STATIONARY BOILER

HAVING finished the boiler tube and fittings as described in the last issue of the magazine, we start now with the construction of

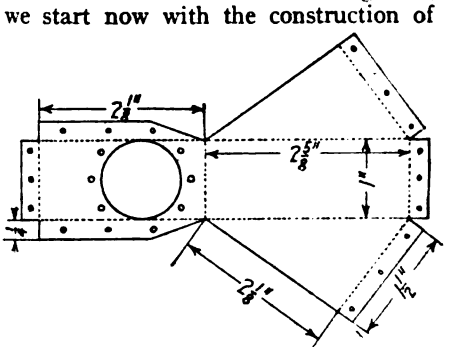


FIG. 14. Blank of Chimney-Support.

the baseboard, the flame guard, spirit lamp, etc. The baseboard is made out of a piece of hardwood 15 in. long, 5 in. wide and 3/8 in. thick. Having it planed and the edges chamfered, to give it a finished appearance, we screw crosswise to the grain of the upper piece two pieces of wood, 5 in. long, 1¼ in. wide and ½ in. thick, to form feet and keep it from warping. This being done, mark out the position of the drip tray and recess the part to a depth of 1/8 in. as indicated in Figs. 7 and 8, showing sectional cuts of the complete boiler.

Boiler Support and Flameguard

Next we take the boiler support and

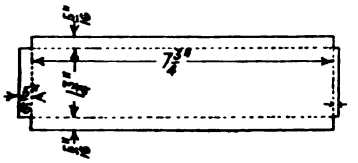


FIG. 12. Blank of Drip Pan

flameguard in hand. It is made out of a piece of tin plate or Russian iron about 1/32 in. thick, the latter being preferred. Having obtained a suitable piece, cut a strip about 24 in. long and 3 in. wide, mark out the developed plan as shown in Fig. 9. Having this done carefully we start by cutting out the ventilation holes, a; the inspection door, b; and the chimney support hole, c. The firebox door opening, d; do not cut out until after having bent the guard to shape. Having cut the holes, cut out the whole piece and smooth the cuts with a file, special attention being paid to the curved parts forming the boiler saddles and slots for the screws to hold the boiler in place. The keyhole slot for the firebox door is made by drilling two holes, a 3/16 in. one and below it a 3/32 in. one and finish up with a small round file. Next we drill the 1/16 in. rivet holes, f; and bend the guard to shape.

The flameguard is fastened to the baseboard by two angle pieces 8 in long. They can be made out of strips of brass and bent to shape and are riveted to each side of the boiler support. Before doing this drill four holes in each for securing it to the baseboard. The ventilation holes may be covered on the inside with fine copper gauze.

Firebox Door

The firebox door is made out of No. 16 gauge sheet brass cut and filed to the size shown in Fig. 10. Drill a ½ in. hole in the position indicated for ventilation purposes and drill and file the slot for the alcohol supply tube of the lamp. The ¼ in. edge piece is also cut out of a piece of No. 16 sheet brass and sweated to the door, after which it is necessary to carefully clean the edges. The door handle is made out of a piece of No. 14 gauge brass wire, the ends of which are flattened out and riveted to the door, after having been previously bent to shape. For rivets we use copper wire. To insure the heads against splitting it is very good to first anneal the wire. We finish the door by drilling and tapping a 1/16 in. hole to receive a small screw, which is intended to fit into the keyhole of the flameguard, to hold the boiler in place.

Inspection Door

Now we come to the inspection door, the dimensions of which are shown in Fig. 11. It is provided to light the lamp and adjust the wicks, etc., without removing the lamp. Like the firebox door it is made out of No. 16 gauge sheet brass. It is held in place by two catch-pieces. One is riveted into place, the other one is free to slide. The latter is kept in place by a screw which travels in a special slot and the tail piece, which slides under the heads of two screws. Before attaching the catch-pieces to the door it is necessary to bend them as shown.

Drip Pan and Chimney Support

This brings us to the drip pan. It is cut out of the same material as the boiler support, to the size shown in Fig. 12. The ends are bent up and the joints are soldered on the inside. In Figs. 7 and 8 the pan is shown in position. It is provided to protect the baseboard against the heat of the flame and against fire, should any spirit overflow and become ignited.

Our next step is the construction of the chimney and its support. They are made out of stout tin plate, by carefully marking and cutting out the developed planes shown in Figs. 13 and 14. Then drill the rivet holes and bend them to shape. It is advisable to first rivet the chimney onto the support before riveting the latter to the flameguard. Copper wire rivets are being employed.

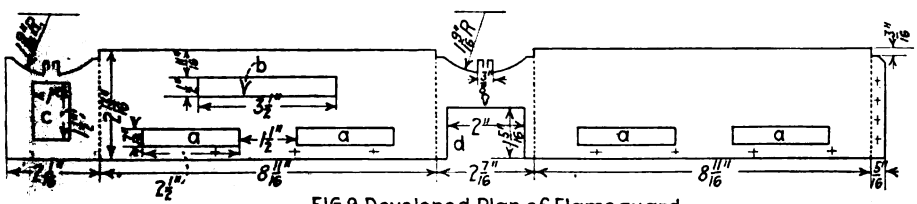


FIG. 9. Developed Plan of Flameguard

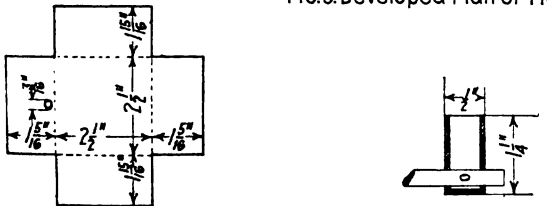


FIG. 16. Blank of Bottom and Sides of Spirit Tank (half-size)

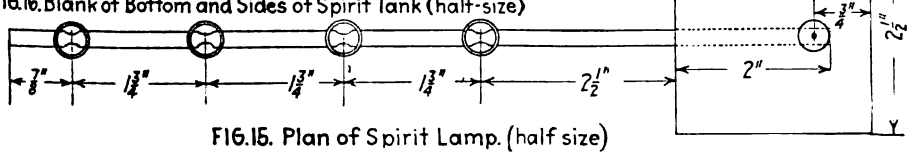


FIG. 15. Plan of Spirit Lamp. (half size)

Details of Spirit Lamp

The spirit lamp which is shown in place in Figs. 7 and 8 and in plan in Fig. 15, is the last part to be finished. For its construction we require two lengths of brass tubing—one 3/16 in. diameter and 10, 11/16 in. long, and the other ½ in. diameter and 5 in. long. The latter is cut into four 1, ¼ in. pieces. Into each one drill a 3/16 in. hole 7/32 in. from each end to take

Digitized by Google

the supply pipe. Having done this take the small tube and file a small hole at each side in the place designated, with a small round file, to allow the spirit to flow into the wick tube. Then we slip the latter into position, having previously plugged the bottom of the tubes with brass discs, well soldered into place. After having the wick tubes carefully lined up, we solder the joints, taking care to make a good job. The end of the supply pipe must also be closed by sweating a ¼ in. brass plug into it. The bottom and sides of the spirit tank are made of tin plate cut to the dimensions shown in Fig. 16. After having drilled the hole for the supply pipe we bend the sides up and solder the joints on the inside. Next we put the supply pipe into place, allowing 2 in. of it to project into the reservoir and solder it to the bottom. The top is made out of the same material and soldered into place after having the filler boss sweated into place. A hole to act as ventilator is drilled into the filler plug, to allow the escape of vapor, which would otherwise create a pressure which would cause an overflow in the wick tube.

TESTING LEATHER

ONE of the most useful of the many bureaus established by the Government is the Bureau of Standards. One of the important functions of this bureau is making investigations of various materials and collating data that is of great value to industry and to all branches of engineering. As an example of the work that is done and the various forms of machinery that are exploited, we present herewith views of two special leather testing machines. One of these is a tensile testing machine that measures the elongation and ultimate strength of various grades of harness, shoe and belting leather. As will be apparent, specimens from various parts of hides and from various forms of hides may be measured and those having the best physical characteristics recommended to the industry using such leather.

Another interesting and simple machine is that developed to determine the durability and endurance of sole leather. This machine subjects the material tested to a strain similar to that obtained in actual service. The mechanism is relatively simple. The operating wheel is driven by a chain drive and suitable reduction gearing from a small electric motor. The leather or composition material to be tested are attached to the rim of this wheel, which bears upon a disk covered with abrasive material. A band brake keeps the disk from moving too freely and the leather is called upon to rub over the surface of the disk as it rotates with an action similar to that a shoe sole receives on a pavement.

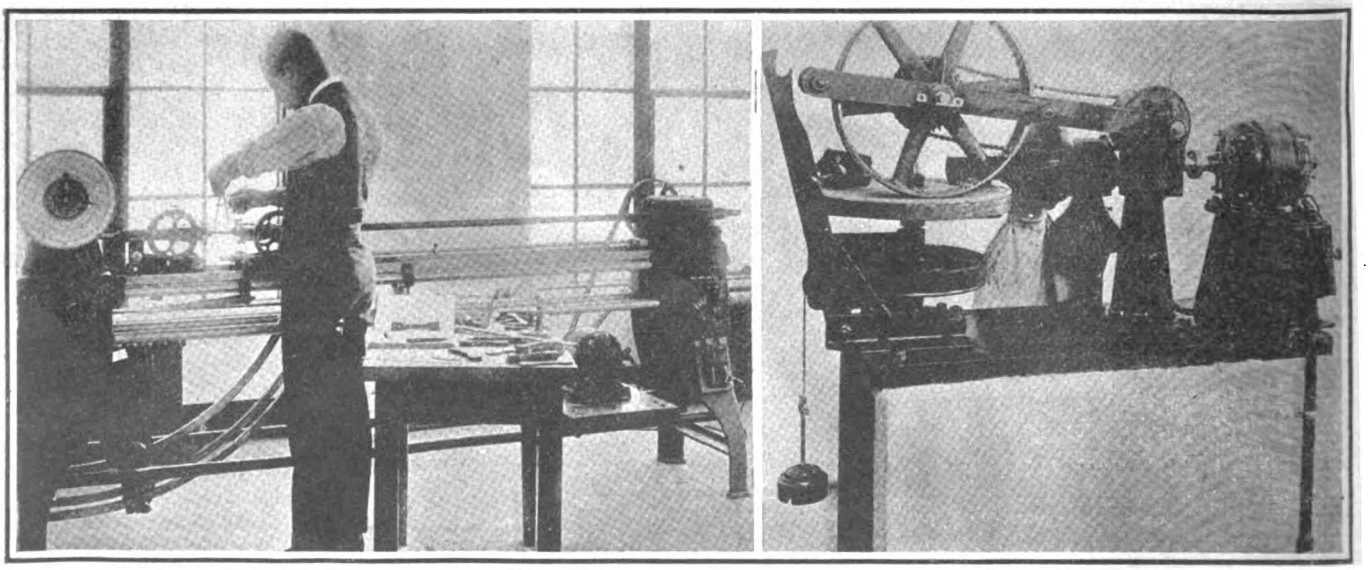
A brush is provided to loosen up particles of leather from the abrasive material and a suction blower draws the dust down into a bag. The general construction of both machines may be readily ascertained from the accompanying photographs.

The tensile machine consists of two carriages moving on the machine bed, one of these being attached to a spring balance, the other to a threaded rod, which passes through the tail stock of the machine and which is screwed up automatically by a small electric motor placed on the machine bed. Each one of the carriages is provided with a suitable clamp or chuck to receive the leather specimens and the ultimate strength is indicated by the dial of the machine, while the elongation may be easily measured with calipers.

CRUCIBLES OF REFRACTORY MATERIALS

DURING the past month the making of crucibles from highly refractory oxides and minerals has been investigated by the Bureau of Standards. It has been found possible to make such crucibles without the use of clay or binder, which would tend to reduce the refractoriness of the finished product. One method is to make the crucible with the use of water by tamping the plastic mass inside of a fire clay mold lined with plaster-of-paris. When the mold and crucible are fired to a red heat, the plaster-of-paris disintegrates and permits the crucible, which is then fairly strong, to be removed from the mold. The crucible is then fired to a high temperature in order to give it the necessary density and strength. The other method is to mix linseed oil with a refractory oxide and then to shape the crucible inside a detachable metal shell; the crucible is then baked in the shell in a core oven, a similar process to that employed in the baking of cores for castings. After the baking, the shell is removed and the crucible fired to a high temperature, which results in a burning out of the temporary carbonaceous binder and a sintering of the refractory oxides, thus forming a dense, strong, and highly refractory crucible. Working in this way, crucibles have been produced from titanium dioxide, zirconium dioxide, and carborundum fire sand.

In casting brass in sand, if the gate breaks off in the mold, it usually indicates that the metal is not good. Such a breakage shows that the metal is red, short and breaks while cooling. The difficulty may be caused by the presence of sulphur, antimony, arsenic or other foreign elements in the metal. Bronze or composition acts in the same manner as brass.



Special machinery developed by the U. S. Bureau of Standards for testing harness and shoe leather

Digitized by Google

EVERYDAY MOTORIST

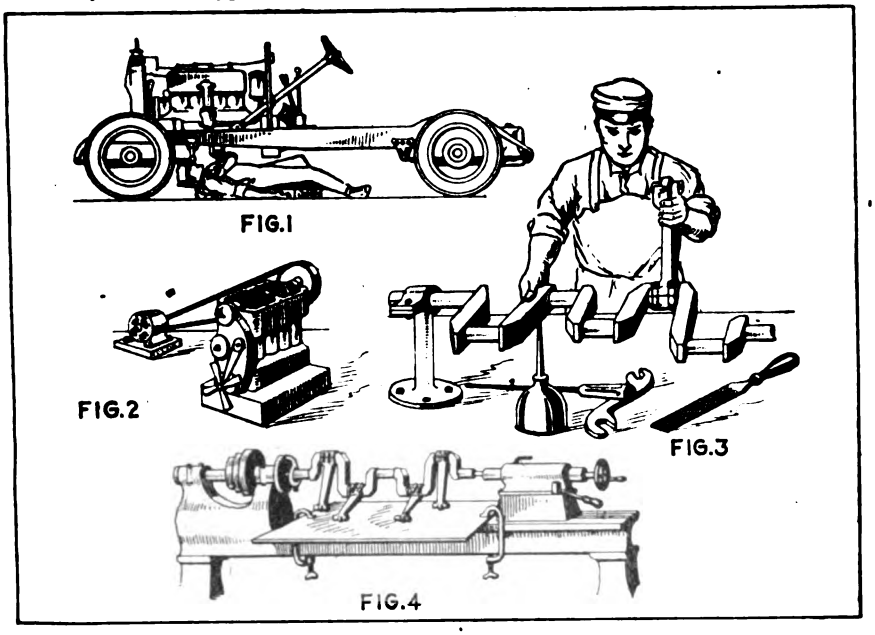
A NEW LAPPING COMPOUND

FOR securing good fits in iron, steel and other hard metal parts, the lapping process is often used. Lapping of main and connecting rod bearings, however, has been practically out of the question because of the tendency for the hard abrasive to stick in the soft bearing material, or the shaft, and continue to grind after the lapping operation has been completed. It is practically impossible to wash the shaft or bearing free of these lapping or grinding compounds and consequently carborundum and emery have not been used.

Recently a new type of compound has been brought out, especially adapted to soft metals, which breaks down after it has been in use for a short time. It is composed of large and small crystals, the cutting surface being the large crystal, and the small crystal being a neutralizing substance. When the large crystal has been worn down so that the short crystals are in contact with the rubbing surfaces, these are broken up and due to their neutralizing action, destroy the cutting qualities of the entire compound. This action generally requires about 10 minutes.

This product is sold under the name of Timesaver, and does not contain any form of emery, carborundum, or glass. It is stated that an 80 or 90 per cent bearing can be secured with it in about one-fourth of the time required to scrape the usual bearing. It is soluble in oil, or it can be removed with gasoline or kerosene after the lapping operation is completed. It cannot be used in grinding valves, or lapping in pistons and rings, as it does not work on iron or steel and carborundum and emery compounds are best for such use.

The method of using this compound is to bore or cast the solid bearings or bushings to a light driving fit on the shaft and grind in Timesaver. This is applied very thinly and with plenty of oil. It is ground or lapped with a turning motion. After a few twists have been given, the shaft is cleaned and fresh compound applied. A number of other methods can be utilized. Fig. 1 shows car with engine in place and the bottom half of crankcase removed. The connecting rods being fitted to the crankshaft are in the reverse position, that is, hanging down. Obviously, the only types of engines on which this can be done are those in which the heads are detachable so the pistons and rods may be removed without dismantling the engine or removing the crankshaft.



Diagrams showing how new bearing metal lapping compound may be used

Enough shims are removed and connecting rods bolted up, just snug with bearing compound and oil in the bearing, and rocked back and forth a few minutes, tightening the nuts as the babbitt grinds out. If one application does not produce the desired surface, repeat operation. A few minutes will generally produce desired results.

Fig. 2 shows crankcase, upper half and cylinder block inverted. Place on stand or box, crankshaft roughly fitted to main bearings and compound applied, cap bolted in place lightly, shaft rotated to belt connection with a line shaft or electric motor, then caps screwed down a little tighter and shaft rotated until bearings show a good surface. Several applications may be necessary.

Fig. 3 shows rods being fitted to the crankshaft. The crankshaft is held in a vise or special holder, rod bolted on with compound applied to bearing. Rock back and forth a few minutes, tighten up as babbitt grinds out, removing shim if necessary until fit is obtained.

It is claimed that bearings produced in this manner do not have to be assembled as tightly as a scraped bearing, so there are no high spots to wear off and the bearing if properly done, is a finished job. There is no abrading action on the steel shaft.

Fig. 4 shows a crankshaft in a lathe, all rods assembled on shaft, one shim removed at a time and assembled so as to turn free, but not tight, and bearing compound put in the bearings with oil, small end connecting rods resting and free to slide on sheet metal plate or board, clamped to the lathe bed with C clamps. The crankshaft is rotated by a lathe dog fitting face plate slot and is supported so it rotates freely on the lathe centers. The lathe is rotated at moderate speed and all rods are fitted at the same time. Shims removed and nuts tightened as the babbitt grinds out, until a perfect fit is obtained.

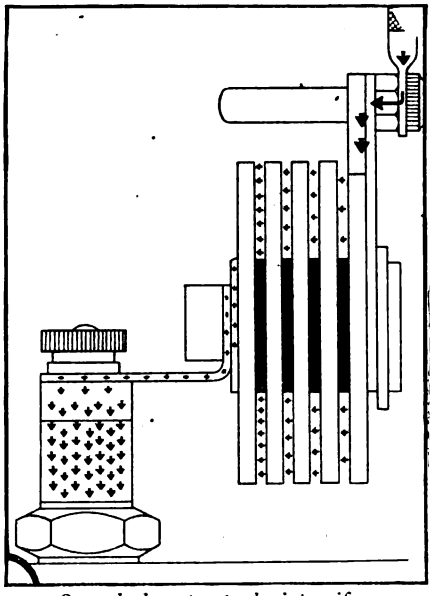
A QUENCHED GAP AS A SPARK INTENSIFIER

FOR some time past it has been known that the insertion of an auxiliary gap in the secondary circuit leading from the coil or magneto to the spark plug would result in the spark overcoming any obstacles in its path that ordinarily would prevent sparking. The sparko-gap is similar in construction to the quenched gap used in radio work and is a simple device that can be used with any spark plug and which is said to permit a plug to spark even if it is short-circuited with oil or carbon.

These claims are supported by Government tests and trials that have been made with this device applied to internal combustion engines, used on all

Digitized by Google

forms of automotive vehicles, running from motorcycles to airplanes. These tests have indicated that the device has merit and that plugs that would be inoperative without it will function under disadvantageous conditions if equipped with a device of this nature.

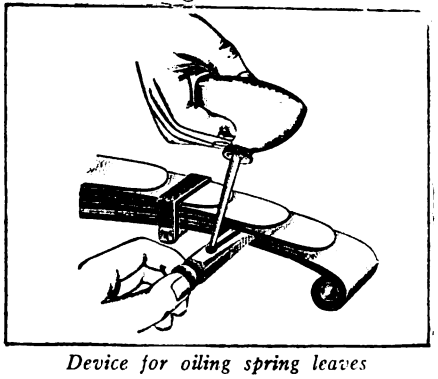


Quenched gap spark intensifier

The device is inexpensive and may be easily applied by any motorist, as it calls for no electrical or mechanical knowledge. There is nothing about the device to give trouble after it is once installed because of its simple and strong construction.

SIMPLE SPRING OILER

THE importance of keeping the springs of an automobile lubricated is not realized by the average motorist and it is often neglected because of the trouble involved in getting the oil in between the leaves. The spring oiler shown affords a simple and easy method of having oil flow between the

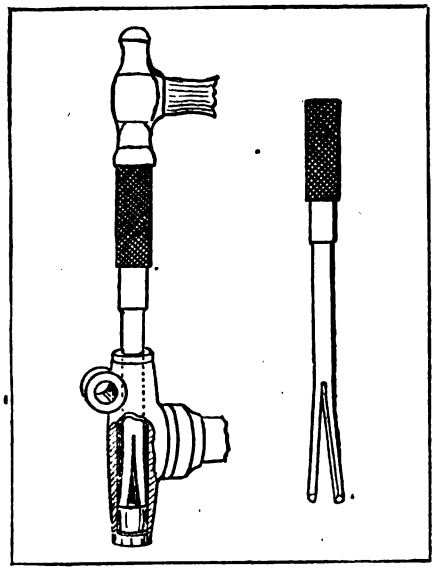


Device for oiling spring leaves

leaves. To use the device, the car weight is taken from the springs by lifting the car frame directly with a jack so that there is no strain on the springs except the hanging load of the axles. The wedge portion of the spring oiler is driven in the spaces between the leaves by a few taps of a hammer, and any oil that is supplied to the groove on the wedge of the device by a hand oil can will naturally flow to the points requiring lubrication.

A BUSHING EXTRACTOR

THE simple tool illustrated quickly and easily removes the steering knuckle, spindle arm and spring bushings in a Ford front axle. It is made of steel and nicely finished. It may also be used for Dodge, Dort, Chevrolet and Overland cars. It is valuable to the repairman and the owner who does his own work. When removing the steering knuckle bushings it is not necessary to remove the wheel. The way the tool works is obvious. The forked end has sufficient spring so it can be inserted in the knuckle through the hole in the other bushing, then the ends spread out as shown and bear on both sides of the bushing so that the

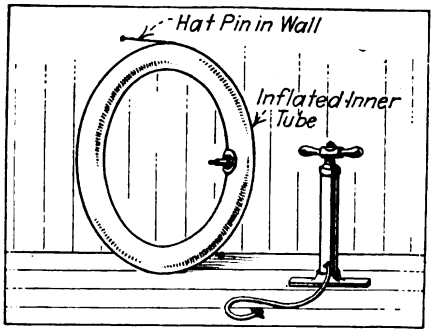


An effective bushing extractor

force of the hammer blows is directed equally on all sides of the metal, preventing cramping or binding due to a one-sided thrust, as is the case if an ordinary punch is used to force it out and thus making for easier removal.

TESTING INNER TUBES OF AUTOMOBILE TIRES

WE illustrate in the cut a simple method of rapidly testing the inner tube of a tire. The tube is blown up to a sufficient pressure to hold its shape,

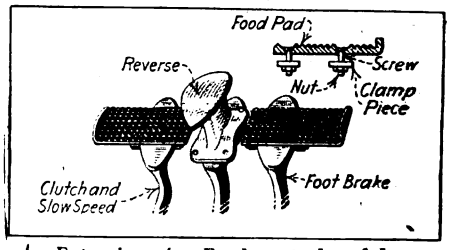


How to test inner tubes for minute leaks

when set up resting against a wall as shown. A hatpin is stuck into the wall above it so as to just touch the rubber at the highest part of the tube. The smallest possible leak will show in five minutes by the tube sinking away from the pin. It is far more sensitive and a much quicker way of testing a tire than the method of hanging it up over night. It is fair to say that, if it does not sink from the pin in five minutes, it is airtight.

EXTENSION PADS FOR FORD PEDALS

THE pedal control group of the Ford car was evidently designed for persons with very small feet because the pedal pads are placed so close together that an ordinary man-sized foot



Extensions for Ford control pedals

covers at least two of them. It is somewhat disconcerting to put on the slow speed and reverse at the same time and does not enable one to make much progress. Extension pedals or rather foot pads which are shown in accompanying illustration make this control group a really practical one that can be operated without confusion. The center or reverse pedal has an extension which raises the foot pad above the level of the other two. For the clutch and brake pedals, special wide foot pads that are corrugated and that furnish a good firm grip for the foot are provided. The ends of these pads are bent up so that it is impossible for the foot to slip off of the foot pad. A number of accidents that have occurred in the past happened because the operator's feet slipped off of the control pedals at the critical time or from not being able to get the reverse pedal down far enough without applying the slow speed pedal at the same time. These new appliances are sold at a low price and can be easily applied by any one and have considerable value for operators of this popular machine. The extensions are attached to the foot pads by the clamping members illustrated, which are fitted to the pad and which firmly clamp the pedal.

CLOGGED MUFFLER

A CLOGGED muffler is a distinct cause of loss of power. When the constricted passages inside the muffler become clogged with carbon or soot, a back pressure is set up and the engine has to work against this pressure. Tap the muffler several times lightly with a hammer, then start the engine and blow out the loosened carbon. Occasionally the muffler should be taken apart and thoroughly cleaned of carbon and the small holes in the baffle plates opened up with a pointed tool.

Digitized by Google

How the Automatic Telephone Works

A Simplified Exposition Defining the Principles Involved in Mechanical Switching and How the Needs of a Large City Can Be Met Adequately By Recently Developed Mechanism

By Kenneth Alton

IN its elements a mechanical switchboard is nothing more or less than a combination of apparatus in which a mechanically propelled cord associates itself with the terminals of your line when you remove the receiver from the hook, and then, under the control of the electrical impulses sent out by your calling dial, automatically associates the other end of this connecting cord with the terminals of the line with which you wish to connect. In other words, we substitute a machine for the operator, who now picks up a cord and inserts one plug in the jack of your telephone line, and upon learning the number required plugs the other end of the cord into the jack of the line you are calling.

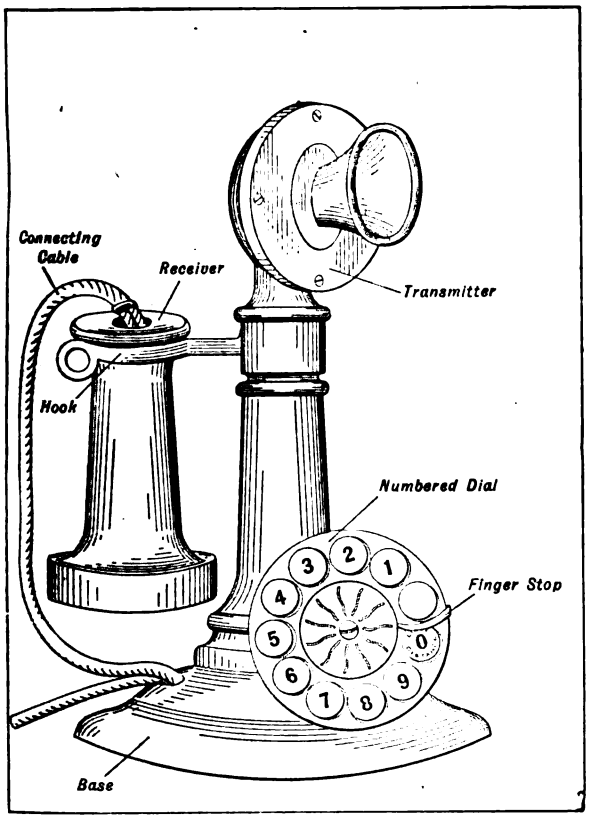


Fig. 1—Desk telephone for automatic exchange system

The above is a fair pen picture of what takes place in the small town where there is no exchange. When we come to the larger places, however, where there are a number of central offices, the chances are that the majority of your calls will be for subscribers connected to exchanges other than your own. It then becomes necessary for this mechanical switchboard, and the manual as well, to perform an intermediate operation, which consists of selecting a trunk line leading to the exchange in which your wanted subscriber is located. The difference here is that your mechanical operator, instead of connecting you direct to your subscriber, picks out an idle trunk to the exchange wanted, and another mechanical operator at that point picks up your connection and through its mechanical connecting cord associates it with the line you want.

The calling dial of a simple instrument which is illustrated in Fig. 1 is located at the subscriber's station. In the case of a desk-stand, it is mounted on the base as shown, and in the case of a wall set, on the face of the set itself, as outlined at Fig. 2. It is so designed that by manipulating a finger wheel electrical impulses are sent out over your line corresponding with the numerals or letters appearing in the holes. When used in the larger cities, the dial will bear certain letters of the alphabet, in addition to the numerals, and in the smaller centers numerals only may be employed. A dial suitable for use in a large city is shown at Fig. 3. In making a call the subscriber will, of course, refer to the telephone directory, and he will find in the new directory that the central office name is printed somewhat differently from heretofore. Typical examples of the new form of listing telephone numbers are shown below:

Argent Co., 1400 Bway....GREley 5513
Argentina, Brazil & Chile Shipping Co., 70 Wall, HANover 0307
Argentine Genl. Consulate, 17 Batry. Pl.....RECtor 6946
Argentine Impt. & Expt. Corp., Prod. Ex.....BROad 1768
Argentine Mercantile Corp., 42 Bway. .....BROad 5066
Argentine Naval Commission, 2 W. 67.....COLumbus 5623
Argentine Quebracho Co., 80 Maiden La.....JOHn 1652
Argentine Railway Co., 25 Broad .....BROad 1383
Argentine Trading Co., 1164 Bway. .....MAD Sq 1871
Argeres Bros., Restrnt., 86 6th Ave. .....SPRing 5337

These conform to the present manual listings, except that the first three letters of the office names are set out prominently. Simple as this change in the form of listing appears, until it was developed by the Bell System experts, no satisfactory system of designating telephone numbers for machine switching systems for large cities, such as New York, Chicago, Boston and Philadelphia, was known.

One advantage of this plan is that it does not necessitate the abandonment of all the existing manual designations. For manual operation it leaves them substantially as at present. For machine switching operation the same form of listing is used in the directory, a clear indication being given as to the portion of the listing which should

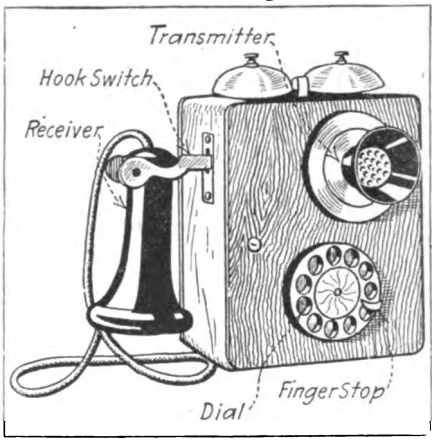


Fig. 2—Arrangement of dial on wall set

be dialed in making an automatic call.

The maze of connections and duplications of detail of the latest systems is apt to be confusing to the reader not entirely familiar with modern telephone switchboard practice, but the basic principles of mechanical selection involved can be easily understood by following the description given and studying the diagrams of a simple system consisting of only a few subscribers and a correspondingly few parts of

Digitized by Google

the mechanism. The more complicated systems used in large cities are a refinement and logical development of the system described which will suffice to bring out enough of the basic principles so the reader can obtain an idea of the way the system works.

Function of Calling Dial

The automatic systems must have some arrangement at each end of the line so the subscriber can call any party desired without any other aid, and suitable mechanism must be provided so connection will be established with the desired party at a central station. The arrangement at the subscriber's end was formerly a series of push-buttons, but at the present time a much more satisfactory and positive device does the calling. This is a numbered dial, previously explained, attached to the base of a desk telephone of the usual form. The numbers around the edge of the dial range from 0 to 9

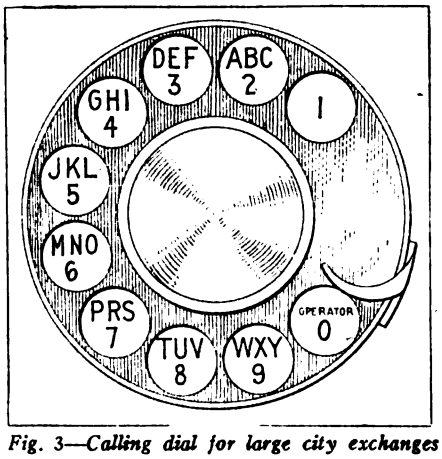


Fig. 3—Calling dial for large city exchanges

and may also have letters adjacent, as in Fig. 3, thus enabling any combination of figures to be selected. The neat dial is all that is visible at the outside of the instrument, but some very ingenious mechanism is hidden inside the telephone base and is actuated by the dial. At the edge of the dial there is a little fixed hook or finger stop. In calling a number, the finger is placed in one of the openings in the upper dial, directly above a specific number, then the dial is rotated in a clockwise direction toward the fixed stop, until its motion is arrested when the finger is removed. Then the dial, which has been turned against the resistance of a torsion spring, is returned to its starting place, but in so doing a toothed segment rotating with the dial makes a certain number of electrical contacts corresponding to the number at which the dial was released. Thus, if the dial was released when the finger in hole No. 7 came against the finger stop, the contacts would send seven distinct impulses over the line to the central exchange, where a special electromagnetic selective device moves contacting fingers over suitable connections arranged so the desired circuit is brought in action. The calling of any number composed of more than one figure is accompanied by inserting the finger in the dial, rotating it to the fixed stop and releasing it for each number in succession, as shown in Fig. 4.

What the Automatic Selector Does

The operation of an automatic selector at the exchange will be understood by referring to Fig. 5, which is a simple selector or circuit finder for an exchange of ten subscribers. The subscriber's lines, or circuits, terminate in ten pairs of plates or "bank contacts" arranged on the arc of a circle and numbered from 1 to 10, respectively. A ratchet wheel, R, is arranged with its center at the center of the arc formed by the contacts and carries a pair of springs. W, technically termed a wiper. The line for subscriber No. 1, for instance, by whom it is supposed this instrument will be used, is represented as being connected not only to the first pair of "bank contacts," but also to the wiper, to the rotary magnets and to the release and rotary push-buttons.

Suppose that subscriber No. 1 wishes to connect to line No. 2. To do this he presses twice (theoretically speaking) the rotary button (Rot. B) in the drawing, located at his telephone. This closes the circuit from the battery through the rotary magnet. Every time the circuit is completed the rotary magnet is energized and attracts an armature (A). This armature, which carries a pawl or finger (P), at its end, which engages the ratchet wheel (R) and moves it, as well as the wiper (W), one step each time the armature is attracted. Consequently, when A has been attracted and released twice in succession, the wiper, W, will have been moved from its normal position at the left of the first pair of contacts and will rest on pair No. 2 of the bank contacts, thereby bridging the gap between the terminals of lines No. 1 and No. 2. By means not shown in the diagram, subscriber No. 2 will be signaled and called to answer his telephone. The arrangement of the apparatus is such that when the conversation is finished and calling subscriber No. 1 hangs up his receiver, the release magnet (Rel. Mag. in cut) will be momentarily energized and so attract its armature. This will pull the retaining dog (D) out of engagement with the ratchet wheel, which is then returned to its normal position by a clock spring. In a similar manner subscriber No. 1 could call any of the other nine subscribers of the system, and they, in turn, could call any other party by using their instruments in the manner indicated. The proper sequence of electrical impulses for the actuating rotary control magnet is automatically sent by the spring-propelled drum and dial at the subscriber's instrument.

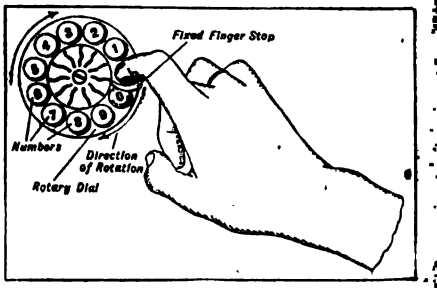


Fig. 4—How calling dial is worked

How a Complex Selector Switch Works

Let us consider next the action of a selector switch suitable for a 100-subscriber exchange. The details of this selector mechanism are illustrated at Fig. 6. The line terminals to the number of 100 pairs will now fill ten "bank rows," with ten pairs of contacts in each row. The ten rows are superposed as shown. The number of the line connected to the first pair of contacts in the lower row would be 11; the number of the line connected to the second contact in this row would be 12; the next 13, etc. The number of the line connected to the second pair of contacts in the second row from the bottom would be 22, that immediately above it would be 32, etc. It is evident that by this arrangement in a system of 100 lines each subscriber's number would contain two digits; the first digit would indicate in which horizontal row of bank contacts his line terminals could be found and the

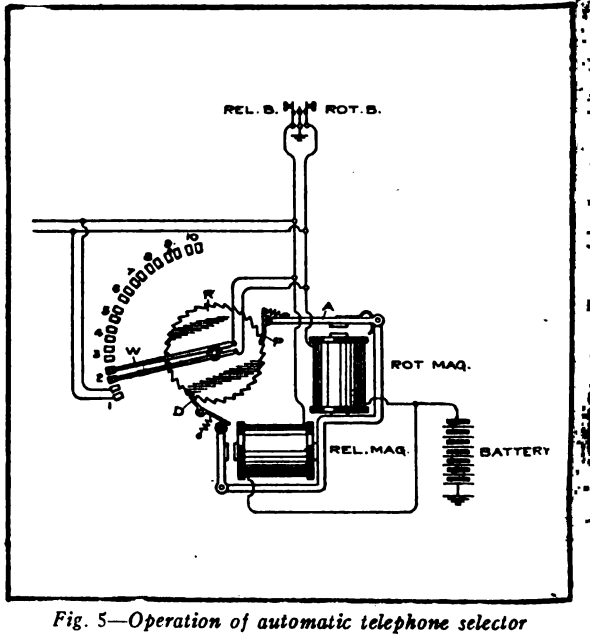


Fig. 5—Operation of automatic telephone selector

Digitized by Google

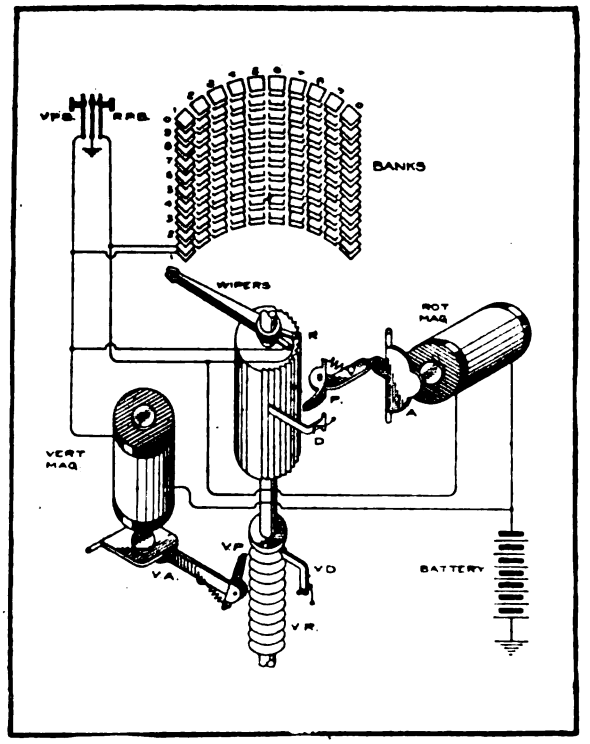


Fig. 6—Diagram showing automatic selector for 100 subscriber exchange

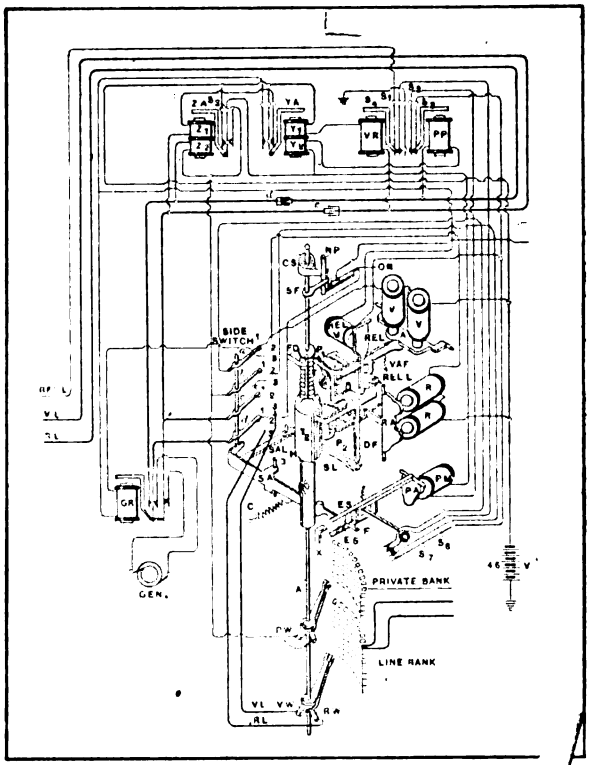


Fig. 7—Diagram showing all connections of 100 subscriber Automatic Exchange

second figure would indicate the exact pair of contacts in this row.

An idea of the method pursued in obtaining a certain connection in a system of this capacity (100 subscribers) may be had by considering that each subscriber circuit or line of two wires is connected to a pair of the "bank contacts" and to a connecting machine, technically termed a "connector switch," somewhat after the method depicted in the cut, which shows the connection for station 11. The important feature of the connector switch is the ratchet wheel or hub (R), which carries the wiper (W), already described in connection with the simple diagram at Fig. 5.

The actuating rotary magnet is represented by Rot. Mag. with its armature at (A) and pawl (P), also the dog (D), for the retention of the ratchet after each rotary step. The shaft upon which the ratchet is mounted is extended and carries another ratchet (VR), called the "vertical ratchet." The vertical magnet is adapted to attract the vertical armature (VA), which carries on its end the pawl (VP), arranged to engage the vertical ratchet and raise the shaft. By means of it the wiper is raised automatically one step whenever the magnet attracts its armature. The vertical dog (VD) is adapted to drop into place each time the ratchet is raised one step and thus retain the wiper in position. It is thus evident that by means of the vertical pawl and ratchet the wiper may be raised to a point opposite to any one of the ten horizontal rows of "bank contact" pairs and then, by actuating the rotary pawl and ratchet, the shaft may be rotated until the wiper rests on any desired pair of bank contacts in that horizontal row. Thus, if the vertical magnet should be intermittently energized three times and the rotary magnet intermittently energized five times, the wiper should be raised to the third horizontal row of bank contacts and rotated five steps, thus connecting line No. 11 to line No. 35. The apparatus, of course, is so arranged that subscriber No. 11 may intermittently energize the vertical and rotary magnets and control the movements of the wiper so that he can talk to any of the other ninety-nine subscribers at will by turning the dial on his telephone, as has been previously explained.

In a commercial telephone exchange of the automatic type there are several connector switches capable of serving each subscriber, the operation of one being intermittent upon that of the preceding one. If it were desired to have the lines so arranged that all the subscribers could talk at once it would be necessary to have fifty connector switches, which would provide for fifty separate conversations between 100 parties. In general, it may be said that in the average automatic exchange it is not necessary to have connector switches for every subscriber, but just sufficient to handle the calls at the busiest period of the day. Usually 20 per cent of the number of subscribers is taken as the proper number of connector switches to employ, but these may be augmented according to the demands made upon the exchange. The actual wiring in connection with a typical selector switch is shown at Fig. 7, and the various circuits may be easily followed by the student. The principles of operation should be well understood, in view of the explanations previously given. Obviously, a complete presentation is not within the scope of a magazine of this character, as it would call for specialized knowledge that few of our readers possess.

INCANDESCENT LAMP WITH DUAL BASE

A NEW double-base lamp by means of which household appliances and fixtures may be used simultaneously from the same outlet without the use of double plugs or adapters has been developed by E. O. Schweitzer, chief testing engineer of the Commonwealth Edison Co., of Chicago. The lamp may be made up in any style and capacity. The lead-in wires are those used for the standard 500-watt lamp and continue through the bulb from base to base, the lamp filament being tapped off from them. The lead-in wires, which are formed into an expansion loop to eliminate strain due to unequal contraction and expansion of the lamp elements, are made with a quarter twist to provide clearance for the filament anchors. Exhaustion is carried out through a concealed tube within one of the bases, continues *Electrical World,* thus making a tipless lamp. By the addition of a light brass shell beaded at each end any standard shade holder may be used. The extra attachment to the lamp may be made by using a socket screwed to its tee base.

Digitized by Google

A Light Four Cylinder Air Motor For Model Airplanes

By Clifford A. Butterworth

A FOUR cylinder, light-weight compressed air motor for use in a model airplane is shown in the accompanying drawings. When properly made this motor should weigh about 4½ ounces, and will have sufficient power to drive a 12 or 14 inch diameter propeller. It is ⅜ inch bore by ½ inch stroke, with overhead rotary valves. This type of valve is the only kind that can be used on an engine of this size. Furthermore it is very simple in construction, and there are no flat surfaces to be finished as with the ordinary slide valve.

The cylinders are turned from ⅝ inch cold rolled steel. They should be finished as smooth as possible by reaming and polishing. Drill the lower exhaust holes before doing the polishing. When drilling the inlet and exhaust ports in the top of the cylinder care must be taken to drill them at the exact angle indicated. The best way to do this is to mount a ⅜ inch pin in a block at an angle of 45 degrees, as detailed in Fig. 6, and hold the cylinders on this when drilling the ports. The lower end of the cylinder is threaded with a forty thread to take the ring shown in Fig. 1.

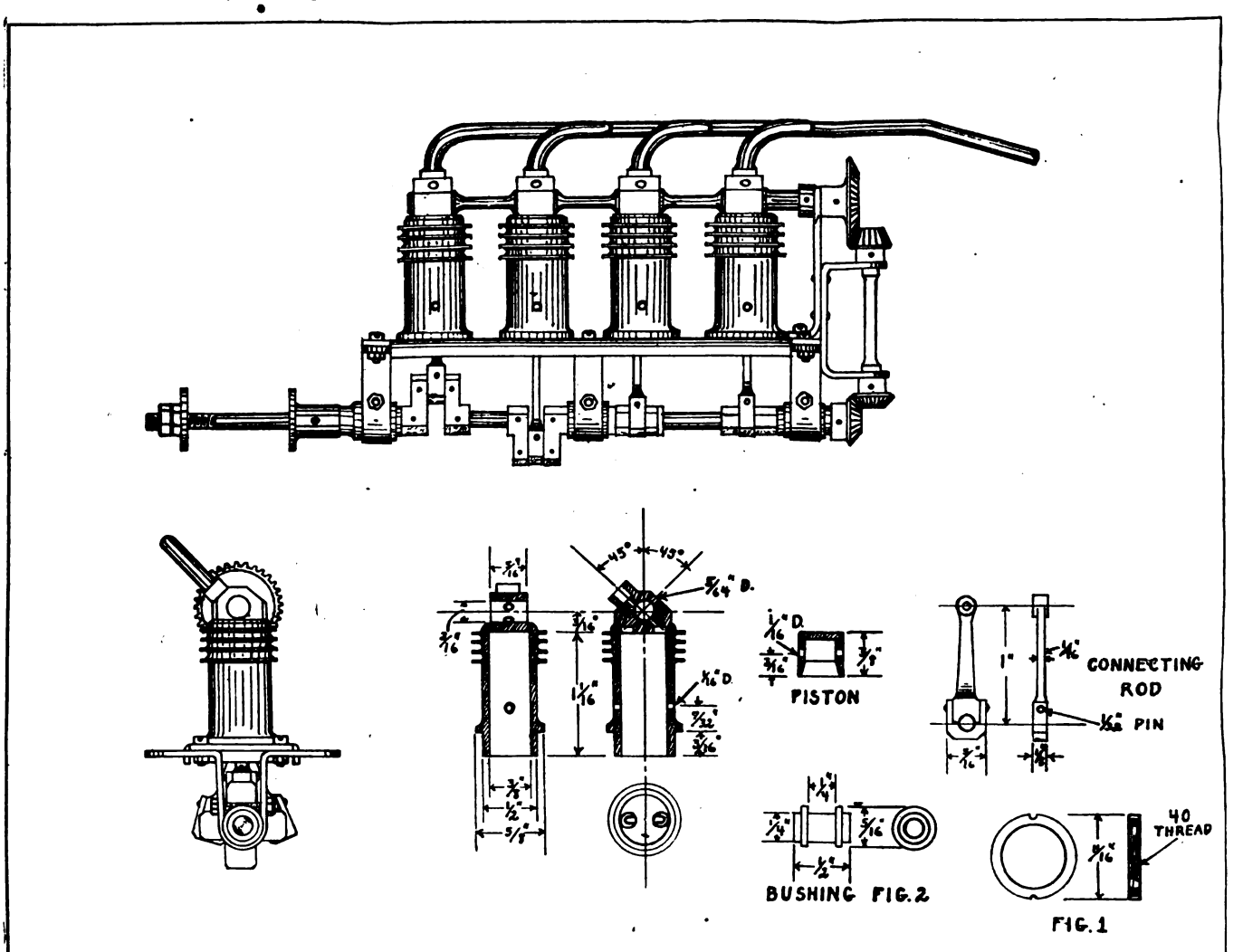
The connecting rods are made from ⅛ inch steel or brass. The lower half of the big end is riveted on carefully after the rod has been put in place on the crankshaft.

The plate to which the cylinders are fastened is made of 1/16 inch steel bent over at the edges to increase the stiffness. The cylinders are held on by means of the ring, Fig. 1. Another method of fastening them is shown in Fig. 5. They are clamped down with small steel strips and screws.

The crankshaft is of the built-up type. The shaft is ⅛ inch drill rod, the crank webs are made from ¼ to 3/16 inch steel, pinned on with 1/32 inch pins. The bushings are brass, the design for the two end ones is shown in Fig. 2. The center bushing is only ⅜ inch in length, and is split to permit its being placed on the shaft.

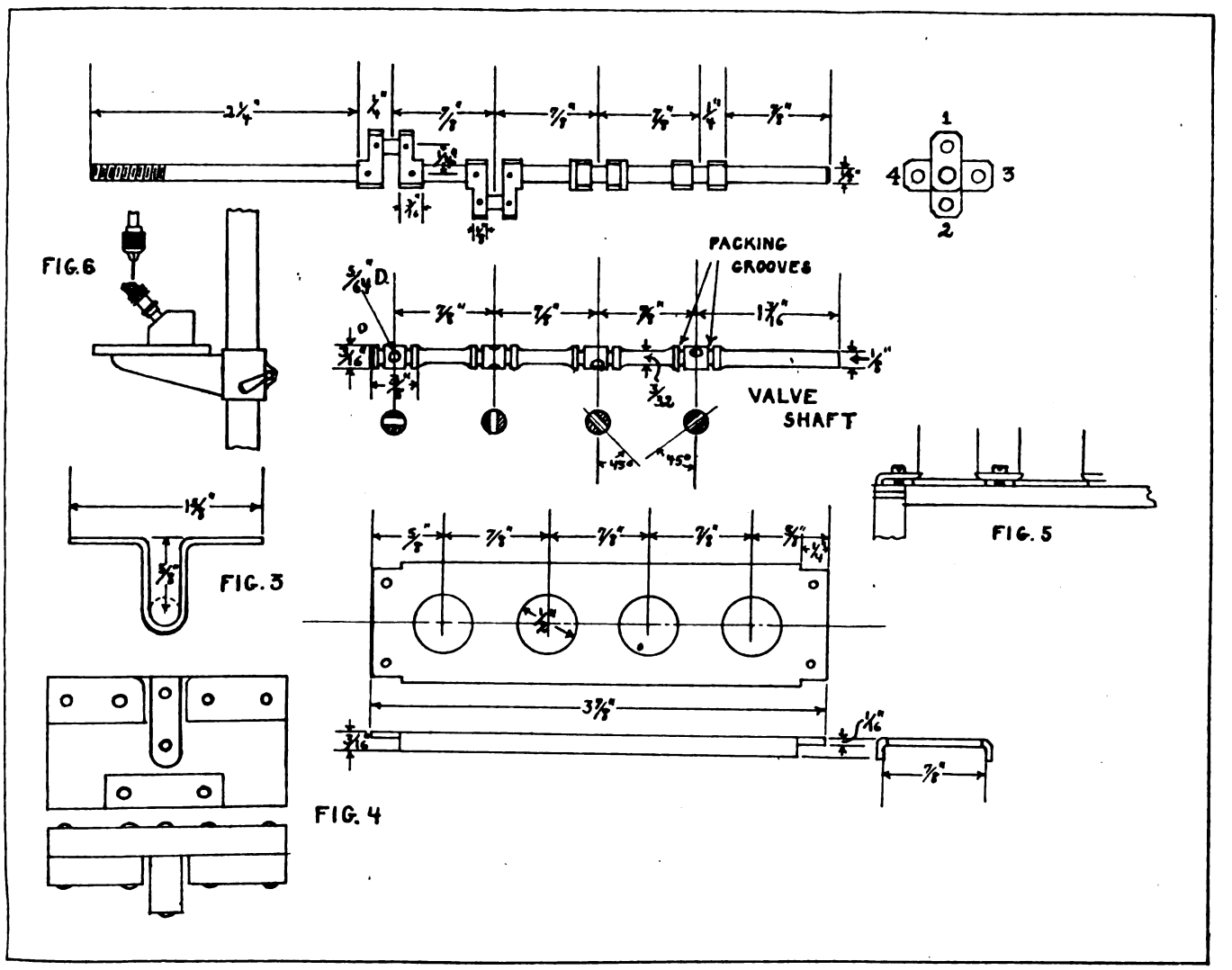
The bearing supports, Fig. 3, are made of ¼ by 1/16 inch flat steel, bent on the forming die shown in Fig. 4. The center support is made only ⅞ inch across the top instead of 1⅝ inches, and must also be bent out to clear the cylinder clamping rings. The bushings are clamped in place with No. 2-56 screws as shown. The same size screws are also used to fasten the supports to the plate.

The valve shaft is turned from ¼ inch steel rod. It should fit the holes in the cylinders as tightly as possible without undue friction. The packing grooves are wound with oil-soaked thread or soft string before it is put in place. It is driven by bevel gears at one-half the crankshaft speed. The large gear is ¾ inch in diameter, the smaller ones ⅜. The bracket supporting the gear shaft is made from ¼ by 1/16 inch steel. The air pipes are brass tubing of ⅛ inch outside diameter. A ball thrust bearing can be mounted at the front end of the crankshaft if desired.



Assembly view of very light four-cylinder air motor using rotary overhead valve at top and details of cylinder, piston, and connecting rods below

Digitized by Google



Details of crankshaft, valve shaft and engine base of four-cylinder air motor

COMMERCIAL AVIATION IN GERMANY

DIE *Deutsche Luft-Rederei* has now published its first annual report of flying activities. According to the figures, 13 twin-engined and 71 single-engined mail aircraft transported 3,000 passengers and 100 tons of mail and other cargo on the six regular lines: — Berlin - Leipzig - Weimar (opened Feb. 5th, distance, 250 km.; mean flying time, 2 hr. 18 min.; number of flights, 893). Berlin-Hamburg (March 1st, 260 km., 2 hr. 10 min., 571 flights). Berlin-Rhineland-Westphalia (April 15th, 490 km., 4 hr. with intermediate landings at Hannover and Braunschweig, 402 flights). Berlin-Warnemünde (April 15th, 220 km., 1 hr. 55 min., 159 flights). Berlin-Swinemünde (July 5th, 175 km., 1 hr. 15 min., 132 flights). Hamburg-Westerland, Island Sylt (July 5th, 175 km., 1 hr. 15 min.); besides 1,389 other flights. Ninety-five per cent of all flights were completed.

With the Government gasoline supply ceasing all flights except occasional ones stopped on Aug. 1st. In July flights were made over the sea surroundings of Berlin each Thursday in G class aeroplanes, and week-end trips to the Swinemünde sea resort. During the fairs in Leipzig a service to Berlin was maintained and numerous other flights carried out with single and twin-engined aircraft to all parts of Germany. Exhibitions in connection with passenger flights were arranged at the aerodromes of Dresden, Leipzig and Gelsenkirchen.

SOFT WOOD PROPELLERS

IT is reported that German airplane constructors, instead of using mahogany and walnut for propellers, are using softer woods of different kinds laminated together. Experiments made to determine the strength of these propellers show that with the wood skilfully compacted together these propellers are as difficult to break as the best hardwood propellers. It must be remembered that the extreme strain necessarily makes the life of even the best propeller comparatively short, and there is something to be said for the view that efficient and durable propellers may be made from comparatively cheap timber so easily obtained.

HOW TO DISTINGUISH MAHOGANY AND WALNUT FROM RED GUM

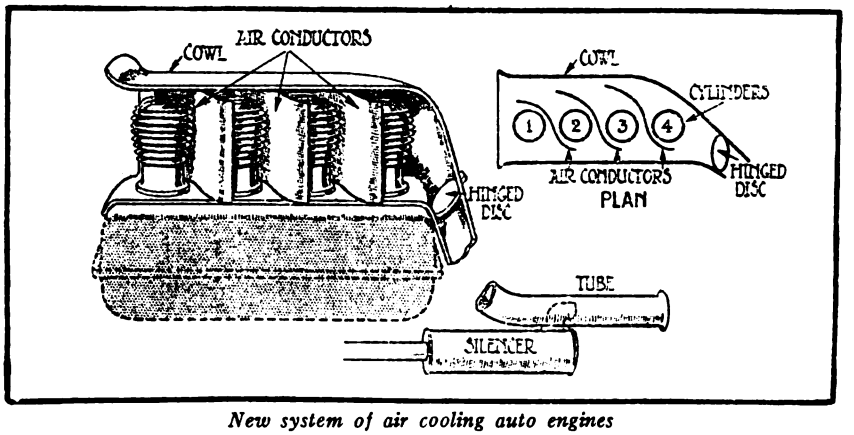
IN the manufacture of furniture and cabinets a great deal of red gum is used as an imitation of mahogany or Circassian walnut. When red gum is properly finished it can be made to look so much like either of these woods that only by very careful observation can the true be distinguished from the substitute. There is a very distinct difference, however, between red gum and mahogany or walnut. This difference lies in the size of the pores. In mahogany, Circassian walnut, and black walnut the pores are so large that they can be seen very distinctly on a smoothly-cut surface of the end grain, where they appear as minute openings smaller than pin holes but visible without magnification. On surfaced faces the pores appear as fine grooves, running parallel with the grain. They are even visible through the varnish, appearing as dark lines. In red gum the pores are much smaller and can be seen only with a magnifying glass.

Digitized by Google

USEFUL AND INTERESTING INVENTIONS
AUTOMOTIVE - MECHANICAL - ELECTRICAL

SCHEME FOR AIR COOLING

THE accompanying illustration depicts a scheme for air cooling small engines which depends on the ejector action of the exhaust gases to draw air around the cylinders. The inventor believes that this scheme will save the power that is used by the usual form of cooling fan which runs from one-half to one horsepower with the engine running at high speed. The advantage advanced by the inventor is that there are no moving parts in the cooling system other than the moving gases, and that the waste gas is made to do more useful work instead of being discharged into the air after it leaves the cylinders.



New system of air cooling auto engines

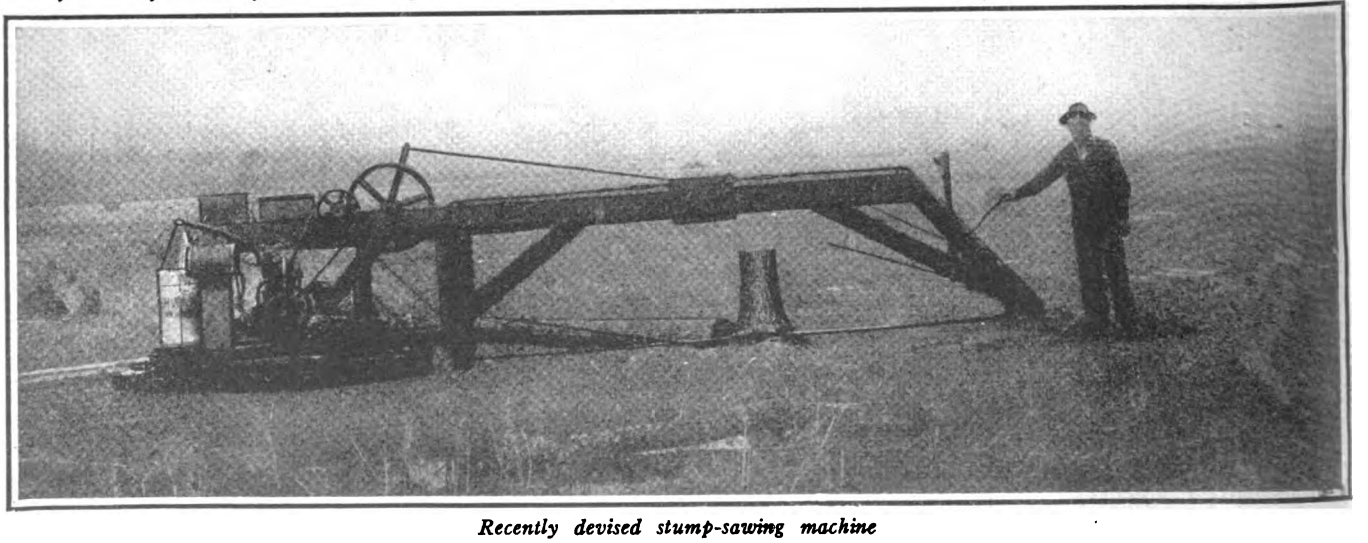
The scheme is a simple one, the cylinders being enclosed by a sheet metal cowl having partitions to deflect air around each one of the cylinders. This is a modification of the well-known Franklin system of air cooling used in this country, with the exception of that on that type the air is drawn through the cylinder jackets by a blower fly-wheel element and the cylinders are provided with vertical instead of horizontal flanges. It is doubtful if the exhaust gases issuing from the silencer would have sufficient speed to induce much of an air draft through the cooling cowl. This is an English invention.

STUMP-SAWING MACHINE

A STUMP-SAWING machine, invented by Arthur Hamilton of Harrisburg, Ark., is portably mounted so that it can be readily drawn across a field and brought into proper position for operating upon any desired stump. The saw is reciprocably operated by cables which are run over rollers on arms depending from an overhead frame. The cables are attached to a reciprocating cross-head, which is driven back and forth by a pittman and drive wheel, which is driven by a gas engine. The machine is operated by one man, with the saving of all the back-breaking work incident to the operation of a cross-cut saw. Not the least of the advantages of the device is that it may be operated very close to the ground—Lester L. Sargent.

NEW ENGLISH VALVE DESIGNS

WHENEVER inventors try to make improvements in internal combustion engines, the point of attack is nearly always the valves or their operating mechanism. Two new British patents were recently reported in *Engineering*, of London, that should be of interest to those of our readers who are following internal-combustion engine design progress. The object of the invention of S. S. Guy of Wolverhampton, shown at the left in accompanying illustration, is to provide for adequate and automatic lubrication of enclosed, valve-operating mechanism and its associated parts. The invention consists in providing the casing enclosing the valve mechanism with openings communicating with the crank-case and outer atmosphere. The openings already provided in the top of the crank-case to accommodate the valve rocker arms may be sufficient to allow of the oil mist entering the casing. The top of the crank-case 2, to which the casing 3 enclosing the valve-operating mechanism is secured, is formed with holes 4, in addition to the openings for the rocker arm 6. The breather orifices 7 are formed in the upper part of the casing 3, and are fitted with gauze caps easily detachable for cleaning purposes. By this arrangement the aspiratory effect produced by the action of the piston on the oil mist in the crank-case causes the said mist to pass through the casing 3 so that while the engine is

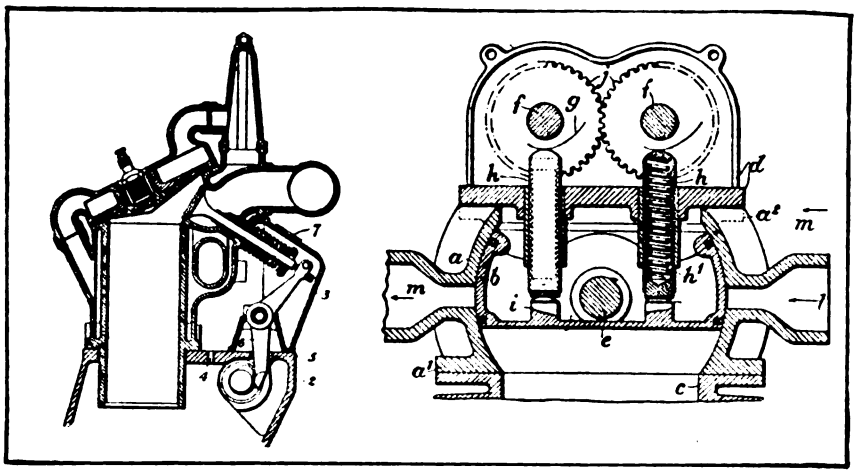


Recently devised stump-sawing machine

Digitized by Google

running there is a constant circulation of the oil mist in the said casing.

Messrs. D. E. Turner of London and E. B. Ware of Tottenham have devised an oscillating valve as shown at the right of illustration herewith. The invention relates to valvular arrangements for internal-combustion engines of the kind in which an oscillating spherical or part spherical valve is mounted to oscillate in a head in the cylinder by means of cams. According to the invention, the valve is actuated in its essential movements by cam mechanism through the medium of tappet



New English valve designs

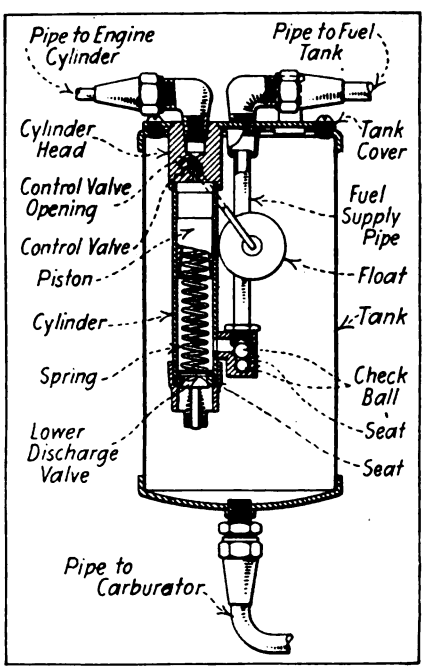
rods adapted to bear thereon so as to control the admission of fuel to, and the exhaust of the products of combustion from the cylinder. The hollow spherical casing a, carrying the valve b, is flanged at a^2 and at a^1, where it is secured to the cylinder c. To the flange a^2 is secured a suitable casing d, to contain the cam-actuating mechanism. The valve b is mounted on trunnions e. The oscillating movements of the valve b are effected by cams g mounted on spindles f, f, passing through and supported by the casing d enclosing the cam-actuating mechanism. Each cam spindle f, f, is provided with a cam g adapted to act on a tappet rod h supported by the cam casing and interposed between the cam g and a projection i on the oscillating valve b. The tappet rods are telescopic, and the two tubular portions thereof are kept extended by a spring h^1, which is always under compression. The cams g, g, are arranged centrally of their spindles f, f, and effect the movement of the valve. The valve spindles f, are geared together as shown at j. The valve b, when moved upward on one side of the supporting trunnion e, will admit fuel through the inlet port i, and when raised on the opposite side will uncover the exhaust port m.

To remove ink marks, such as writing, from celluloid, light rubbing with a rag moistened with acetone is effectual. After removal of the ink marks, it may be necessary to polish the surface with a dry cloth.

NEW FUEL FEED DEVICE

THE Sparton Fuel Feeder introduces a principle thus far never commercially applied to a fuel feed—positive force generated in the combustion chamber so applied as to pump fuel in direct proportion to the motor's needs. Instead of employing a vacuum created by suction from the intake manifold, the Fuel Feeder pumps direct from the supply tank the moment cylinder compression takes place.

The mechanism is housed in a small cylindrical tank, which is to be mounted under the hood. It has few moving parts, and should be strong and durable. The compression pressure pushes a small piston down against a spring and on the up-stroke of the piston it acts just as any plunger pump does



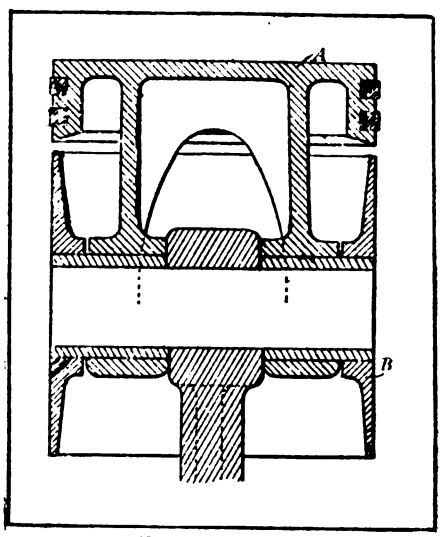
Fuel feed device

and draws in gasoline through the check valve which opens to give access to the main fuel container. On the down-stroke the discharge check valve leaves its seat and the gasoline previously pumped into the cylinder is forced into the tank. As soon as the fuel rises enough to lift the float, it closes off the pressure pipe and the pump is inoperative until the level becomes low enough to allow the float to drop and again open the control valve.

Simple compression furnishes the pumping power, the action of the Fuel Feeder is not only positive but it varies directly with the engine load. Reference to the mechanical drawing will make clear how the float and cut-off mechanism maintains a constant fuel level and thus insures a full fuel supply that is under automatic control.

TWO-PIECE PISTON

THE accompanying illustration shows an internal combustion engine piston that has been devised in England. It is composed of two distinct parts, the upper part or piston proper which takes the thrust of the explosion and the lower slipper or guide member to take the thrust of the connecting rod The slipper member is securely fastened to the wrist pin but the piston member has a certain degree of movement and can adjust itself to the bore of the cylinder. It is claimed that the separation of the two members assists in materially reducing the



Two-piece engine

temperature of the guide member and results in improved lubrication of the part that is subject to the greatest side thrust.

Both sections are held together by the wrist pin which passes through wide bushings extending through bosses on both parts of the piston. As should be expected, the larger part of the bearing area is on the portion of the piston subject to the explosion pressure.

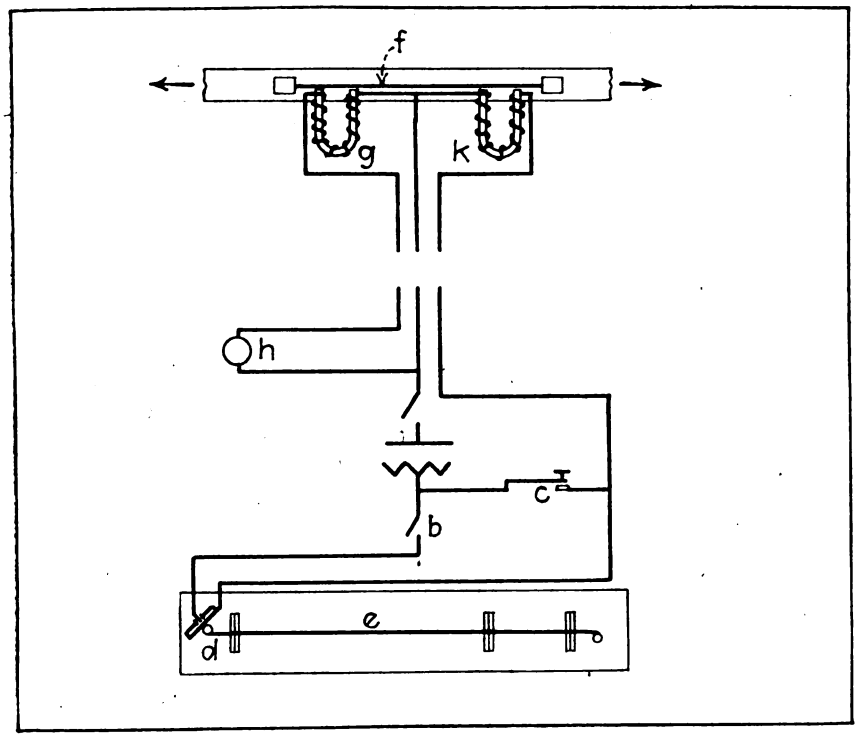
A cement for mending hard rubber and similar materials is made by melting one part of rosin and adding to it one half of its weight of india rubber cut into small pieces, slowly with constant mixing, taking care to do it at as low a heat as possible. To use it melt and apply keeping the parts under strong pressure for several hours.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

DETERMINATION OF MINUTE LENGTH CHANGES IN BRIDGE MEMBERS

THE note given by a vibrating wire, whose ends are absolutely secured, will vary greatly for a change in the distance between the ends which may be brought about by any cause. In a wire a yard long, a change of distance between its points of attachment of as little as 1/100th of an inch may change the note nearly one-fifth. This shows how exceedingly delicate a base is given for length measurements. In the diagram, f represents the wire secured to a member of a bridge-truss, which in stress of wind or of load, changes in length. The diagram illustrates the connections clearly.



Method of determination of minute length changes in bridge members

A source of direct current is supposed to be somewhere in the system. If the key, c, is depressed and released it will set the wire, f, into vibration as the electromagnet, k, acts upon it just as if it had been machanically vibrated. By listening with the telephone receiver, h, the note of the vibrating wire will be heard as it reproduces by induction its vibration in the circuit of the electromagnet, g. For perfect quietude, the hearer may be stationed in a distant place. Alongside him is a second stretched wire, c, with a movable bridge. The fundamental note of this wire being known, the number of its vibrations per second is also known. The observer moves the bridge back and forth until the notes given by the two wires are of exactly the same pitch. This is done while the bridge member or strut is loaded and unloaded. Each time a different note wil be given, the member of vibrations is noted, and by application of a simple formula the change in length of the wire, f, is determined with extreme accuracy. The above method implies a more or less musical ear. This qualification is dispensed with by introducing a microphone at d, and closing the switch, b. The string, e, is then plucked by hand and if, by proper placing of the bridge, it is in tune with f, the latter will be thrown into vibration by the action of the current passing through the coils of the magnet, k, and by the magnet, g, and the note will be reproduced in the telephone. The bridge of the wire, e, is shifted back and forth until the induced note is at its loudest. This point gives the number of vibrations of the wire, f. The formula is a simple one, except that certain constants, such as the specific gravity and the coefficient of elasticity of the wire have to be known with great exactness.

ELECTRIC LIGHTING INCREASES EFFICIENCY OF LAYING HENS

ELECTRIC lighting is being utilized to increase the efficiency of the laying hen, according to a writer in *Edison Current Topics,* published by the Southern California Edison Company. For several years experiments have been made and the results obtained have been so satisfactory that almost all the poultry breeders are now increasing their egg production from 35 to 70 per cent during the off season by lighting the chicken pens in the early morning hours before daylight. Some of the poultry journals make the statement that in some parts of the Middle West there has been such a large increase in the egg production in what was the off season, that during the past year the off-season production exceeded the regular supply during the regular laying season.

Beginning about the fifteenth of October, the lights are turned on in the chicken houses at 3:30 A. M. to get the hens off the roosts; they are immediately fed. The egg production depends on the amount of warmth and food supplied to the hens in the early part of the day. As soon as the hen is properly warmed and properly fed, she goes on the nest. If the stock is left to get off the roosts after daylight during the winter, the egg production drops off after the days grow shorter. This lighting in continued, if the chickens remain in good physical condition, until about the fifteenth of February. After that time, the lights are not turned on until about 4:00 A. M. and a month later the artificial lighting is discontinued altogether for the season. The amount of light used per square foot varies and seems to be a matter of the individual opinion of each rancher. The average, however, is about one watt for every fifty square feet of floor surface.

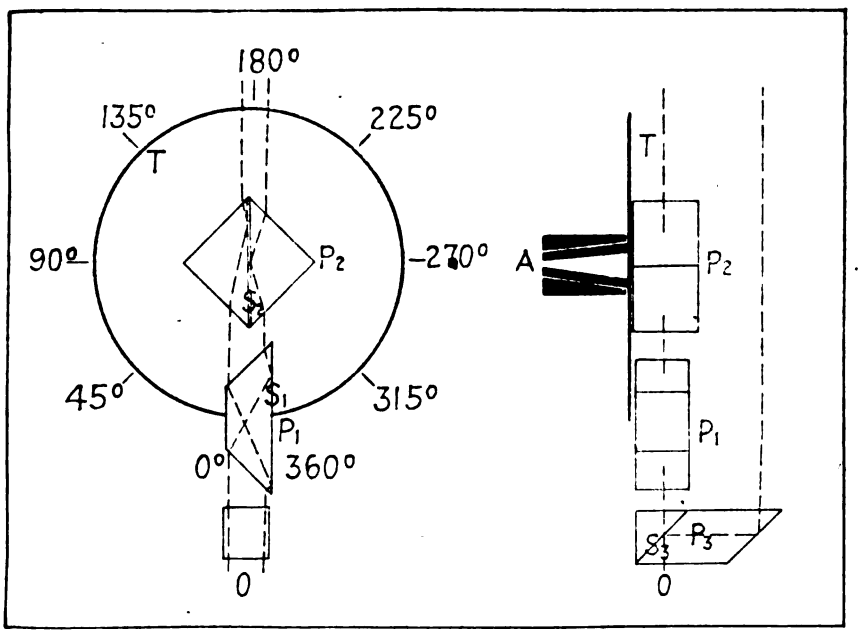
In Norway, a great deal of interest is being excited by the use of electric smelting. It is believed by some that this is a clue to the future development of the iron industry there. It is proposed in one place to construct electric works capable of producing 80,000 tons of iron per annum, as far as possible from Norwegian ores and utilizing water power for the purpose.

Digitized by Google

HAND INSTRUMENTS FOR MEASURING ANGLES

THIS apparatus, which compares with the sextant or other reflecting instrument of that type, is based upon the use of reflecting prisms. They are mounted upon a circular plate whose periphery carries a scale of angular measurements. The prism, P_2, consists of two right-angle pieces secured face to face as shown, with reflecting surfaces of silver deposited upon the two faces in contact. This prism is mounted so as to rotate freely, the angular scale, T, turning with it. The spindle is received by the handle A, of the instrument. This is shown clearly in Fig. 2. The prism, P_1, has a silvered face and the dotted lines indicate the course of rays from a distant object when the scale is set at zero. The rays are reflected from the silvered surfaces, S_2 and S_1, and are brought by refraction back into line. P_3, represents another prism also with reflecting surfaces, the one at S_3, being very thin so that it can be seen through by the observer. With his eye at 0 the observer by direct vision looking through the prisms P_3, P_1 and P_2, sees a distant object. By turning the prism P_2, different objects are brought into the field of view, and the reading of the angular displacement on the scale gives the angular distance of the object.

Looking at Fig. 2, it will be seen that by reflection the observer sees the object directly opposite to him. Rays from it strike the oblique face on the right of the prism, P_3, are reflected from that face to the face, S_3, and fence the observer's eye. To determine the angle between two distant objects one of them is brought into the direct field of view by double reflection in the prism, P_3. The prism, P_2, is then rotated until the other distant object is brought into line with the first one. The angular reading is then taken giving the angle between the two objects. The instrument can be used for vertical or horizontal angles and as made is remarkably compact.



Diagrams defining principles of instruments for measuring angles

LOSSES IN CAR GENERATORS

ONE of the most popular systems of regulating current generation in small dynamos of the automobile type used for storage battery charging is the third brush system and while the practical value of this system cannot be questioned it appears that dynamos regulated by this means are not as efficient at all speeds as those having other methods of control, such as speed governors. The matter was considered by a writer in *Automotive Industries* in a recent issue. He cites the current output of a typical shunt wound machine running at 1200 r.p.m. as 110 amperes, at 8 volts potential, if the only loss to be considered was armature winding resistance.

Brush loss brings the current down to 75 amps; reactance to 55 amps; field distortion to 32 amps; and then changing the excitation from shunt to third brush reduces it to the final rate, 14 amps.

In ordinary non-interpole generators, commutation is improved by shifting the brushes forward under the tip of the leading pole, thereby bringing the coils undergoing commutation into an assisting field. But in the third brush machine under load condition, shifting either forward or back of neutral, brings the coils into an unfavorable field. This indicates why the output of this class of machine may change 50 per cent after being installed on the car in case the brushes are not well ground in.

From the theory that was given the following operating points are deduced:

1. Poor connection in the charging line increases the amperes output.

2. Increasing the main brush or third brush width, decreases the output.

3. Setting the third brush to give higher output than normal is dangerous because the trailing edges of the main brushes will be burned away, resulting in still higher output.

4. Setting the main brushes ahead of the manufacturer's position is dangerous because a larger field current will be drawn for a given output.

5. Setting the main brushes back of neutral is dangerous because it will cause heavy short circuit currents to flow through the main brushes, eating away the trailing edge.

6. Setting the brushes on neutral by finding the position of "no rotation," with only armature current flowing, is correct only with generators having symmetrical pole faces; that is, equal airgaps at the entering and trailing edges.

The third brush regulating system is very simple and even if it does not permit of maximum efficiency, it gives much less trouble than centrifugal governors or voltage regulators of various types incorporating vibrators and contact points and its use on the greater part of the product of American manufacturers is proof of its practical merit and reliability.

ELECTRICITY APPLIED TO AGRICULTURE IN GERMANY

SUMMING up an article in the *Journal of the Royal Society of Arts* on the use of electricity in agriculture, with special reference to its development in Germany, a writer in the *Journal of the Franklin Institute* says that there has been an astonishing increase in the application of electricity to agricultural operations in Germany. In Saxony, at least, electricity was thus employed to a larger extent by small or moderate holders rather than by large farmers. Rural co-operative societies are common. In 1901 there was one; in 1913 more than 600. Some societies develop electrical current themselves, while others merely distribute it.

(1) The British farmer feeds from 40 to 50 persons; the German farmer feeds from 70 to 75 persons.

(2) The British farmer grows 15 tons of corn; the German farmer grows 33 tons.

(3) The British farmer grows 11 tons of potatoes; the German farmer grows 55 tons.

(4) The British farmer produces 4 tons of meat; the German farmer produces 4¼ tons.

A chief factor in favor of the German farmer is his increased use of artificial fertilizers.

Digitized by Google

The Process of Nickel Plating

How the Amateur Can Do Good Work With Simple Apparatus

L. M. Blakey

MANY amateurs and experimenters, and others for that matter, have small articles they wish to nickel plate, or probably have tried to plate with little or no success. It is for these I have prepared this article. Also for the benefit of the experimenter that has not had the advantages of a chemical education, I have omitted all chemical formulas. The formula given here is, at the present time, in use by a number of commercial houses and is giving good results.

For the average experimenter, a one or two-gallon glass or crockery jar is of sufficient size. To each gallon of water, add nine ounces of nickel sulphate, one tablespoon of boracic acid and about one-half pound of salt. The latter is used to make the solution a better conductor of electricity.

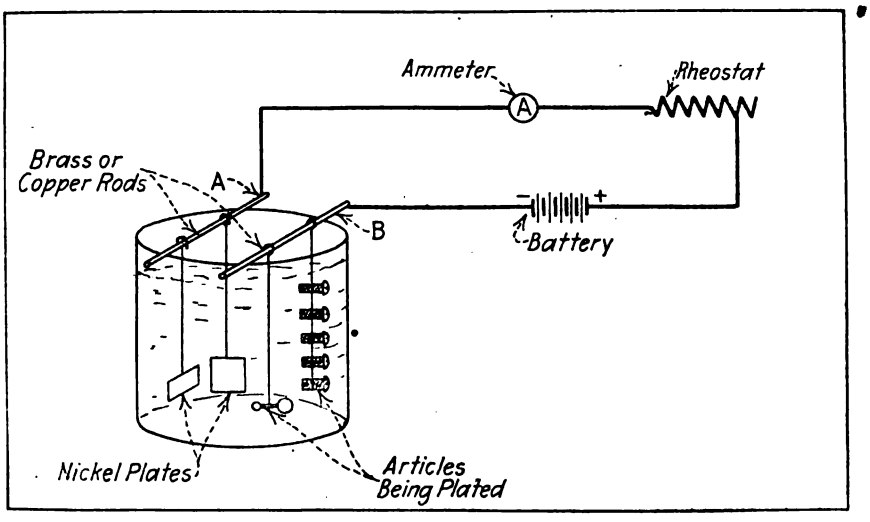


Fig. 1. How small articles may be electro-plated by the amateur

The electricity may be supplied by one, two or three dry cells, but a storage battery is more desirable. The rate of plating may vary from three to ten amperes, according to the size of the objects to be plated. For best results an ammeter and simple battery rheostat (Fig. 1) should be used to gauge and regulate the flow of current, but these are not absolutely necessary. Ten to thirty minutes will be required to plate an object, depending on the thickness of the layer of nickel desired. It is advisable to plate at a slow rate, for if a high rate is used, there is a tendency to "pile" the nickel on, causing a rough brownish surface. It is also desirable to keep the solution in motion while the current is on.

The reason so many fail to plate objects successfully is because the metal is not properly prepared before placing in the plating solution. Wherever possible a small buffer should be used and objects should be highly polished, if a bright, smooth surface is desired in the end. Next a strong solution of lye water should be prepared in a metal bucket or pan—other than aluminum—placed over a fire and allowed to approach the boiling point. Also a solution of potassium or sodium cyanide should be prepared in a glass or crockery jar. The potassium cyanide is more desirable than the sodium, because it is more active, but the latter is very satisfactory. *Caution—Do not* breathe the fumes or get any of the solution in your mouth, because it is a deadly poison. Always keep the jar covered when not in use.

Now the polished screws or objects—if small—should be fastened on a wire or placed in a wire basket and immersed in the hot lye solution for two or three minutes. When removed, they should be thoroughly washed in clear cold water and placed in the cyanide solution for the same length of time, after which they are again washed and placed in the plating solution. Do not touch the articles with the hands after the washing is begun, for the oil from the body will probably cause the nickel to peel. All objects to be plated should be placed on rod B—(Fig. 1) and the nickel plates—which may be secured from some chemical house, or maybe some old heavily plated article found around the shop, on rod A. The rods should be separated three or four inches. After a few minutes, if a dull brownish or whitish color is noticed you must reduce the flow of current.

Metals other than brass or copper should be copper plated before nickel plating, as copper will fasten itself to iron, etc., much more readily than nickel can. For this purpose use a copper sulphate solution.

After plating remove objects and wash immediately in clear cold water, then place in hot water for a minute. This prevents streaking and the objects will dry at once. They are now ready for the final polishing and use. If the above has been carefully followed there is no reason why you should not be rewarded with a perfect and lasting job.

FLAT PANELS AND NO SURFACE CHECKS BY MAXIMUM-HUMIDITY METHOD

IF panels are over-dried their tendency toward warping and twisting is greatly increased. The lower the moisture content the more the warp. The short time required for drying panels, varying from a few hours for thin panels to a few days for thick ones, makes it impracticable to make actual determinations of moisture content to decide when the material has reached the desired degree of dryness.

An automatic method of insuring the proper moisture content in dried panels is proposed by the Forest Products Laboratory. This is what may be called the "maximum-humidity method," in which the relative humidity of the air in the kiln or drying room is regulated so as to remain at the highest level which will permit the wood to dry to the desired degree (and no further) in a reasonable length of time. By this method checking of face veneer is also prevented.

The maximum-humidity method lends itself to the most convenient and economical handling of the panel-drying operation. As there is little danger of over-drying, the stock may be left in the drying chamber for any reasonable length of time beyond the minimum required. Thus, thin panels and thick panels may be taken from the press and placed in the kiln at the same time and removed at the same time, even though the thin panels dried much quicker.

For panels made up of normally dry veneer, a kiln temperature of 120 degrees F. throughout the drying period is a good schedule to follow. If with this temperature the humidity is maintained at 46 per cent, the panels will come uniformly to a final moisture content of about 8 per cent within a reasonable drying period.

Digitized by Google



CHEMICAL NOTES, RECIPES AND FORMULAS



NICKEL PLATING SOLUTION

A GOOD nickel plating solution follows:

Nickel Sulphate	100 parts
Ammonium Tartrate, neutral	72 parts
Tannin	0.5 parts

Dissolve the nickel salt and the tartrate in half a quart of hot water and add the tannin, previously dissolved in a little ether; mix and dilute with water to a volume of two quarts.

OXIDIZING COPPER

CLEAN the piece with caustic soda solution, then treat with weak nitric acid. Finally immerse in a solution of antimony chloride in hydrochloric acid. It gives a tint bordering on violet.

TO REMOVE RUST SPOTS FROM CLOTH

PLACE the part, on which the spot is, in a saucer, containing a mixture of one part of hydrochloric acid and three parts of water. After the spot disappears the goods must be thoroughly rinsed out with abundant water and washed. If the spot is of long standing or if someone has used Javelle Water on it, a 15 per cent solution of tin salt (stannous chloride) is recommended applied as above and followed by thorough rinsing and washing. No acid or salt must be left in the goods.

BLUE-PRINT PAPER

The two following solutions are separately prepared.

1

Ammonio-citrate of Iron	25 parts
Distilled Water	100 parts

2

Potassium Ferricyanid	45 parts
Distilled Water	100 parts

The two solutions are mixed, filtered and immediately spread on paper free from all sizing. It is to be dried before use and all the operations should be conducted in the absence of actinic light. After the paper has been exposed under the negative, it is washed until the yellow tint completely disappears. To accelerate the operation the prints may be placed for a few seconds in a bath composed of:

Chloride of Lime (bleaching powder)	1 part
Hydrochloric Acid	10 parts
Distilled Water	200 parts

The prints are finally thoroughly washed and dried.

SEALING WAX FOR BOTTLES

Melt together the following:

Rosin	160 parts
Lanoline	40 parts

To remove it from the bottles when they are to be opened it may be melted in a flame and wiped off with a cloth.

ABSORBTION OF CARBON MONOXIDE

Satisfactory results in the absorbtion of this very dangerously poisonous gas have been obtained by the use of the following mixture:

Manganese Binoxide	50%
Cobalt Oxide	15%
Copper Oxide	30%
Silver Oxide	5%

It may be used in gas masks wherever there is danger of its evolution. The mixture loses in efficacy by the absorbtion of humidity from the air.

ENAMELED LETTERING ON GLASS

The following process may be used for lettering glass bottles in chemical laboratories and the light.

Red Lead	15 parts
Zinc Oxide	15 parts
Borax	10 parts
Cryolite	10 parts

The letters are painted on the glass with varnish. The mixture is dusted on with a bit of waste and it is then placed in a muffle and the enamel brought to fusion and the bottle allowed to slowly cool. Many laboratories have their own muffle furnaces.

A much simpler process is to use a solution of sodium silicate (water glass) in which there is rubbed up some very finely powdered red lead. The inscription is painted on with this mixture, and it is said that after a few days it becomes very firmly adherent.

CLEANING METAL SURFACES

TO remove oxides from metallic surfaces, a weak solution of sulphuric acid followed by rinsing and drying in saw-dust may often be used. Another method is to plunge the object into a solution of perfectly neutral stannous chloride leaving it there for two hours, wash and dry as above. The stannous chloride may be made by dissolving tin in hydrochloric acid until the acid is saturated. Pure tin such as is used for wrapping chocolate may be employed.

ALUMINUM SOLDER

Zinc	70 parts
Tin	30 parts
Silver	3 parts
Copper	8 parts

The zinc and tin are first melted and the silver and copper are then added, preferably melted together as an alloy.

CEMENT FOR ATTACHING INDIA RUBBER TO METALS

Shellac	10 grams
Ammonia, 22°	100 cu. centimeters

This solution requires long standing, several weeks being necessary; it should be perfectly limpid at the end of this time. Parts by weight may be substituted for the above.

CASEIN GLUE

Casein	35 parts
Slaked Lime in Powder	30 parts
Sodium Silicate (water glass)	20 parts
Ammonia, 22°	5 parts
Water	10 parts

Rub up the casein with the sodium silicate, add the lime previously moistened with the water and then add the ammonia.

CEMENT FOR PHOTOGRAPHIC FILMS

WHILE sealing wax will serve as an expedient for this purpose, the following is a formula for home-made cement. Some old photographic films may be used to supply the celluloid. They are to be thoroughly washed in warm water to remove every trace of gelatine. They are then dried and dissolved in acetone to which it is well to add some amyl acetate. The formula is given as follows:

Acetone	50 cu. centimeters
Amyl Acetate	50 cu. centimeters
Celluloid from old films	2 grams

If the above are all taken as parts by weight the formula will work perfectly.

PREPARING CANVAS FOR OIL PAINTING

THE canvas is first stretched on its frame in the regular way. It is next sized; for this purpose a solution of glue may be applied or a solution of starch. The latter is made by stirring 25 parts of starch with 1,000 parts of cold water, which is then brought to boiling. When the canvas thus treated is perfectly dry it is smoothed off with ground pumice applied with a bit of cotton. After this it is given a coat of oil color, white or slightly yellow; the oil color should have two thirds of its volume of turpentine mixed with it.

REMOVING PAINT FROM WOOD

CAUSTIC soda solution, while very effective in removing paint raises the grain of the wood and also soaks into it so that it is almost impossible to remove it. The following formula is recommended for removing paint:

Kerosene	25 parts
Acetone	150 parts
Ordinary Alcohol	300 parts
Benzine	550 parts

The kerosene is dissolved in the benzine. The acetone is then added and last of all the alcohol. It is said that it works very rapidly. It is brushed over the paint and allowed to stand for a little while when the latter can be scraped off easily.

CEMENT FOR ATTACHING COPPER TO PORCELAIN

Caustic Soda	40 parts
Water	50 parts

When dissolved, add to the above little by little, 30 parts of resin. When the cement is to be used mix with it its own weight of plaster of paris and apply at once.

OXIDIZING COPPER

Water	1,000 parts
Powdered Orpiment (Arsenious Sulphide)	2 parts
Crystalized Sodium Carbonate	20 parts

Boil for a few minutes and immerse in it the object to be oxidized or bronzed, constantly moving it about. When darkened sufficiently, wash and dry.

Remember that the bath is very poisonous.

BRONZING ZINC

Prepare the two following solutions:

Potassium-Sodium Tartrate	30 parts
Caustic Soda	40 parts
Warm Water	250 parts

In another vessel dissolve 35 parts of copper sulphate in 250 parts of warm water.

The second solution is slowly poured into the first with constant stirring with a glass rod or stick of wood, until any precipitate, which forms, is redissolved.

A brush, free from all metal winding, is used to apply the solution to the zinc surface; the first color which shows is violet but it soon develops a brown color, and must be immediately washed copiously the instant the desired tint is attained. It is well to varnish the metal after it is absolutely dry.

For liquid glue soak good glue in cold water for twelve hours and then liquefy by heat. Add to the solution one tenth of its volume of water glass solution.

Digitized by Google

How to Get More Mileage

A Concise Exposition of Some of the Factors Governing Fuel Consumption of Automobile Motors and Points to Observe to Secure Most Economical Use of Gasoline

By Victor W. Pagé, M. S. A. E.

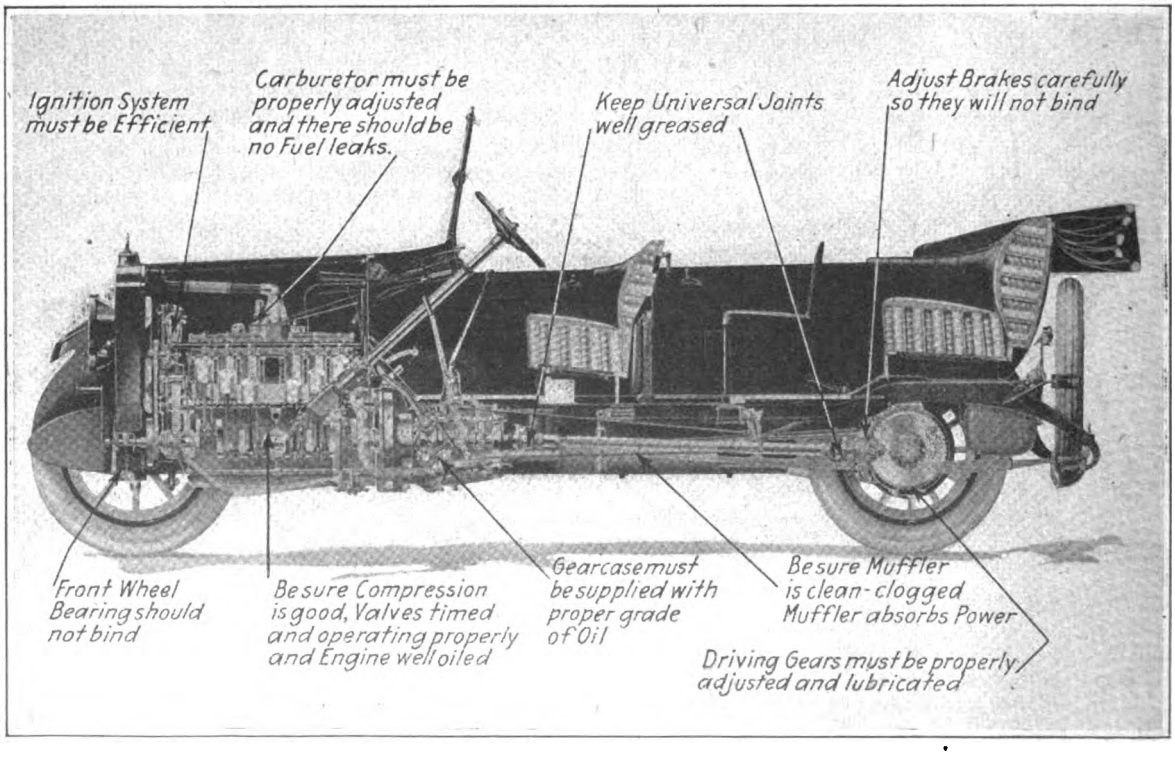
OLD timers in the automobile business can remember the time when gasoline was a drug on the market and when it could be procured for a few cents a gallon. For a number of years the best gasoline could be bought for ten and eleven cents, even after automobiles began to be used in quantities. The automobile, however, is not the only piece of automotive apparatus that uses liquid fuel, nor is it the only one that has increased greatly in numbers during the past decade. In addition to the demands made upon the fuel producers by the automobile, we have an additional demand created by the increasing use of motor boats, farm tractors, small farm power plants, isolated electric lighting plants, and even the airplane, all of which use the more volatile constituents derived from fuel oil in their engines. In addition to the consumption of the refined products, we find a greatly increased consumption of the fuel or burning oil due to the use of oil burning locomotives and ship boilers and naturally any oil burned in this way cannot be refined or become available for use by the engines requiring a more volatile fuel.

A careful study of the statistics in a memorandum issued by the American Petroleum Institute, shows that the amount of crude oil available during the period of very low-priced gasoline was so great as to excuse for the time being any expenditure of effort on the part of the automotive engineer to conserve fuel. That time is past. Today, we are facing a problem both from the automotive engineer's and the oil man's aspect of an insufficient production of crude oil to meet with the great demands being made upon it. It would seem that at the present time, the problem of the automotive engineer is to build engines and so design the cars they are to drive that instead of going from 7 to 12 miles on a gallon of gasoline, the car will go from 20 to 30 miles on the same amount. Another problem is not only to construct engines to burn refined oil produced from petroleum but also to contrive power plants that will work efficiently on alcohol or certain synthetic or manufactured fuels that have been broached as substitutes for petroleum.

It is not possible, however, to do this designing overnight and meanwhile there are several million automobiles and other pieces of automotive apparatus that were designed initially for the purpose of utilizing volatile liquid fuel. The owner of such machinery cannot throw an investment representing thousands of dollars in some instances, into discard, even if a new engine and fuel suitable for it were developed in the near future. All such people can do is to do the best they can with the equipment they have and to try and conserve the available supply of fuel that their engines will operate on.

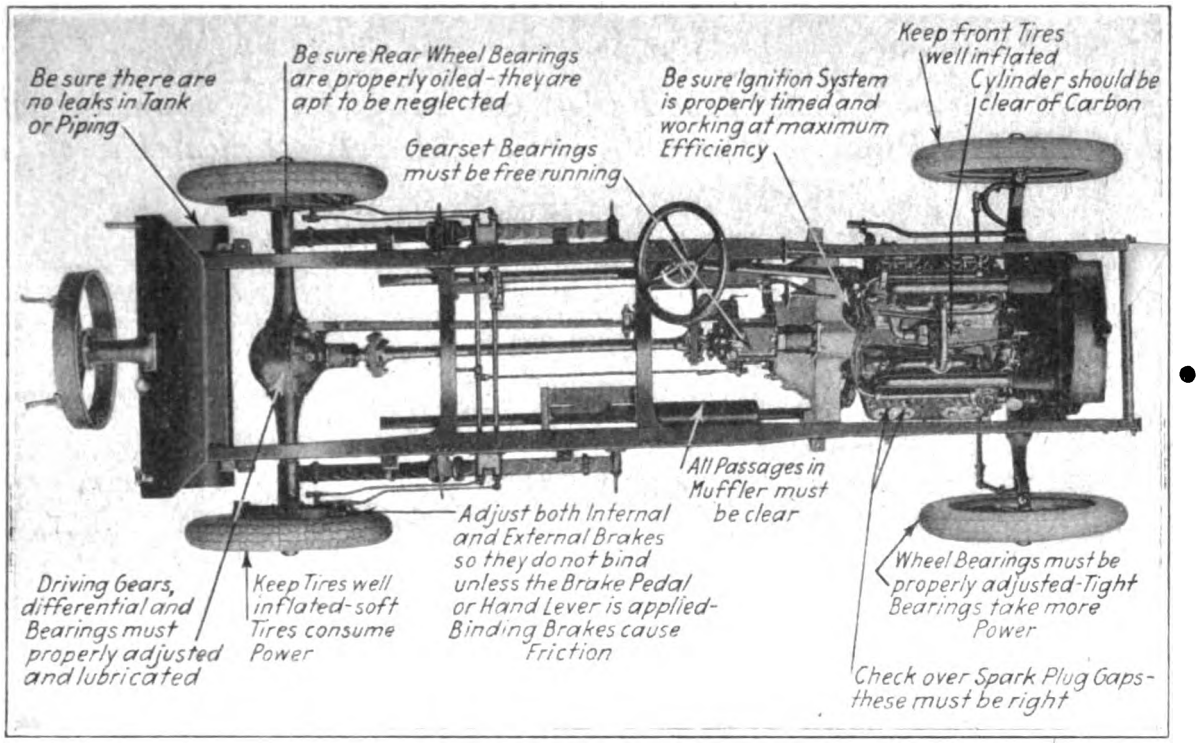
It is possible for a careful car owner to off-set the augmenting cost of gasoline in many cases, if he will make sure that all parts of his car, which contribute to the fuel consumption, are working properly. There are various factors that contribute to the waste of gasoline that has been almost universal in times past and which, of course, was largely due to the low cost at which it could be obtained. It is possible for any motorist to reduce the fuel cost per mile by eliminating various sources of waste that make a demand on the motor. Illustrations are presented to show a few of the common points about an automobile that demand attention if the motorist wishes to conserve gasoline.

Obviously, one of the most common causes of waste is in poor carburetion and even in cars of recent development, we find manifold designs and carburetors that use more gasoline than they



Sectional view of Packard Twin Six automobile showing parts needing inspection in endeavoring to save gasoline

Digitized by Google



Plan view of King eight-cylinder chassis showing location of parts to inspect in the search to eliminate wasted power

should. Changing a manifold is a problem that requires the services of an expert engineer but it is not a serious matter to provide heating means by which either cooling water or exhaust gases may be supplied to heating elements attached to the unheated manifold. Motor fuels of today are not as volatile as those marketed several years ago, so a man who owns a type of car dating back more than a few years, should be careful to see that all precautions are taken to not only supply warm air to primary air intake of the carburetor but also to heat the manifold to assist in vaporization. The carburetor should be carefully inspected to see that there is no leakage at the float control needle valve which will permit a slow flooding to take place and a loss of gasoline from the mixing chamber.

One should be sure that the carburetor is properly adjusted. If it is of the non-adjustable, spray nozzle type of carburetor, an expert should be engaged to try and see if a smaller size of jet will not give adequate results. If the carburetor has an air adjustment, it should be remembered that after the motor gets started and heats up that it is possible to supply more air to the mixture than can be used advantageously with a cold motor.

This mistake made by most men in adjusting a carburetor is to supply a mixture that is too rich in order to permit rapid acceleration and easy starting. The point that should be considered, is to set the carburetor with maximum economy because there should be no difficulty in starting the engine and instead of depending on a rapid acceleration or pick-up of the motor and adjusting the carburetor to supply a rich mixture, the motorist should use the change speed gearing which has been provided for a specific purpose and shift to a lower speed when it is desired to make a quick get-a-way in traffic instead of having the carburetor set "rich" so that the car will accelerate on the high gear.

Even if the carburetor is adjusted properly, if the ignition system is not functioning as it should, or if for any reason the spark occurring in the cylinders is not of sufficient intensity, or properly timed, it will require a wider throttle opening and consequently a greater consumption of gasoline to obtain sufficient power from the motor to drive the car at the desired speed. In other words, one must supply a rich, easily ignited mixture to compensate for a weakened ignition spark. As most cars are now equipped with self-starters, there is no excuse for running an engine idly when the car is not in motion so this cause of waste is easily eliminated.

To get the maximum amount of power from an internal combustion engine, it is evident that it must be in proper working order. If any of the bearings are fitted too tightly, or if lubrication is inadequate, there will be considerable friction that must be overcome by burning an extra amount of gasoline. Valves should be ground in and properly timed, there should be no carbon in the cylinder head or on the piston top. The piston rings must be in good condition because it is essential that the compression pressure be maintained to the point of maximum efficiency.

The working pressure obtained by burning combustible gas in a cylinder depends upon the amount of compression prior to ignition. If the engine is designed to operate on seventy pounds compression, a leakage by the pistons, piston rings, or because of score marks in the cylinder walls, will reduce its compression and in some cases even cut it in half. Obviously this will reduce the efficiency of the engine because there will be diminished force to the explosion and it will call for a greater throttle opening and a larger amount of gas to produce anywhere near the amount of power needed for average running conditions.

It is important to inspect all parts of the ignition system, making sure that the spark plugs have the proper gap between the electrodes and also that points in the timing device are clean and in correct adjustment. Positive and energetic ignition has a very great bearing on gasoline economy. This is not usually understood. In examining the various parts of the transmission system, the clutch spring tension should be such that there is no slipping and the various portions of the clutch that transmit power must be functioning properly because a slipping clutch always means power wasted.

Various bearings on the running gear, especially those in the rear axle, are apt to be neglected as far as lubrication is concerned. Tight bearings or binding brakes hold the car back and increase the amount of frictional

(*Continued on page* 429)

Digitized by Google

AEROMARINE AIR YACHT

ALTHOUGH the yacht has a wing spread of 104 feet, there have been larger flying boats used in the American and British navies, and it is not in size that the Aeromarine yacht is most noteworthy. It is in features that make the big ship a yacht rather than a boat—refinements like wind and waterproof cabins, large ports screened with curtains, electric lights, comfortable wicker chairs, ventilators and furnishings—that the new craft excels.

In the bow of the big yacht, which is painted pure white, is a cockpit which is used for observation purposes. It affords an unobstructed view. Just behind this in the top of the hull is a sliding door. This leads into the main passenger cabin, beautifully furnished, roomy, and comfortable. This compartment contains six wicker chairs arranged two by two with an aisle between. Each passenger has a circular window of celluloid eighteen inches in diameter to himself. A sliding door connects with the front cockpit, so that passengers need not go up the stairs to reach it.

To the rear of the big cabin but ahead of the front wing beam is a space for baggage or mail. Behind that is another compartment corresponding to the chart room of a yacht, in which pilot and mechanic sit together. The roof of their compartment is raised above that of the main cabin so that they have a clear view ahead. Beneath this compartment are the gasoline and oil tanks. The pilot and mechanic are located under the upper wing close to the two Liberty motors, which are set a short distance on either side of the hull in the gap between the wings. The propellers are set in front of the wings. From the pilot's compartment a door opens direct to the lower wing so that the mechanic can reach the motors while in flight. A dual control system is used to enable a pilot and pilot-mechanician to alternate in handling the "ship" in long flights.

Behind the pilots, and also behind the great wings, is another commodious cabin in the hull. This is not quite so large as the main cabin, for it is designed to seat four passengers. Large windows enable the voyagers to watch the earth or clouds passing by. The great plane deserves the description of air yacht or cruiser not only on account of its size and beauty, but because of the distance which its large gasoline-carrying capacity enables it to cover in a single flight. The boat has a high speed of 85 miles an hour and a low or landing speed of 50 miles. Fuel and oil supply for four hours may be carried in addition to the full load of twelve persons each of an estimated weight of 180 pounds and 620 pounds of mail, freight or baggage.

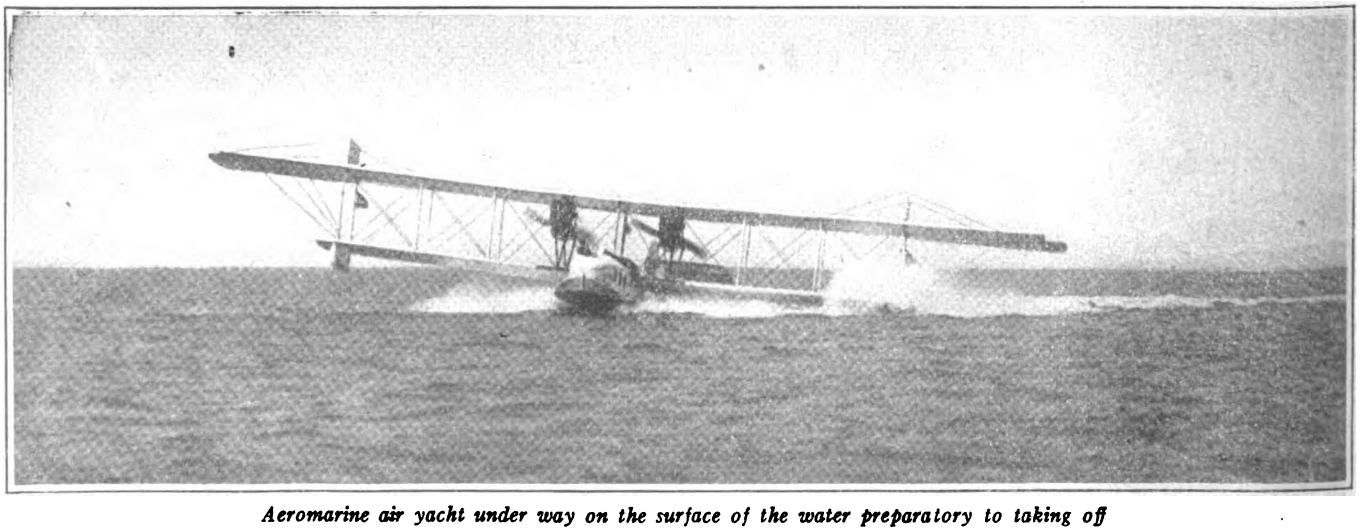
The air yacht has an upper wing spread of 104 feet and a lower wing of 75 feet, giving her a total of 1,397 square feet of supporting surface, not including that of elevators and stabilizer. Her height is 18 feet 9 inches and length 50 feet. Two Liberty twelve-cylinder motors totalling 660 horse power drive her through the air. Her gasoline-carrying capacity is 230 gallons and her oil capacity twenty gallons. Fully loaded she weighs 12,823 pounds. Without passengers, fuel, etc., she weighs 8,456 pounds.



View of Aeromarine air yacht hull, showing cabin and location of power plants

SEWING MACHINE OILS

THE best oil for lubricating sewing machines and other delicate mechanism is composed of 3 ounces rectified benzoline, 1 ounce foreign oil of lavender and 9 ounces pale oil of almonds, which are well mixed together and filtered. A good mixture is 3 ounces petroleum, 9 ounces pale nut oil, 40 to 50 drops essential oil of almonds, all of which are mixed together and filtered. A very good light oil is made of 2 parts sperm oil and 1 part petroleum. Another method is to take a light oil, mix it with eight times its weight of absolute alcohol and put it in a retort. This mixture is boiled for ten minutes, poured off and allowed to cool. It is then evaporated until it is reduced to 1/5 of its original volume, at which time it is ready for use. It should be kept in well-stoppered bottles and is suitable for the finest work.



Aeromarine air yacht under way on the surface of the water preparatory to taking off

Digitized by Google

Simple Kite Photography

By L. B. Robbins

MUCH interest has been aroused regarding aerial photography since the war. Remarkable pictures were taken from airplanes and observation balloons, but as the general public does not own either one of these things, we can confine our efforts to photographing from kites. All the essentials of aerial photography can be enjoyed with a common kodak, either the folding or the box kind, and a good kite capable of lifting four or five pounds will be sufficient to carry all the apparatus you will require.

As the modern kite is capable of lifting about 3/10 of a pound to each square foot of surface, a kite of 20 sq. ft. area will do the trick. Use a tailless or box kite if possible, otherwise be sure the one you do use is as steady as it is possible to make it.

The whole trick in kite photography is to raise the camera to the desired height and then release the shutter of the camera at a time when all possible scenery is within range of the lens. The higher the camera is raised above the ground the shorter the exposure it will be necessary to give the film or plate. Also, with a short exposure, there will be less liability to blur the picture by sudden whirling of the camera or lurching of the kite.

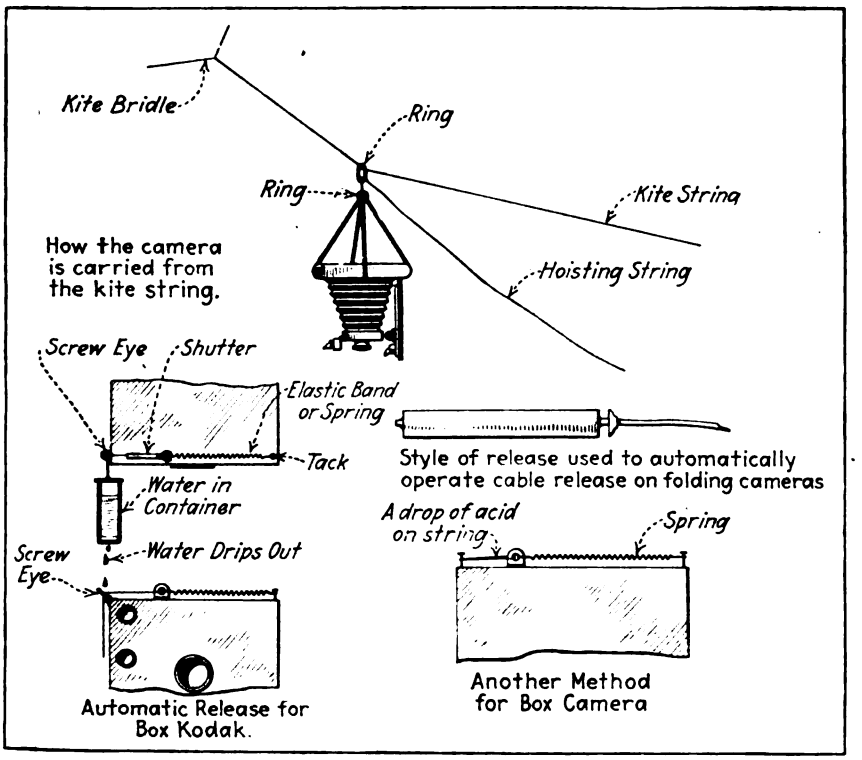
Choose a bright day and a time when the sun rides high so it will not shine in the lens. This will also make your pictures sharper with the short exposure it is necessary to give them. The sketch shows a good way to suspend the camera. Lash a smooth ring to the kite string just in front of the bridle. Then make a harness of heavy cord so the camera will hang lens down and tie the top of the harness to a second ring. This ring is then attached to a light but stout line which passes through the ring on the kite string. After the kite is flying the desired height, pull gently on the free end of the camera string and raise the camera to the ring on the kite string. Then lash the camera string to the place where the kite string is fastened or held.

The methods of releasing or snapping the shutter are many, but the most simple for our use are illustrated in the sketch. There is an attachment on the market which will operate the shutter of a folding kodak having what is termed a "cable release". This is set to work from 10 seconds to more than a minute. By using this you can set it for the greatest length of time possible and then hoist the camera to the kite in ample time for the shutter to open and make the picture. By a little ingenuity, this can be adapted to operate the shutter on a box camera.

Two other methods for working the box camera shutter are also shown. One is to tie the shutter over with a piece of cotton string to a tack in that corner of the camera. A second tack is then driven in the opposite corner and an elastic band or light spiral spring run from the shutter to it. When the camera is ready to raise to the kite the string is touched with a drop or two of strong acid. Then in the course of a few moments, the acid will eat through and rot the string so that the pull from the spring will break it and pull the shutter lever over and make the exposure.

The other method is one that will enable one to estimate the duration of time a little closer. Arrange a spring the same as just explained. Then lead a string in the opposite direction, through an eye and hang a vial or other container which will hold an ounce or two of water. Drill a small hole in the bottom. When filled this should hold the shutter closed against the tension of the spring. A certain quantity of water will drip away in a certain length of time so when the balance between the weight of the water and the spring tension has been reversed, the shutter will be snapped. Other methods may be suggested to the experimenter which can be adapted to his own case.

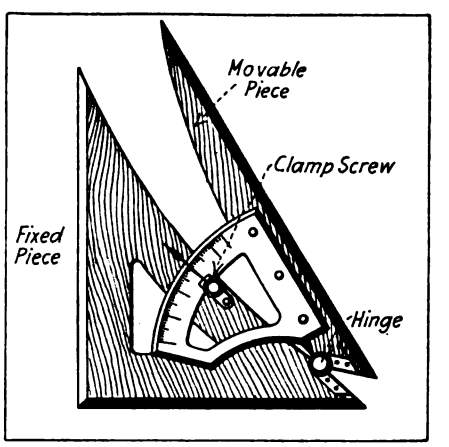
Of course, the camera will have to be lowered after each exposure and a fresh film turned in place. Films are preferred to plates because of their not being liable to breakage if the camera receives a shock in flight or in lowering to the ground.



How camera may be operated for simple kite photography experiments

NEW TRIANGLE

THE triangle illustrated will certainly be appreciated by draftsmen and others who have occasion to use tools of this nature, because it combines in one simple piece of apparatus the usual form of triangle and also a protractor. The protractor scale is riveted to the movable piece of the triangle, which is hinged to the lower end of the fixed piece. A clamp device is attached to the fixed piece so that the scale may be locked in any desired position. Any desired angle from zero to 90 degrees may be obtained by this tool, which means one device will do the work of several fixed side triangles and a protractor.



New English triangle and protractor combination

Digitized by Google

Commutation and What it Means to the Electric Motor

By N. M. Ferris

THE successful operation of any direct current dynamo depends very extensively upon good commutation. The commutator and brushes on a dynamo are its most troublesome parts, so if a motor could be designed to operate without these features a big improvement would be made in the design of dynamo-electric machinery. When motors do not commutate properly there is sparking between the commutator and brushes. Continued sparking is destructive to the commutator and brushes in that it burns them badly and causes them to wear unevenly which, in turn, makes the matter worse as this condition continues.

To simplify the explanation of the operation of a commutator it might be said that its function is the same as that of a switch; to make and break a circuit. Now, when the brush leaves contact with one segment and passes to the next, the brush endeavors to draw the current to segment 2, but the current which had been passing through segment 1 to the brush refuses to be interrupted so suddenly. This is due to the inertia of the current. As a result when the brush has left the first segment, the current continues to flow, but not through a metallic or carbon medium but through air in the form of a spark (just as it does when you open a knife switch).

At some moment the brush short-circuits a coil and it is at this time that the current in the coil is reversed and this should be done without sparking if the machine is to run efficiently and for a long term of years. The success of this operation depends upon whether the current in the short-circuited coil has been reversed or not before the brush leaves the first segment of the coil. If the current has changed its direction of flow all well and good, but if not, sparking will result.

Due to the fact that the short-circuited coil is carrying a current, a magnetic field is set up which tends to prevent the reversal of the current by generating a counter electromotive force. This reverse voltage is caused by the changing field surrounding the coil under commutation. The field is made to vary in magneto motive force by the reducing of the current flowing through the coil which takes place as the commutator moves from the position in which the coil carries the greatest current, as shown in Fig. 1, to that in which it carries much less current, shown in Fig. 2, because, as can be seen by the arrows, the current divides at M, part going through the coil and the remainder through the segment 2 to the brush. The self-induction resists the quick change of direction of the current in the short-circuited coil as, we might say, momentum resists the quick stopping of the motion of a heavy body such as a heavy ocean liner.

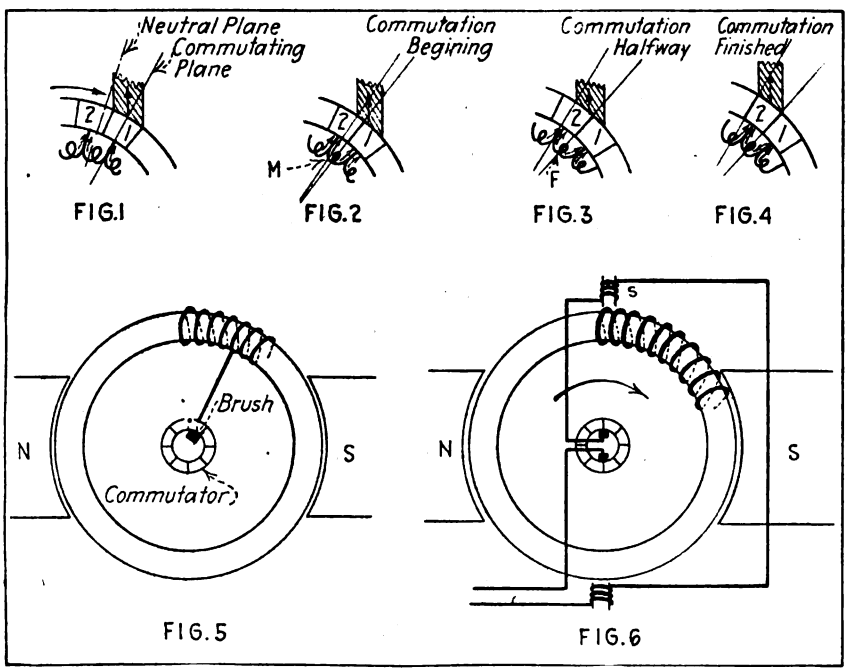
As an analogy we can say that the different directions of revolution of the propeller represent the field poles; the motion of the ship can be compared with the direction of current flow in the coil. Now if we rotate the propeller in a clockwise direction the ship will move forward, but when we suddenly stop the propeller from rotating in this direction and cause it to revolve in a counter-clockwise direction, it will take some time for the ship to stop and change its direction of motion. Thus, even if the coil is cutting lines of force of a different polarity it will take some time for the current to change its direction of flow.

Referring to Fig. 3, we see that coil F has passed the neutral plane and is beginning to cut more lines of force which tends to set up a flow of current in such a direction as to come out at the segment 2, but the self-induction of the coil prevents this from taking place, consequently the current in the coil is at zero. A current then commences to flow in the opposite direction to which it did before, but just as the brush is about to leave segment 1, the current is but small compared with that flowing in the other coils, so it will divide at S, part going through the coils (as indicated by the arrows in Fig. 4) and the remainder through the lead to segment 1.

It can readily be seen that if the brush is to break connection with segment 1 under these conditions, that the coil F will be thrown into series with the other coils on the right of the armature. At once the current will rise from almost nothing to a maximum, which cannot take place as quickly as the machine requires and as a result some of the current jumps across the air gap between segment 1 and the brush, causing the spark. The greater the speed at which the coil undergoes commutation, the greater the effect of induction.

In a machine of slow speed and low voltage the commonest way to remedy this trouble is by means of the "reristance method", as it is called. To obtain sparkless commutation by this method the current in the coil is caused to reverse by the variation of the contact resistance between the brushes and the commutator. Carbon brushes are always used in this method because their resistance is very great compared with that of the individual coil.

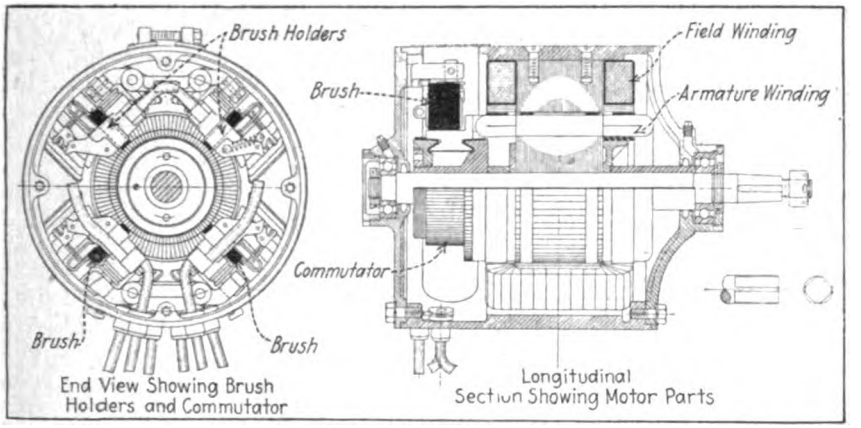
The second method is by generating a counter electromotive force in the



Diagrams explaining commutation and showing its influence on motor action

Digitized by Google

short-circuited coil which will assist in reversing the current in that coil. This opposing voltage must be as great as that which is generated by self-induction. This method is well adapted to high speed machines carrying considerable current. There are two ways of producing a counter electromotive in the coil under commutation. Until recently the only method of generating an opposing voltage in the short-circuited coil of a machine was to shift the brushes slightly in the opposite direction to that of rotation. In a generator the brushes are shifted forward or in the same direction of rotation.



Sectional views of typical vehicle motor showing commutator and brushes

This is done so that the coil under short circuit will be cutting the lines of force of the trailing pole as shown in Fig. 5. In this way a voltage is generated opposing that which has been forcing current through the coil, which in turn aids in reversing the current.

The angle through which the brushes are shifted depends upon the load of the machine and is found by trial. The greater the load, the greater the shifting angle. The brushes must not be shifted too far because this also will cause sparking owing to the fact that the opposing voltage will have to drop to normal value before the brush leaves the segment, which is impossible.

In a machine which is subject to quick and great changes of load, it is impossible to place the brushes in such a position as to obtain sparkless commutation, at all times. When confronted with this obstacle the brushes are placed in the mean load commutating plane. That is to say, they are so placed that no sparking takes place when the machine is running at the average load. If the load is greater or lesser than average, sparking will result. The brightness of the spark and its destructive ability will be greatest when operating at the farthest from average load in either direction, i.e., above or below average

During the past few years a much better means of generating a counter electromotive force in the short-circuited coil has been developed. It is known as the "interpole" or "commutating pole" method. Principally, it consists of a very narrow magnetic pole placed between each of the main field poles. The interpoles are wound with heavy copper wire and are in series with each other and with the armature as illustrated in Fig. 6. If the load increases, causing a greater current to flow into the armature it must also pass through the interpoles, thereby increasing their strength which would, in turn, tend to generate a greater voltage in the short-circuited coil to counteract the excessive flow of current in this coil, which would result in sparking. These poles work automatically, always neutralizing the effect of self-induction. The number of ampere turns in these interpoles are determined by the manufacturer according to the H.P. of the machine and thereafter adjustment is unnecessary. A greater range of speed and load can be had with this type than with a machine without interpoles.

HOW TO GET MORE MILEAGE

(*Continued from page* 425)

resistance that the engine power must overcome. The rear axle, differential housing and change speed gearing should be filled with a medium weight, special transmission lubrication and not a heavy fibrous grease because a heavy grease at these points will cause a certain amount of friction and contribute its small quota to the total power loss.

Improperly inflated tires will make for greater power consumption. A motorist can easily tell this by noting the amount of effort it takes to move a car by moving it with even one tire partly deflated and how easily a car moves when all the tires are blown up to the proper point. If a car is driven in a district where there are some hills, it is always well to stop the motor while the car is going down the hill and allow the car to coast down by relieving the clutch. Some motorists have a mistaken idea that they are saving gasoline if they keep their clutch in and cut out the ignition. Positively, this is not making one iota of saving because the pistons are drawing in a charge of gas through the carburetor all the while that the engine is turning over, even though this gas is not exploded. This practice is a valuable one in cooling an over-heated engine, but is not of any value in saving gasoline. In order to determine if brakes are adjusted properly, or if there is undue friction in the axles or power transmission parts, the car should be tested from time to time by having it coast down a slight grade and seeing how far it will run without power.

Even such a trivial thing as driving with the top down and wind-shield open will have material influence on the fuel consumption, especially on a long trip or if the car is running against the wind. By proper attention to the details enumerated, it is often possible to make a material saving in fuel consumption.

LITMUS TEST PAPERS

LITMUS test papers are widely used in the chemical industry for indicating acid or alkaline reactions. Litmus paper may be prepared by rubbing good litmus with a little hot water in a mortar, pouring the mixture into an evaporating basin; add water until the proportion is half pint water to 1 ounce litmus; cover up so as to keep warm for an hour, then filter the liquor and pour fresh hot water on the residue. This is boiled, covered as before, and allowed to stand. The operation is repeated a second time and if much color comes, a third time. The first solution is kept separate from the second and the third, which may be mixed together. The first one will not require evaporation, but the others may be so far reduced in quantity that when a piece of blotting or filtering paper is dipped into them and dried they will impart a blue color of sufficient intensity for use. Blotting paper or any unsized paper of good color and moderate thickness may be used. The paper is cut into convenient size and dipped into the solution. The paper used should be free from earthy matter or carbonate of lime. Pour the litmus solution in a plate and draw the slips of paper through it so the liquid will coat both sides, allow excess liquid to drip and hang across lines to dry. The tint should be a distinct blue. When the paper is dry it should be tied up in bundles and preserved from both air and light. A glass stoppered bottle is best suited for the purpose of holding test papers, and if a piece of black paper is pasted around the outside of the bottle the light will be excluded.

Digitized by Google

How to Make a Horizontal Sundial

By James W. Bulman

ALTHOUGH sundials are not used for indicating the time, they are of great interest to those who are scientifically bent, and in this short article the writer gives some simple instructions for making a circular horizontal dial.

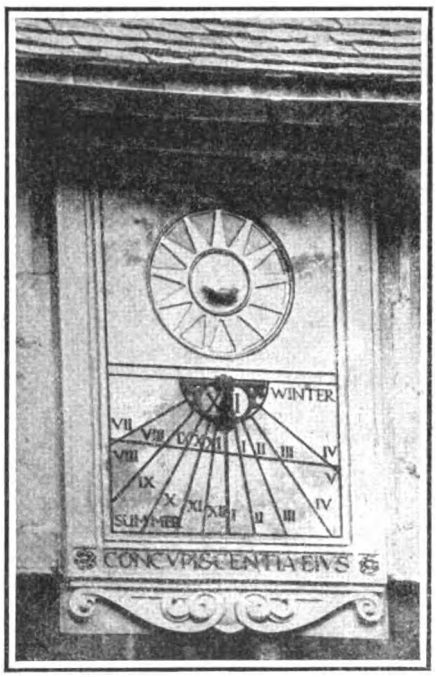
First of all procure a piece of soft white wood about ½-inch thick, and about 10 inches square. Draw on this a circle 9 inches diameter with a pencil compass, and cut round along this line with a fretsaw, the resulting circular piece of wood being shown at A in Fig. 1. Now scribe a circle 7 inches diameter with an old pair of dividers, on this, as shown in Fig. 3. Cut out a slot 3½ inches long and ⅛ inch wide with a fretsaw, which is to take the gnomon or style Fig. 2.

This gnomon, or style, should next be fitted to the circular wooden base by inserting the bottom into the slot B and gluing well into place as shown in Fig. 4. Care must be taken to ensure that the style is fixed exactly at right angles to the dial board. This can be done by testing it with a setsquare, first one side and then the other.

Now the dial is practically finished, excepting the markings to record the time.

The two lines representing noon can be scribed with a sharp penknife, as shown in Figs. 3 and 4 on the north side of style, i.e., the direction to which the style is pointing. The reason for these two lines ⅛ in. apart, is to allow for the thickness of the style. The lines for 6 a.m. and 6 p.m. can be scribed as shown. The intervening hours had better be found by trial, although if those shown in Fig. 3 be transferred they will be approximately correct.

The best way to do this is to place the dial perfectly level with the aid of a spirit level, on a suitable support in the garden where the sun shines all day, so that the noon marking is pointing to the north. Select a sunny day and with the aid of a good watch showing meantime, (i.e., one hour slower than summer time) and adding or subtracting so many minutes to allow for the equation of time, endeavor to mark the half-hours, and hours. Supposing you wish to calibrate this sundial on August 1, you would have to add 6 minutes to the time shown on the watch.



A vertical sundial of English design that indicates both summer and winter time

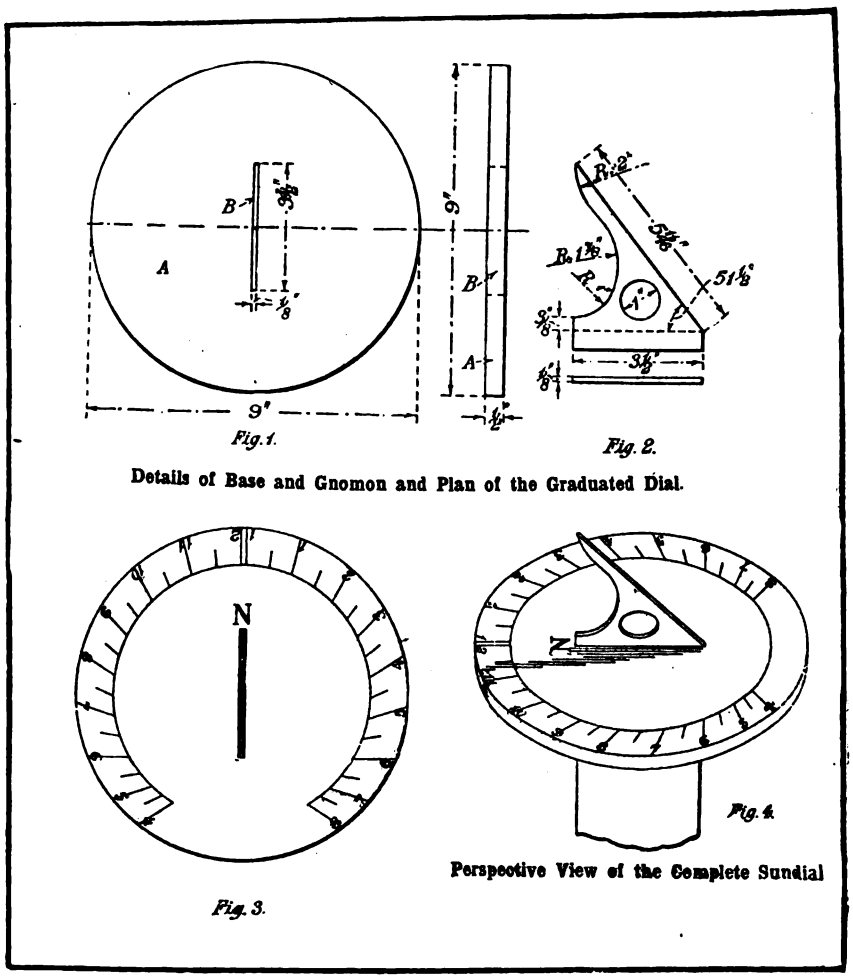
The dial being temporarily fixed as before stated, a mark should be made every half-hour with a fine pointed pencil, and when all the hours and half hours between 4 a.m. and 8 p.m. are obtained they can be scribed on with a penknife and the figures put on as shown in Figs. 3 and 4.

The sundial is now complete and should be given a thin coat of any good transparaent varnish and left to dry for at least two days. When dry it can be permanently fixed on the top of a stout wood pole or fancy pillar in a sunny position, care being taken to get it exactly level and pointing to the north. Fig. 4 shows the finished dial on a wooden pole.

The following table gives the approximate equation of time for the first of every month throughout the year:—

	Min.
Jan. 1st	+ 3
Feb. 1st	+ 13½
March 1st	+ 12½
April 1st	+ 4
May 1st	— 3
June 1st	— 2½
July 1st	+ 3½
August 1st	+ 6
Sept. 1st	— 0
Oct. 1st	— 10
Nov. 1st	— 16
Dec. 1st	— 10

The plus sign indicates that the equation of time is to be added to the meantime and the minus sign that it is to be subtracted. Times for intervening dates can be found in any nautical almanac.—*Junior Mechanics and Electricity, London.*



It is interesting to note that American Sperry gyroscopic compasses are to be installed in two steamships being built in Great Britain.

Digitized by Google

The Utilitor Garden Tractor

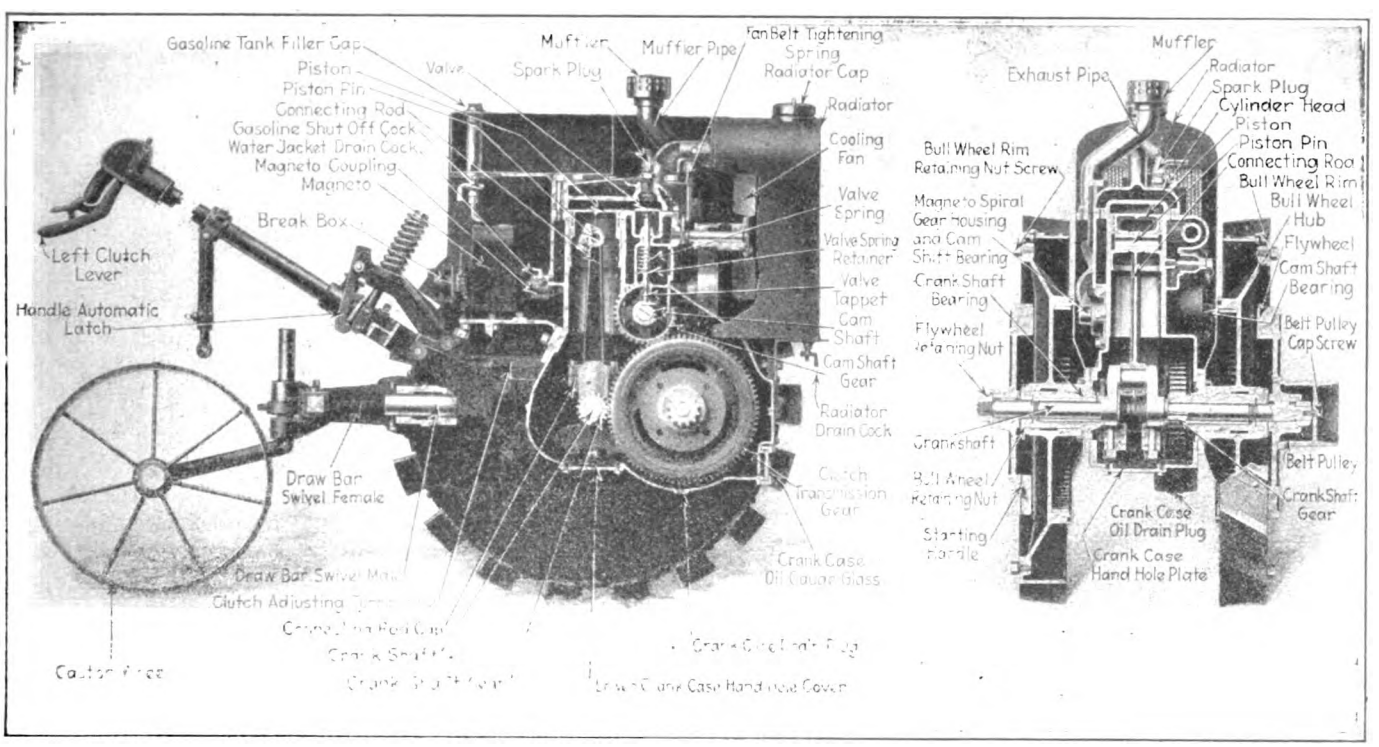
THERE is considerable interest at the present time on the part of gardeners and owners of small estates in small-sized tractors that may be used for work where one of the ordinary, medium-duty tractors could not be employed profitably. The utilitor machine, which is shown in accompanying illustration, is a good example of this type of light machine. It is controlled by an operator walking behind it or riding a light cultivator through the medium of control levers mounted on grips that in turn are carried on extended handle-bars that resemble those used on various types of agricultural implements that must be guided by an operator. The machine is exceptionally compact in construction and of light weight. The sectional view at Fig. 1, which is a longitudinal part section, and that at Fig. 2, which is a cross section taken from the end, shows the arrangements of the various parts of the mechanism very clearly. The engine is a single-cylinder, four-cycle type having a detachable cylinder head.

The bore is 3½ inches, the stroke 4½ inches and the normal speed 1,200 revolutions per minute. It is rated as delivering from 2 to 4 horsepower at the belt and 1½ to 2 on the drawbar. It is fitted with a Kingston Model Y carburetor, and is intended to be operated on gasoline fuel. Ignition is by Eisemann high-tension magneto. Another feature is the use of detachable rims. These rims are fitted with different kinds of lugs, according to the work to be done, and when it is desired to change the lug equipment, the complete rim is changed by means of a few bolts rather than by the tedious process of bolting and unbolting each lug individually.

There are standard types of rims, for cultivating, plowing and lawn-mowing, respectively. Other departures from garden-tractor construction are found in the use of heavier fly-wheels and the use of more weight and strength generally. It is claimed, also, that the hitching of implements to the utilitor has been simplified to a marked degree. The transmission is fitted with Fafnir bearings, while the axle bearings are of the company's own make. Final drive is by internal gear, the gear ratio between the motor and the wheels being 35 to 1. The drive wheels are 23¾ inches high and are so spaced that the overall width is 17½ inches. A belt pulley 4⅝ inches in diameter is furnished. The weight of the utilitor is 700 pounds.

The fuel tank is carried above the engine, while the usual form of water-cooling radiator is carried at the front end of the tractor. A gear on the engine crankshaft drives a spur gear, which transmits power to the clutch casing. This spur gear forms an intermediate reduction of speed, the final reduction being obtained between the pinions on the ends of the clutch cross shaft and the large internal gears that are attached to and drive the traction wheels. The clutch is controlled by handles at the right and left of the machine, there being two clutching effects provided, so that either wheel may be driven independently of the other, or both driven together. This handle clutch control is obviously necessary to make for easy steering of the tractor, as it renders the machine straight steering and does not require the operator to exert any strength in attempting to swing it around by the leverage obtained by the long handle-bars.

The tractor will run in a straight line when both clutches are engaged and will turn in one direction or the other depending upon which clutch is engaged. Ignition is by high-tension magneto, and the engine is easily started with a starting handle that forms part of one of the engine fly-wheels. Engine cooling is by the thermo-sylphon system, and there are very liberal water spaces provided around the cylinder and cylinder head. While this machine is light in weight, it has been proportioned with due regard to continuous duty, and it is stated that it will have a drawbar pull equivalent to one horse. A belt pulley is attached to the crankshaft end and will enable the machine to be used for stationary power purposes within its capacity. Obviously, it could be coupled up to any other form of machine that did not require more than 4 or 5 horsepower in the same manner.



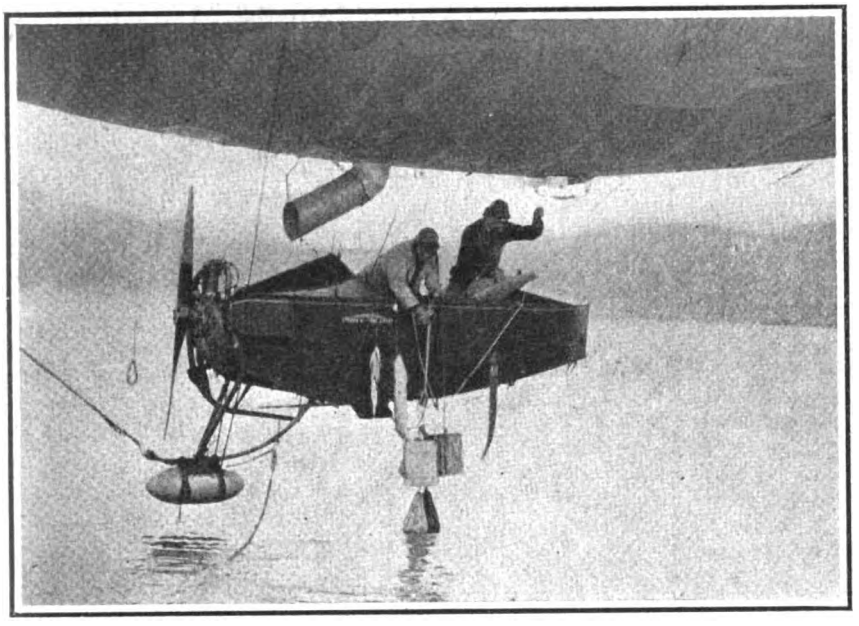
Sectional views showing arrangement of parts of typical small garden tractor driven by a one-cylinder engine. Fig. 1. Longitudinal part section. Fig. 2. Sectional end elevation

Digitized by Google

AVIATION BRIEFS

FISHING FROM A BLIMP

ONE of the features of the dirigible balloon is that it is possible to balance the load carried by the gas bag so accurately that the balloon may be readily moved to any desired level. As is well known to balloonists, the lifting power of the gas contained in the bag may be balanced so accurately by using ballast that may be easily disposed of, such as water or sand, that a balloon may be made to rise by disposing of such a small quantity as a few ounces of the ballast.



Expert aeronauts fishing from nacelle of Blimp type dirigible

The expert aeronauts in charge of the blimp depicted in the accompanying illustration finally succeeded in making an accurate enough balance so that the bag remained suspended just far enough above the surface of the water so the car carrying the aviators was near enough to the surface to permit of casting out the lines and making a reasonably good catch of fish, if one is to believe the evidence presented by the photograph. Those of our readers who are not interested in fish stories will surely appreciate the intimate view afforded of the three-cylinder, air-cooled power plant and general arrangement of the car and its relation to the gas bag.

For drilling holes in glass hardened steel drills can be employed which are supplied with a solution of camphor in turpentine. It is recommended to work the drills back and forth; this, of course, would apply only to flat drills.

A FRENCH AVIETTE

AT various times we have published short items detailing experiments that are being carried on in France with small airplanes intended to be propelled by man power. Inasmuch as a prize of some value has been offered by one of the Paris newspapers for flights with machines of this kind, there is considerable activity on the part of French experimenters in devising these light aircraft. One of these, which is shown in the accompanying illustration, is stated to have made short hops of a few yards several feet above the ground.



Typical French aviette or flying bicycle

As will be apparent, an ordinary safety bicycle forms the basis of the device, and to this a light monoplane wing structure has been fastened. A belt pulley is secured to the rear wheel and from this a round leather belt runs over pulleys to the two four-blade tractor screws mounted on a light framework at the front end of the bicycle. When pedaled briskly enough, in addition to the degree of movement produced by the tractive effect of the bicycle wheel on the ground, there is an added thrust obtained from the rotating air screws. The advantage claimed for this dual driving system is that it is easy to secure sufficient speed to lift the machine from the ground. Reports indicate that machines of this nature have made short flights under favorable conditions of a few yards.

Anyone who is familiar with the principles of aerodynamics will not believe that the limited amount of power produced by a man will be enough to keep a machine off the ground a sufficient length of time so that practical flights can be made by this means. As a continual power-producing proposition, the average man is able to exert one-eighth of a horsepower. For short periods a human being may exert two or three times this amount.

Even the maximum amount that a man can exert, and it makes no difference what kind of mechanical gearing is employed, will not be sufficient to propel an airplane of even the lightest form through the air for any distance. A machine of the type illustrated must always remain a scientific plaything, rather than becoming a device having any real value.

RECORD PARACHUTE JUMP

SERGEANT BOTTRIELL of Mc-Cook Field recently made a record parachute descent from an aeroplane at 19,500 feet. The aeroplane, piloted

Digitized by Google

by Sergeant Madan, climbed to an altitude marked by the indicator as 19,500 feet. Bottriell climbed out on the fuselage to make his jump. The wind caught his parachute and pulled him through the tail of the machine, tearing the rudder. He bruised the muscles of his arm and strained the ligaments.

Bottriell landed safely near Germantown, ten miles west of there, with his parachute ripped where it had been in contact with the tail wires of the plane.

COMPLETELY ENCLOSED AIRPLANE FUSELAGE FOR HIGH ALTITUDE FLIGHTS

IN an interesting article in our French contemporary, *Le Génie Civil,* an eminent French scientist, describes a type of airplane having completely enclosed power plants and passenger compartment as shown in accompanying illustration. The air plane is a modified Bréguet passenger-carrying type provided with a completely enclosed fuselage, within which the passengers, the crew and the engines are accommodated, and within which the air pressure at all altitudes is maintained at that of the ground level value by means of a pump. With this arrangement it is claimed that not only are the occupants of the machine practically unaffected by the rarefaction of the air at very high altitudes, but the engines are likewise supplied with their full quantity of oxygen at all heights, while as an additional advantage the compression and decompression reaction on the passengers and crew resulting from a rapid descent or ascent are avoided. The fuselage, it will be seen, is, so far as the conditions prevailing in its interior are concerned, quite comparable with the body of a submarine, except that whereas the latter may have to withstand an external pressure of three or four atmospheres the fuselage skin has to withstand an internal pressure of not more than half an atmosphere.

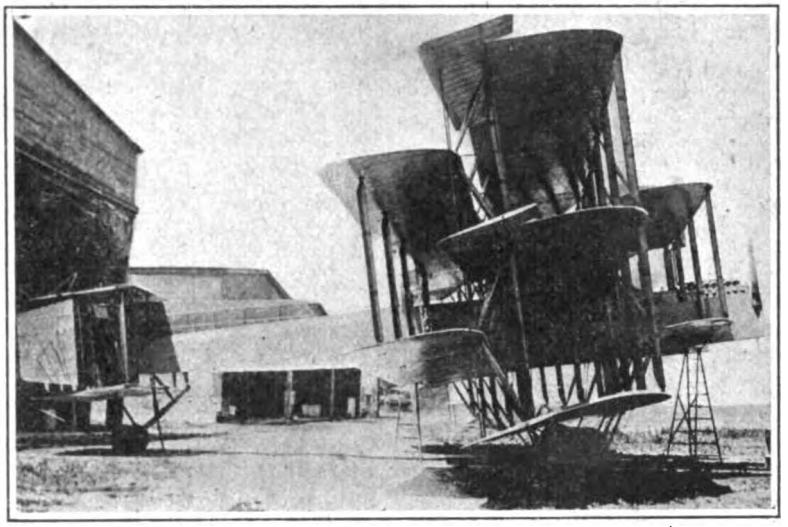
The Bréguet high-altitude biplane fuselage is equipped with four Bréguet-Bugatti motors B on the system exhibited at the Paris Aeronautical Salon last December. The total horsepower developed is 950. All four motors drive the one screw A, and should one or other of them develop a defect it is automatically cut out by a clutch C. The radiator is shown at D, the oil tanks at E, and the fuel tank at F. A turbo-compressor G, presumably of the Rateau type, driven by the exhaust gases of the engines, draws in air from the outside and supplies it both to the engines and the compartment in which the pilot and passengers are placed. The usual expedient of supplying oxygen, if breathing becomes difficult, can be utilized just as required if the supercharger could not supply air enough for the four engines and the passengers.

The physiological effects of ascents to high altitudes are now fairly well understood, and in their aeronautical bearing have been made the subjects of considerable research by the medical officers attached to the air services of this and other countries.

EXPFRIMENTAL MULTIPLANE

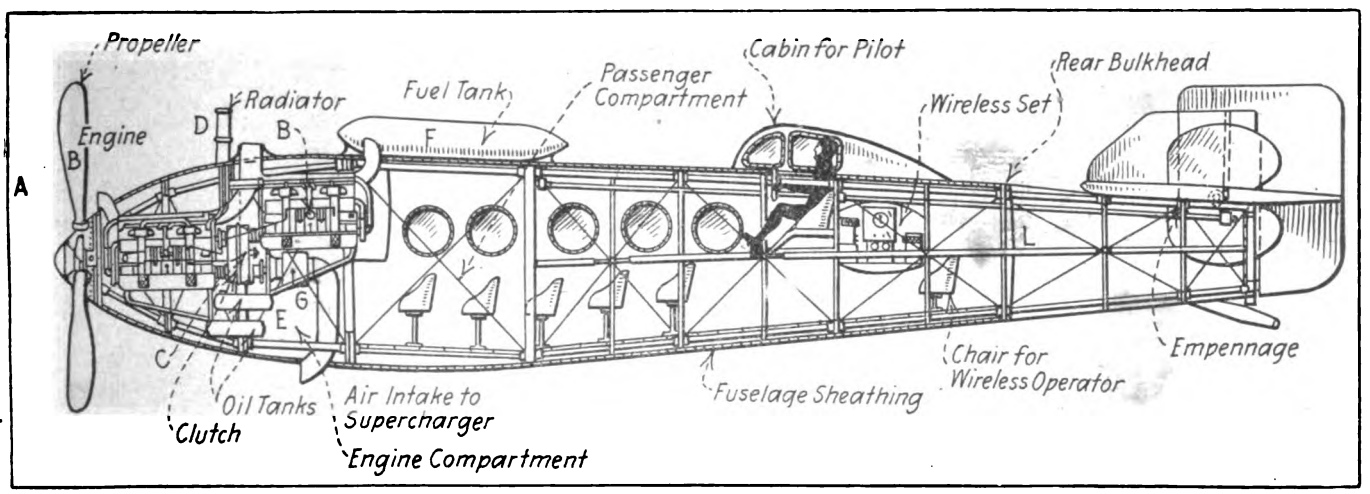
FOR some time past some aeronautical designers have favored airplanes having more than three sets of wings, and various wing arrangements have been tried to get more lifting surface than it is possible to obtain with the usual biplane or triplane arrangement and without having too great a wing spread.

The latest multiplane machine to be constructed full size is now being exhibited at Langley Field, Va., preparatory to a series of flying tests. It is a unique affair, as will be seen from accompanying illustration. The main part of the machine consists of a triplane arrangement, but right behind this and arranged midway between the triplane wings is a biplane arrangement. Evidently the designer of this machine has endeavored to get more wing surface with a minimum of interference. Whether he has succeeded or not remains to be proved. The fact is that this machine has plenty of power —two engines for propellers and one engine for a tractor screw, so there is no question of its ability to fly, even though its efficiency may be in doubt.



Unusual multiplane design having three sets of lifting surfaces

To preserve the softness and flexibility of india rubber coats, overshoes, and the like, it is recommended to immerse them in water which has been boiled, so as to be free of dissolved air, and to keep the whole in a dark place without extremes of temperature.



Completely enclosed airplane fuselage for high altitude flights designed by Bréguet

Digitized by Google

MANUAL ARTS AND CRAFTS

PROJECTS FOR THE SCHOOL, HOME OR SHOP

ELECTRIC BOUDOIR LAMP

THIS lamp has been designed for the average novice to make. It is extremely simple in construction and requires very little knowledge of electricity, and that may be learned by inquiring of the party selling the electric fixture, how to connect the wires to the proper terminals within the socket fixture. The important consideration being to keep the wires well insulated and from coming into contact with one another.

The bracket A is best laid out by taking a sheet of paper, (drawing paper or light card board) 6¾ wide by 14" long folding it thru the center lengthwise to 3⅜ x 14, then draw one half the design on it. Now cut out the pattern folded and when opened it is sure to be symetrical with the center line well defined and true. Tack this pattern to, and trace its shape carefully on "A". It is essential that the bracket A and two brackets B are cut to the correct length, 14 inches, and should have one straight edge with both ends square at 90 degrees to the true edge.

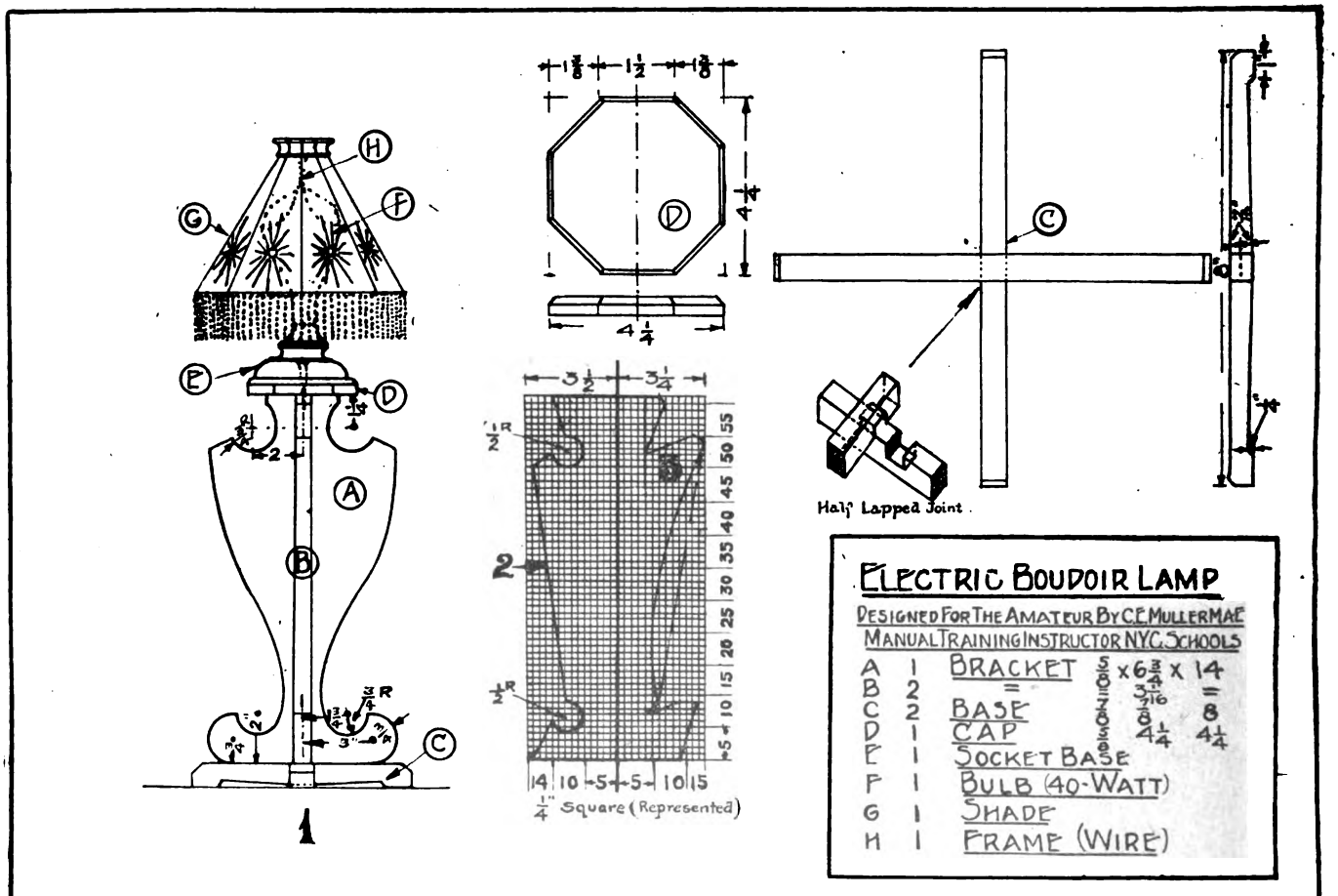
The pattern is slightly changed by laying off ½ the thickness of the material used, on each side of the center line (the crease made by folding). This allowance is made so that when the brackets B are nailed or glued on to A all four sides will be approximately the same from the centerline. Suggestions are offered for three different contours for the brackets. These will suggest others. It is very gratifying to design one's own. The principal dimensions are given in all cases. Contour No. 1 requires an expansive bit, set to 1½" dia., the holes bored as indicated, and using a fret or turning saw.

No. 2 requires a 1" bit. The centers may be located by counting the squares, each one represents ¼ of an inch. The rest of the contour may be made with a cross cut saw if a rip saw is not convenient. No. 3 is made with a saw only and may be hollowed as shown with a chisel (bevel side in) or a spoke shave. Coarse sandpaper or file will smooth the edges. The whole project should be sandpapered with No. 1 followed by No. 10 carefully dusted before staining or finishing.

A saw-kerf or groove is made in A along the center line to permit the two wires to be concealed before B is attached. Care must be taken if B is nailed to A not to pierce the wire insulation. It is therefore safer to glue B to A, or depend on nailing the base C and the cap D to the brackets A and B.

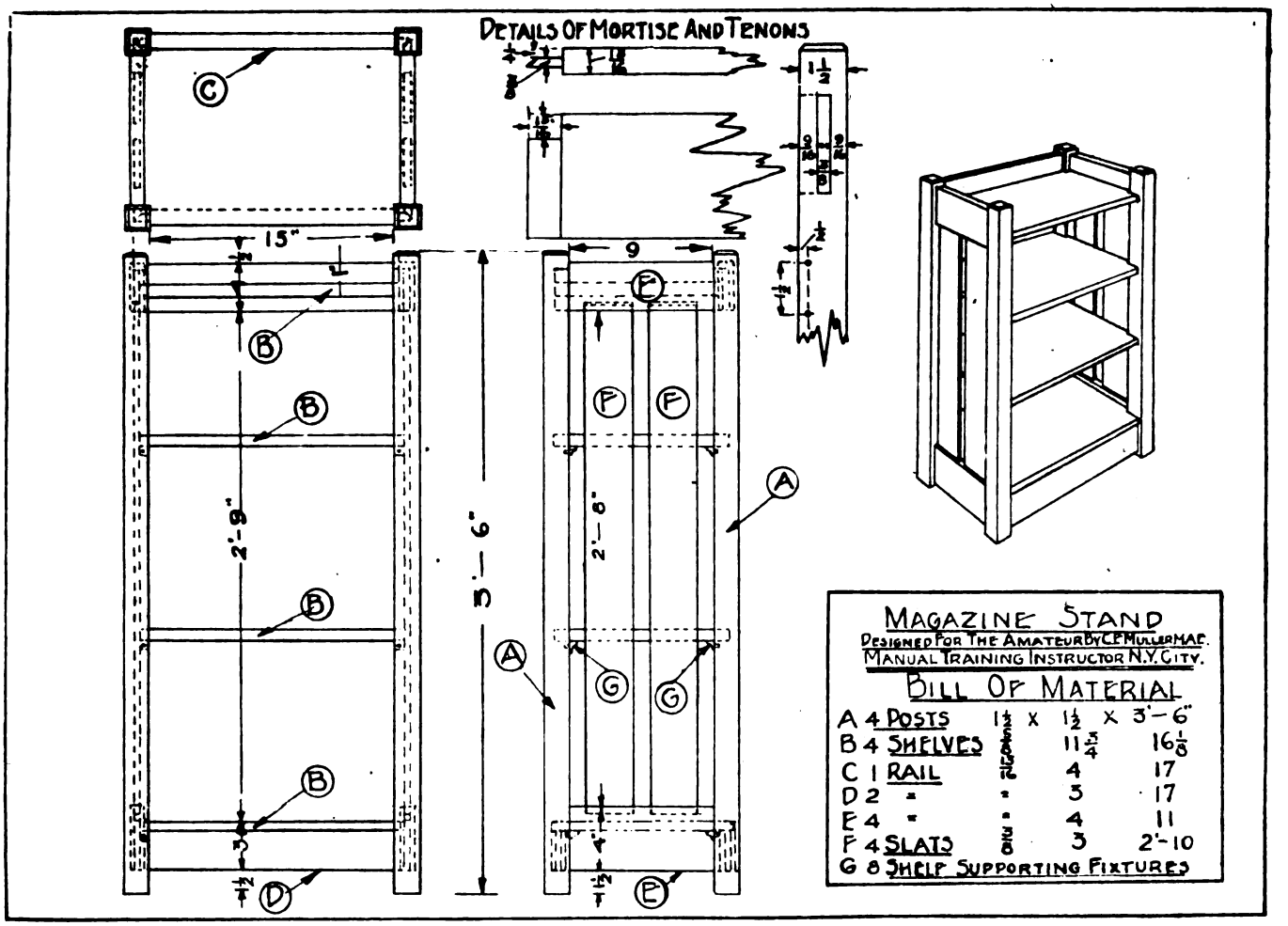
The base C is then laid out. Cut 2⅞ x ⅞ or thereabouts x 8" long, half lap them at the center making a cross, figure C, then shape them as shown. A sketch of the half lapped joint is shown. This is easily made by notching each piece C so that one part crosses the other at 90 degrees or at right angles.

Bisect the 8" lengths, lay out ½ the thickness of the stock on each side of the center. Place the piece that crosses over the lines thereby checking up the lines. If correct, gauge the depth of the cut out ½ the thickness of the stock. If this joint is made first it eliminates any possibility of making the common mistake of having one side upside down. Keeping them in position, lay out the recessed bottoms. This



		ELECTRIC BOUDOIR LAMP		
		DESIGNED FOR THE AMATEUR BY C.E. MULLER MAE		
		MANUAL TRAINING INSTRUCTOR N.Y.C. SCHOOLS		
A	1	BRACKET	⅝ x 6¾ x 14	
B	2	=	3/16	=
C	2	BASE	⅞	8
D	1	CAP	⅞	4¼ 4¼
E	1	SOCKET BASE		
F	1	BULB (40-WATT)		
G	1	SHADE		
H	1	FRAME (WIRE)		

Digitized by Google



is made by measuring 1" from each end, then sawing ¼" deep, tapering from O at the center to ¼" near the ends. The reason for this is that the surplus material may easily be chiselled out with a slicing cut. After the model is assembled, it is then advisable to pare a slight clearance at this point so that only the four outer pads or feet may rest on any surface such as a table top. A ¼" hole must be drilled at this place and thru the cap for the wire to lead thru.

The cap D and the base C are nailed to the brackets A and B with 8 1½" No. 18 wire brads carefully centered so that they will not protrude thru the sides. The socket base E is then located and fastened with two oval-headed 1" No. 12 wood screws. The wires are fastened each to their respective binding posts, properly tightened. It will be found convenient to always make the loop end turn in the same direction as the nut of the binding post tightens, as this tends to draw in the ends of the wire, especially when flexible cord wire (multi-strand wire) is used. The opposite end of this cord or wire must have a socket plug to fit into the wall or chandelier socket.

The bulb is inserted, of any candle power desired up to 100-watt. The shade frame may be a lateral ring at the top of the fringe with three or four braces of 3/32nd round wire clamped between the socket E and the cap D. The double loop arrangement as shown may be purchased for 15 cents or easily made of 1/16" brass wire.

The shade G may be made of silk, cretonne or crepe paper of an infinite number of designs. If fringed with beads it will surely commend itself to anyone. The stand may be stained to suit ones fancy, left a dull stain or waxed with a floor wax to a polish. A small can of colored varnish, such as Japalac, will give a fair finish with two coats. Allowing the first coat to dry thoroughly, then sandpaper carefully. Dust well before applying the second coat. Keep the project in a dry place free from dust when varnishing it.

See the second article for other methods of finishing.

MAGAZINE OR DICTIONARY STAND

THIS project was designed for the advanced worker and handy boy. It looks particularly well in chestnut, whitewood, redwood, cypress, oak or ash. It may be used for a magazine stand, book rack or dictionary rest. The construction is of the conventional type using mortised and tenoned posts and rails with the three lower shelves adjustable. An extra shelf may be added if desired. The shelves in the latter case may be spaced 4" for the upper one to lay the magazines or current newspapers flat, the next 6¼" for small text books, another 8¼" for an ordinary text book and the last 12½" for books the size of the standard dictionaries.

The rail tenons are shown in the detail. They will be mitered at 45 degrees as indicated when they come in contact with each other. Three-eights of an inch dowels may be used instead of the mortise and tenon joint. Many cabinet makers use this method especially where single pieces of furniture are made mostly of handwork.

When gauging the mortises care should be taken not to scratch beyond the shoulders, so that no gauge marks will show after assembling the parts. Bore a series of holes with an augur bit that just fits the width of the mortise. A Stanley bit jig is surely worth the price, and will positively insure excellent results. It may be also used to employ the dowel method of construction. Many cabinet makers and practical carpenters use the dowel method, using two or three ⅜-in. dowels 2 ins. long instead of the tenons. The centers of the dowels may be located by driving in small brads, cutting off the heads with nippers, then pressing the adjoining surfaces accurately against these brad joints. Using the intersection of the lines produced by the gauges and a squared penciled line is the common method. The slats are usually

Digitized by Google

housed into the back rails their full thickness width about ½" deep.

The mortises are shown ⅜" wide but may be increased 1/16" to ⅛" to accommodate a ½" bit. It is advisable to gauge these mortises on two adjacent corners of each post, taking care not to gauge beyond where the rail cover, as the scratch marks are disfiguring in the finished product and are always more prominent when stained and varnished. A series of holes bored carefully within the gauge lines will facilitate the removal of the desired material.

The slats are usually housed into the rails for ½" to 1" deep. A housed joint differs from a tenoned joint in the fact that it has no shoulders. In other words, it is mortised into its component its full thickness and usually its full width. The reader will observe that the rail is omitted in the front at the top. Also that the lower rails at the front and back butt up to the lower shelf.

The upper and lower shelf corners are cut out to fit the posts and will butt the rails, thus will be approximately 15¾" long. The other shelves are also cut out at the corners to fit the posts so that they will butt up to the side slats. All shelves should be uniformly back ⅛" from the front edge of the posts, front and rear. Sandpaper carefully with the grain, removing all surplus glue at the joints.

The June edition of this magazine gives a number of suggestions for making different, very inexpensive stains with turpentine, kerosene, gasoline, water and vinegar. Diamond dyes mixed with alcohol or shellac will also produce stains that will prove satisfactory on chestnut, whitewood and basswood.

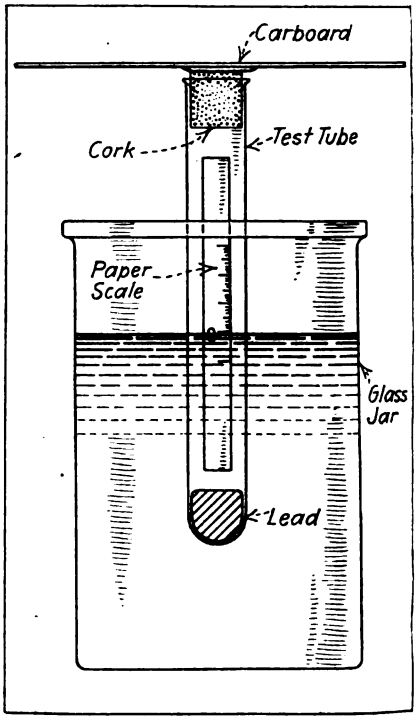
The following method of finishing is one of the very best to be recommended: Stain the project with a bicromate of potash diluted with water followed by an application of Wheeler's No. 7 filler for mahogany. This will develop a wonderful mahogany red especially on whitewood. Let this dry for 24 hours. 2. Then apply a coat of white or orange shellac. Let this dry for 6 hours. Smooth carefully with No. 0 steel wool. 3. Dust thoroughly, apply a coat of Glidden's varnish (Glidden's hard oil finish varnish). Let this dry for 48 hours. 4. Rub down with crude oil and fine pumice thoroughly, wipe clean and dry. 5. Apply second coat of varnish, allowing it to dry for 48 hours or more. 6. If a brilliant lustre is desired, rub down well with crude oil and pumice. If a smooth, dull finish is wanted, rub down with pumice and water. Remove all pumice and moisture with a dry flannel cloth. The method of fuming oak with ammonia will be described in a subsequent article.

A Simple Balance

A USEFUL scale for weighing mail or other very light things may be easily made from odds and ends that can be found in any experimenter's work-shop. Any wide-mouth glass jar, such as a water tumbler, jam or pickle jar, is used to hold the water in which the balance floats. A small glass test tube is weighed with a little lead or with iron filings so that it will float vertically in the water. The test tube is fitted with a cork and a piece of light cardboard about three or four inches square is attached to the cork by means of glue or sealing wax, but care should be taken to center the cork in the middle of the cardboard scale.

The scale is a sheet of paper which is pasted up the length of the test tube. The test tube is floated in the water with the scale pan or cork in place and a mark is made to indicate the flotation level with waterproof drawing ink, this mark being indicated by a figure 0. The rest of the scale is marked by procuring weights of known value and placing them on the cardboard scale pan. For example, a weight of one ounce will sink the test tube a certain amount. The figure one is placed opposite the line that indicates this new level. The amount of weight is increased and new markings are made at the various levels to show the amount of weight supported by the scale.

After the main indications are made, the intermediate marks that indicate ½- and ¼-ounce subdivisions can be put in by dividing the main lines



equally. After the balance is finished and properly calibrated, one or two coats of white shellac varnish is applied to preserve the scale against the action of the water.

How to Make a Small Lift Truck

By Harry A. Mount

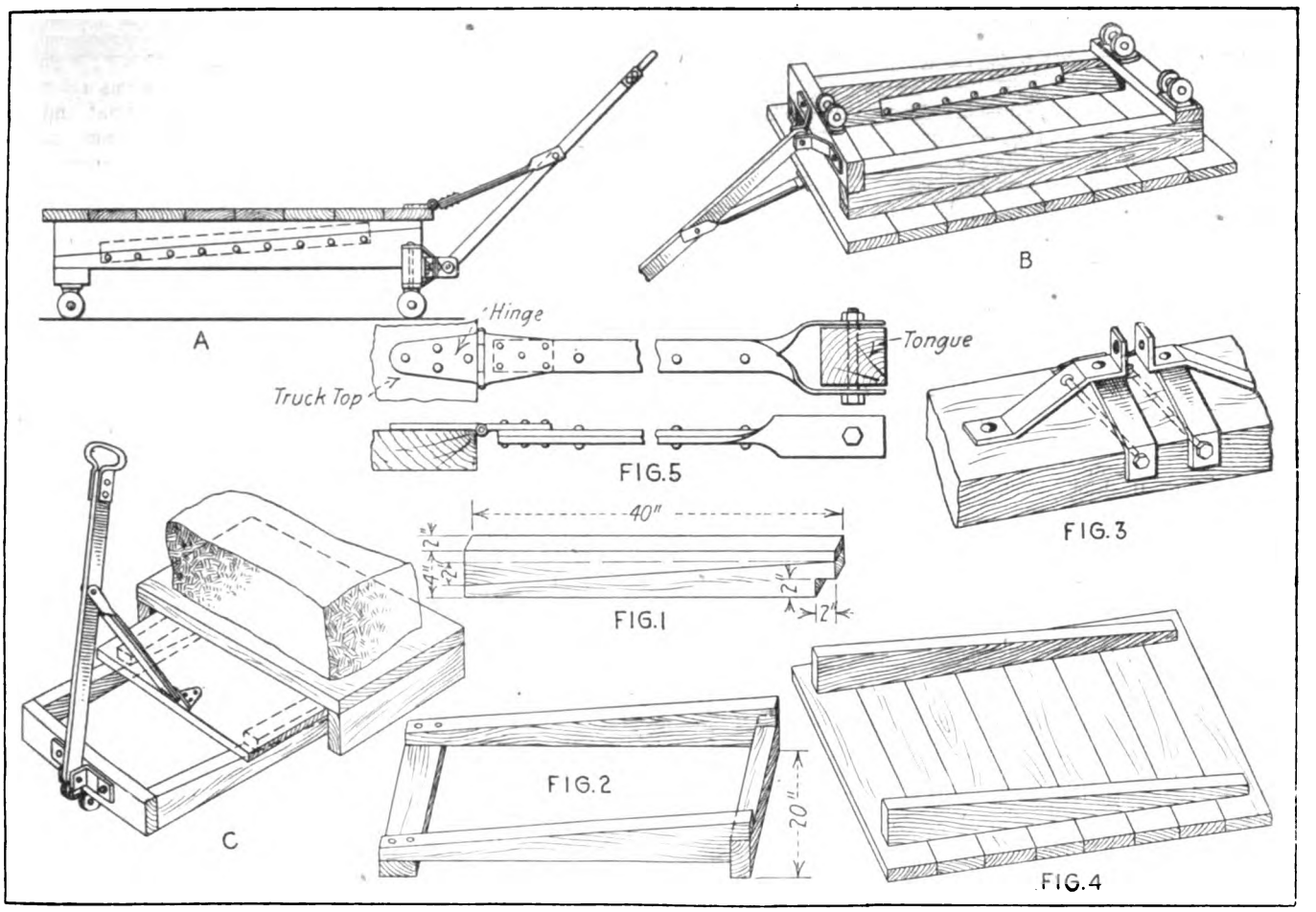
THE small lift truck of unique but simple design illustrated can be quickly and cheaply constructed by anyone handy with tools. It will prove serviceable in the small shop or factory. The truck will lift and carry weights up to a ton. In addition to its extreme simplicity, it has the added advantage over most of the commercial models of lift trucks of being able to turn within its own length, making it particularly adaptable to crowded quarters. The truck described was for use in a small printing establishment and the dimensions could be altered to meet other conditions.

The "sliding wedge" principle was employed to obtain the "lift." Two 2x4 pieces 40 inches long were used in making the two sets of bearing surfaces. These pieces were sawed, as is indicated in Fig. 1, so that there was a "pitch" of two inches. The two inclined surfaces were then planed down until they were perfectly smooth. Two pieces of 2x4 20 inches long were then cut and the undercarriage of the truck assembled, as in Fig. 2. Screws were used in assembly and where they were driven through the thin edges of the wedges the heads were countersunk below the surface to prevent scratching the upper member. It will be noticed that the 2x4 on the heavy end of the wedges was set upright and mortised into the ends two inches to allow a projection equal to the thickness of the cross-member on the other end.

Two tongue supports were made of strap iron, as shown in Fig. 3. Each support consisted of two pieces, one a V-shaped piece, fastened to the 2x4 by a bolt passing through both ends and through the timber. The other part was a longitudinal brace, anchored to the wood by a bolt and riveted to the V. An upright projection was drilled to receive the tongue bolt. It is desirable that the two tongue supports be made of rather heavy material and that they be bolted rigidly in place to the front upright 2x4 of the truck undercarriage, as considerable strain is imposed on them.

The tongue may be of hardwood, 1½"x1½", or be made of a section of

Digitized by Google



Details of easily made shop truck

iron pipe about 36 inches long. In either case a hand hold of heavy strap iron should be made and bolted to the end. The other end should be bolted between the two tongue supports, allowing as little side-play as possible.

Next the top may be constructed. This is done by nailing boards to the two top wedges, as shown in Fig. 4, taking care that the wedges are spaced exactly as the lower ones and are kept parallel. Two small boards are then nailed or screwed to the inside of each of the top wedges (Fig. 4) to serve as guides. The top may then be placed on the base. If there is any tendency toward "binding" between the two parts this must be corrected by planing. The four wedge surfaces should then be greased with axle grease so that there is perfect freedom of movement between them.

A strip of strap iron long enough to reach from the front edge of the truck top to a point about two-thirds up the handle is now required. One end is drilled and riveted to a door hinge (Fig. 5). The other end is split with a cold chisel, the two ends twisted at right angles and drilled so that they can be bolted to the tongue.

The truck is now complete excepting for wheels. Large castors with double wheels, of very heavy construction, such as are obtainable at any hardware store, were used. Four castors were employed, arranged as shown at B. The two rear castors were placed on the extreme corners of the truck so that the weight of the load bore directly on them, with little strain on the thin ends of the bottom wedges. The front castors were placed side by side in the center of the truck, which was permitted by the heavier construction of this end of the undercarriage. Each of these castors was rated at 500 pounds capacity, making a combined capacity of a ton.

The use of castors, rather than wheels, saved the complication of a movable axle for guiding the truck and made it possible to move the truck in any direction or to turn it within its own length. This was found to be a decided advantage.

In operation the tongue was pushed back, sliding the top back about half its length. The truck was then pushed under a platform, built according to standard practice, just high enough off the floor to allow the truck to get under. The platform carries the load. Then the tongue is pulled forward until the wedge action causes the top to engage the platform. Then a quick pull of the tongue shoves the bottom of the truck back under the load, raising it clear of the floor. In lowering the load, a quick pull should be given to the bottom of the tongue.

It was found that the end of the tongue moved about twenty inches in raising the top an inch, so that a pull of 50 pounds on the tongue would raise a load of 1,000 pounds (not allowing for loss by friction). It can readily be seen that the truck can be made much more substantial if sheet metal and angle iron are used instead of wood in the construction.

PRACTICE IN ASSEMBLING AUTOMOBILE WORM-GEAR DRIVES

IN the assembly of worm-gear drives for automobiles it is the custom to offset the wheel relative to the worm a few thousandths of an inch sidewise. The object of this is to counteract the inevitable looseness which there is in the ball or roller bearings, not only of the differential but of the worm itself. There necessarily must be a very slight looseness in any bearing, otherwise it could not run freely. According to an engineer well versed in the design of worm drives, this sidewise assembly is of little importance in ordinary commercial truck work, but in gears for electric vehicles where the elimination of noise is an important factor, this sidewise assembling has to be very carefully done. It is generally supposed that worm-gears run quietly, and compared with internal gear drives they do, but they produce enough noise so that this factor must be considered in the design of drives for electric pleasure cars, which must run almost noiselessly.—*Machinery.*

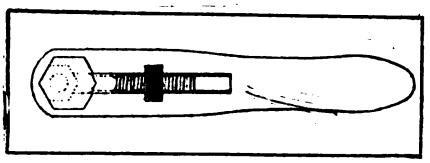
Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

SIMPLE SPANNER WRENCH

WE have already had occasion to illustrate a couple of adjustable spanners and in the accompanying article we show another form. In this a hexagonal hole at the end receives the nut and a screw actuated



by a knurled nut and with a notch in its end of 60° opening, is screwed back and forth so as to grip the nut as clearly shows in the cut. A feather and groove device is provided to prevent the screw from turning.

In Arizona there is a small perfectly circular lake, called the Meteor Crater, which is supposed to have been formed by the fall and explosion of an aerolite. Fragments of meteoric iron are scattered around it. It is taken as being what may be called a lunar crater, as the craters on the moon are undoubtedly in large part due to the fall of meteorites.

Experiments which have shown that the presence of carbon dioxide gas is favorable to plant life have been carried out in Germany. The exhaust gases from an internal combustion engine plant at a blast furnace were caused to act upon vegetation, and the result was a great increase in yield. It actually suggested a way of regenerating burned coal. It in a sense established a reproduction of the carboniferous era. It was calculated that a blast furnace producing 1,000 tons of pig iron per day could supply gas for the cultivation of 4,000 tons of potatoes. Tomatoes yielded three times the normal, cucumbers twice the normal, and equally good results were obtained by supplying the gas through perforated pipes traversing the plot. The first tests were done in a sort of cold frame with a mixture of the gases with an equal volume of atmospheric air.

It has been found that ostrich eggs last for many weeks without any particular care. Eggs sent from Africa to France were edible after more than three months. The volume of one egg is put at about three pints.

A snow storm made it possible to determine the weight of soil transported as dust by the wind. It was in Madison, Wis., that the snow was observed to be colored a brownish red. By collecting the snow, melting it and evaporating the resulting water, it was a simple matter to determine the dust in any given quantity. It amounted to nearly seventy-five grains of dust to the square yard. The mineralogical characteristics and chemical composition of the dust pointed to New Mexico and Arizona as the place of origin, involving a transfer of fifteen hundred miles. The weight of soil thus transported over this great distance in the one storm was put at a million tons.

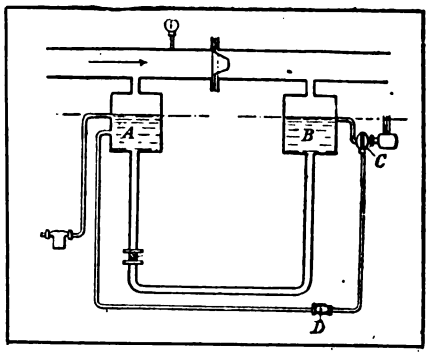
Petroleum has been found in Greece, and this time by the engineer officers of the French army, certainly a more beneficial operation than fighting. One of the wells bored gives 50 barrels of oil a day.

In the cuts are shown two simple methods of filtering lubricating oil which in service gets charged with bits of brass and steel so as to greatly impair its value for a second use. In the first one charcoal is placed in a special wire basket and below it is a bag or diaphragm of cloth and the oil is shown as it pours through the two and drips into lower compartment. It is so pure as to be available for a second use. In the next cut the oil is syphoned through a heavy wick which may be plaited or twisted out of a ball of lamp wick. As long as one end of the wick is longer than the other and a difference of level is maintained between the two vessels of wire, the fluid will pass through the pores of the wick from the higher to the lower level and be perfectly purified in such passage.

The soaring flight of birds which is most frequent in the tropical regions has been examined by scientists lately and it has been found that the air has a vertical ascending component in the regions where this flight is mostly observed. In other words, the wind blows vertically upwards hard enough to keep the birds in suspension, as in the case of a parachute. The conclusion is new that the wind in these regions nearly always has a vertical component in places; to find and use it the birds seem to be limited to the zones having these ascending components. Of course, the object of the bird is to keep in the rising zone and if its flight enters a descending zone it will turn its course and recover its zone of supporting air. This accounts for their apparently unaccounted for turns, and the old idea expounded by Langley, that the soaring can be accounted for by the sudden changes in velocity of the wind is pretty definitely abandoned by these observers.

GAS METER

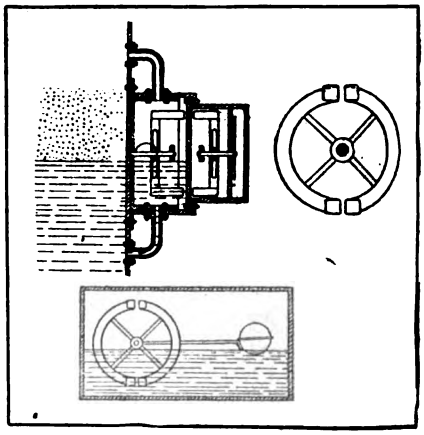
AN interesting meter for registering the flow of gas is shown in our illustration. The level of water in the two tanks, A and B, when gas is passing through the diaphragm lying in the pipe directly above the tank, the course of which gas is indicated



by the arrow, will vary with the amount of gas passing. The water in A will be depressed and that in B will rise. A pump in C keeps the level invariable in the two tanks pumping out of B into A through a water meter D. The reading of the water meter will vary with the difference of pressure exerted by the gas upon the two tanks and will give the measure of the gas flowing.

FLUID LEVEL INDICATOR

THE apparatus shown in the cuts is designed to show the level of water or of other fluid in a tank by the use of a floating ball. The point involved is that a stuffing box with its attendant friction is dispensed with. A magnet of the shape of an approximate circle is attached to the axle of the floating ball. A soft iron partition cuts off the interior of the tank, as shown on the right of the section of the tank, and



the magnet on the shaft of the floating ball has its poles close to it. An identical magnet is mounted on a shaft in line with the other shaft and carries a second magnet with its poles also close to the iron diaphragm. The effect of this is that the outer magnet follows with great accuracy the motions of the interior one and thus the position of the float is given free from all inaccuracy which might be occasioned by friction. Especially bad would be the friction of a stuffing box, which this construction dispenses with. It contains a hint which might be utilized in other appliances.

A catalyzer of good power is made by precipitating silver on a base of asbestos or similar inert substance. At the temperature of 250° C. this will effect the oxidation in air of many organic substances. Calcined alum has also been found quite powerful.

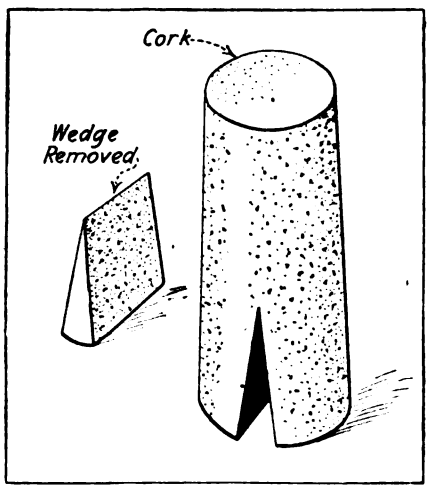
In Germany the great gas holders are cheaply protected from rusting by putting a layer of oil less than half an inch thick on the water in the tank. As the holder rises it carries up with it a coating of the oil which protects it perfectly. The expense is a small fraction of that of painting. Of course, the part which does not descend into the water must be painted.

The Czecho-Slovak Republic by the Peace Treaty after the world war has been awarded free transit on the Elbe and Oder Rivers to Hamburg and Stettin. It has now been decided by the Prague Government to canalize the middle Elbe and to connect it with the Danube and the Oder. This waterway will connect three great seas, the North Sea, through the Elbe by Hamburg, the Baltic by the Oder through Stettin, and the Black Sea through the Danube. This, it will be seen, gives waterway from the Mediterranean to the waters in the North of Europe.

Digitized by Google

Armco iron, made by the American Rolling Mill Co., has been elaborately reported on in France. It was found to be 99.8 per cent pure, with only traces of impurities. It was found to weld easily, to resist corrosion, and to be of good electric conductivity. Of French home products electrolytic iron approaches it in characteristics. One of the products made from electrolytic iron is weldless tubing. Electrolytic iron is so pure that it answers for the manufacture of crucible steel, where Swedish iron has long been employed. Success has not yet been attained in the manufacture of electrolytic sheets.

By cutting a wedge-shaped piece out of a cork which is too large for a bottle, the



cork in question can be made to fit perfectly. It is the upper end which is supposed to be thus treated and the reversed cork can then enter the neck of the bottle.

Of 100 horses in the United States 82 are of the heavy order, 53 Percherons, 12 Belgian and 5 or 6 English. This type of almost giant horse is said to fail in the United States in a few generations, so that importations of new stock are constantly needed. The Percheron and two or three other breeds are said to have suffered but little in the war; other kinds were badly reduced in number.

From New Caledonia comes the tale of the utilization of the deer. It seems that these animals have increased until they have become a plague, just as the rabbits in Australia have. Now they are being utilized as material for canned food products. One provision house is cited as using them to supply canned venison. The hunters are paid 25 francs apiece and the carcases are brought in by the truck load.

The use of a spectroscope with quartz prisms for the study of the ultra-violet spectrum has been quite successful in the hands of Drs. L. and Eugene Bloch. The spectra were produced by the electric spark between electrodes of the metal to be studied. As an advance on this method the same investigators are using fluorite prisms and to avoid the slight absorption of the ultra-violet rays by the air are conducting the work in a vacuum. An exposure of five to ten minutes is given and aluminum or mercury lines are used as the standard or basis of work.

The death of a French scientist is noted. He was engaged in the investigation of the effects of war gases on the human system and fell a victim to his work. The soil of the earth was found to possess an absorbing power for the gases in question, so that by a proper disposition it is sometimes possible to dispense with gas-masks. The best way to dispense with them and the most obvious would seem to be not to go to war.

Iron has long been protected from rusting by various processes based on the formation on the surface of an oxide, usually or always the magnetic oxide. The well-known Bowers-Barff process, in which the treatment with steam at a high temperature is utilized, effects the deposition of such an oxide. From Italy comes the description of an electrolytic method of giving a protective coating to iron. A bath of sodium ferrite is employed. The piece to be coated is the anode. The passage of a current gives it a surface very sensitive to oxidation. The current after a while is reversed and the iron then receives a firm coating of oxide, so as to be protected from rusting. The sodium ferrite is produced and maintained in the bath by the normal action of the current. Black magnetic oxide of iron, Fe_3O_4, is the form of protective coating produced.

The action of air on the funnels of steamships has been investigated and it has been found that the air is in compression over only about 78° of the front portion of the smoke stack. There is a slight depression on other parts of the smoke stack so that a component reverse in direction to the wind results.

Synthetic pig iron is now being produced in the electric furnace. Steel turnings are melted along with charcoal and basic slag. The composition of the resulting pig iron, which may run up approximately to 4% carbon, can be greatly modified by the ingredients of the charge. One furnace produces from 80 to 100 tons per 24 hours, using 675 kilowatt-hours per ton; 5 kilograms of electrode and 80 kilograms of coke per ton are used. Charcoal in small pieces of about the fineness of the turnings, works very well and it is advisable to treat the melted charge in a mixer before casting. It is found to give excellent material for malleable iron castings.

An odd instance of the change of view is reported from Sumatra. Normally the tiger is not a favorite neighbor, but on this island a palm tree is cultivated, whose fruit is a favorite with the wild pigs, and the result has been a plague of wild swine. Now it is considered good policy to protect, for a while at least, the tiger, until he kills off the too numerous porcine population.

The maximum theoretical flight and the speed which is theoretically possible for aeroplanes has been investigated by M. Rateau. He finds that it is extremely difficult to establish the possibility of a flight of 4,300 miles without descent to earth. The flight would have to be at an elevation of five miles for ten hours. As maximum theoretical limit of speed he gives a little less than 300 miles an hour. These figures are of only theoretical interest.

The French are giving much attention to the finding of substances fit for the manufacture of paper pulp. Pine tree needles have been suggested, and waste products of the wine press have been tried; the latter is to be exploited on the large scale in Spain. In the French colonies, notably in Algiers, it is believed that paper pulp can be made and exported as such, to be made into paper in the mother country. Alfalfa is produced in great quantities in Africa, and it is possible to increase the area devoted to it. Hitherto England has been the principal consumer of this crop.

It is claimed that radioactive substances have a fertilizing value for plant life. The residues from the manufacture of radium preparations have been used as fertilizers with beneficial results. It is believed that they increase the root development, activate the nitrating ferments, and favor the chemical reactions of the soil and of ordinary fertilizers, playing the rôle of stimulants

Animals fed with food sterilized at a high temperature die of starvation with definite symptoms, which have received the name of avitaminosis. This fact has led to the theory that vitamines are formed in the intestinal tract by the action of bacteria. It has long been known that bacteria played an important rôle in the life of animals, human and others. A completely sterilized animal would soon die.

The French have long been famous for their artificial cultivation of oysters. During the war this industry suffered severely. Now attention has been directed to the natural beds, and it is claimed that there is to be found in them a source of large revenue. It is stated that hitherto nine-tenths of the possible oyster harvest has been lost by neglect of the natural beds.

The pressure produced by the blow of a whip lash has been investigated by a French humanitarian. By receiving the blows of a whip lash on a surface of soft clay and measuring the depth of penetration, it was a simple matter to determine how many kilograms or pounds were required to effect the same result by simple pressure. The force of the blow was found to be far higher than supposed; it varied from 72 to over 300 pounds. The plea is made to spare the uncomplaining servant of man and to practise kindness and restraint in the use of the often brutal whip.

The action of ultra-violet rays on vitamines has been recently studied. The vitamines required for growth of immature beings, such as infants, are destroyed by eight hours exposure to the light. It is therefore asked if the sterilization of milk by the ultra-violet light may not impair its value as a food, especially for infants, who depend so largely upon it for their growth and nourishment.

X-rays have been applied to the disclosure of ancient paintings. In old times a painting was often obliterated by a coat of ground color and a second painting made on the new surface. Now by the use of the X-ray some of these ancient paintings have been photographed through the overlying and more recent picture with interesting and important results. In one case an absolutely invisible picture has been radiographed and in another case numerous restorations and changes in a painting by an old master have been disclosed. It is believed that the same method may prove of value for the study of palimpsests, manuscripts which have been erased so as to permit the parchment to be used for other writing. Often it happens that the old erased matter can be brought to the light of day, and in this way priceless finds are possible.

Australia has long been pictured as in great part a desolate area surrounded by a margin of fertile country. Preliminary operations for extensive irrigation work are now in progress. The water which it is proposed to utilize flows between two cliffs, several hundred feet high which approach each other until they are only separated by about 150 yards. By closing the gap with a concrete dam the water will be impounded and a great reservoir will be formed. The first section of the work will be sufficient to provide water for the irrigation of 10,000 to 12,000 acres. It is at least a beginning of what may become a very extensive development. The operations are in the state of Queensland and in the same district, the Government is investigating the development of the great magnetic iron ore deposits at Mount Biggenden. There is also an enormous coal field there and other iron deposits.

Digitized by Google



RADIO
TELEPHONE AND TELEGRAPH APPARATUS



The Design and Use of Loop Antennas

A Discussion of the Problems Involved in the Design and in the Operation, at Maximum Efficiency, of Loop Antennas

By M. B. Sleeper

A LOOP, or coil antenna, or, as the British call it, a frame aerial, is not merely a solenoid or pancake arrangement of wire. The loop has very definite characteristics, controlled by the mechanical dimensions, the frequency at which it is used, and the circuits connected to it. Experimenters may know that these things are true, but few understand the process of actually designing a loop, or how to use it.

In the first place, let us see for what purposes a loop can be used. Below are the most common ones:

1. Short-distance reception.
2. Long-distance reception.
3. Direction finding.
4. Directional transmission.

1. A properly designed loop is good for short-distance reception, particularly on 200 meters, for, as will be shown later, the efficiency is higher at short wavelengths. This type of work calls for a small loop, 2 or 3 feet square, which can be mounted over the operating table. An audion detector will permit reception over several miles from a spark coil.

In cities and harbors a great deal of receiving can be done on a small loop from ships and 200-meter stations. The directional effect helps to reduce interference.

2. Long-distance reception requires a multi-stage amplifier or a very large loop, 10 to 15 feet square. If possible, a loop should be set up indoors, as moisture and dust tend to reduce the insulation between the turns. In general, a straight antenna of the single-wire type is much better because it is easier to erect and is more efficient. On the other hand, local interference, if not in the line of direction of the loop, is reduced.

3. Loops used as direction finders, like those for other purposes, must be designed for the wavelength range over which they are to operate.

4. For transmitting, the loop is not as good as a straight antenna because of its low resistance. However, it is well adapted to vacuum tube transmitters, and extremely interesting experiments, either in telegraphy or telephony, can be conducted with it. Spark coils have also been used in the loops, and quite successfully.

In the following paragraphs we shall consider the design factors which influence the inductance, natural period and resistance of a loop.

Higher Efficiency at Short Waves

In order to set up a current in a loop there must be a difference in potential between the two sides. If equal potentials are set up in both sides of the loop at the same time, no current will flow. In a loop this difference is brought about by the time which elapses between the cutting of the near side and the cutting of the far side by the lines of force radiated from the transmitter. Increasing the size of the loop increases the time difference and the potential difference.

Also, since the speed of the waves is constant, the shorter the wavelength, the greater is the fraction of a cycle through which the wave will pass while it is travelling from the near side to the far side of the loop.

To make this more clear, suppose we have a loop the vertical sides of which are 4 feet apart, receiving a 200-meter wave. The difference in phase of the approaching alternating current wave as it cuts the two sides is only 2.5 degrees. If the wavelength is increased to 2,000 meters, this difference is only 0.25 degrees.

This does not mean, however, that any loop operates more efficiently as the wavelength is decreased, for each loop has its own maximum response frequency, but the overall efficiency of a short wave loop is greater than that of a long wave loop. At the same time the peak of a curve of the reception factor plotted against wavelength occurs at the short wave end of the curve.

In actual practice it is found that a loop should not be operated at less than 1.5 to 2.0 times its natural wavelength.

The Reception Factor

In experimenting with loops some measure of efficiency is necessary. This is called the reception factor, given by the expression

$$\text{Reception Factor} = \frac{NaL}{\lambda^2 R},$$

N = Number of turns on the loop,
a = Area enclosed by a turn,
L = Inductance of the loop,
λ = Wavelength of the incoming signals,
and R = Effective resistance of the loop at λ.

To determine the efficiency of a loop over a range of wavelengths the reception factor is determined at a number of wavelengths and plotted against those wavelengths.

Tests Made on Loops

In the Everyday Engineering Laboratory a series of tests on 2-, 4-, 6- and 8-foot loops were made to find the correct size, number of turns and spacing for various wavelengths.

It was necessary to work backwards, building the loops first and then determining their characteristics. A complete summary of the data taken will not be given here, for, while it would be interesting, the purpose of this article is to give a method of designing loops for maximum efficiency.

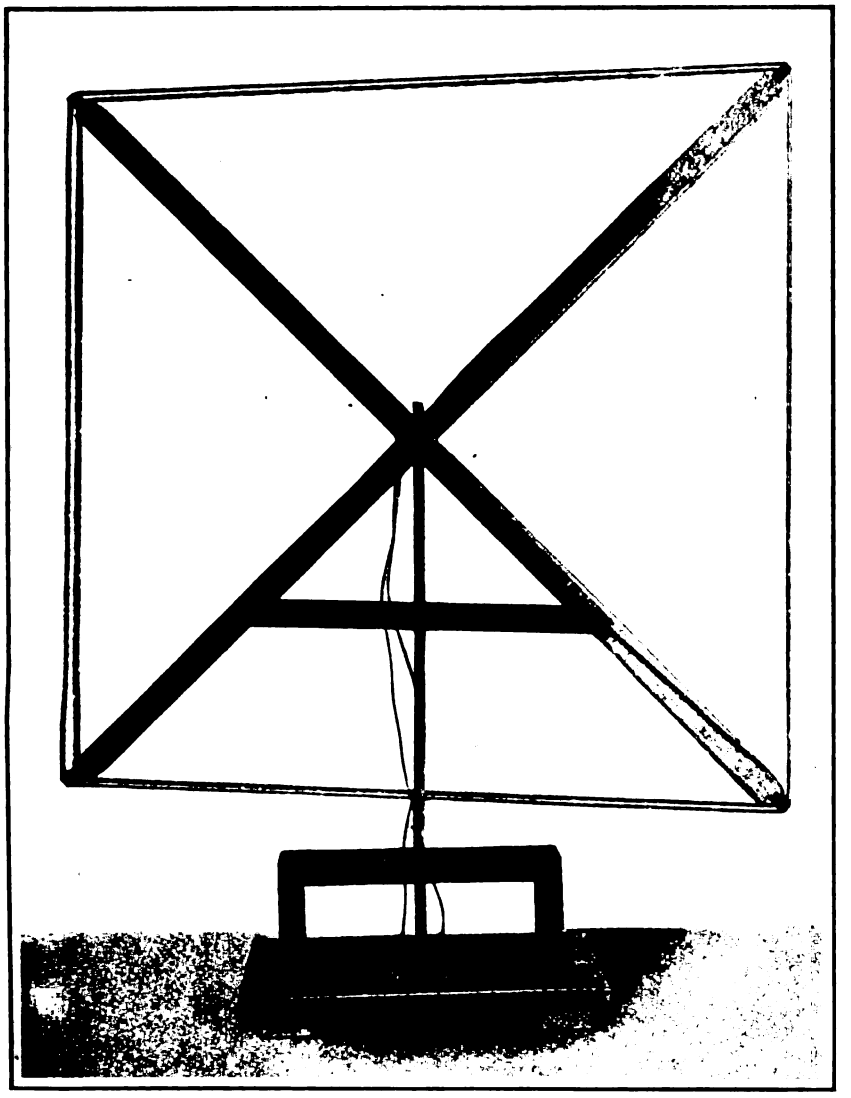
First of all, experiments were made to find out what effect, if any, the spacing had upon the reception factor. Obviously, a larger number of turns were required, when the spacing was increased, to keep the inductance constant. This increased the value of N, but it also increased R very rapidly. An average of the results showed that,

Digitized by Google

for the square solenoid type loop, which was used in all tests, the best spacing was that given in Table 1.

TABLE 1.
SPACING OF TURNS.

Loop	Spacing
2 ft.	0.1 in.
4 "	0.3 "
6 "	0.5 "
8 "	0.6 "



A loop and mounting used in the Everyday Engineering Laboratory

Next, loops of the sizes listed were wound with fifty turns, using the spacing values in Fig. 1. Then, taking off five turns at a time, the wavelength was determined at which the reception factor was maximum. The results are given in Table 2.

TABLE 2.
WAVELENGTHS FOR MAXIMUM RECEPTION FACTOR

2-foot loop			4-foot loop			6-foot loop			8-foot loop		
Turns	Wavelength	Reception Factor	Turns	Wavelength	Reception Factor	Turns	Wavelength	Reception Factor	Turns	Wavelength	Reception Factor
5	200	1,200	5	250	2,500	5	400	4,500	5	500	4,500
10	250	2,000	10	450	3,100	10	600	5,000	10	900	5,800
15	425	3,100	15	800	3,700	15	950	5,400	15	1,300	6,300
20	550	4,500	20	1,200	4,300	20	1,400	5,900	20	1,700	6,900
25	700	5,000	25	1,450	4,700	25	1,700	7,000	25	2,100	7,600
30	850	6,000	30	1,600	5,000	30	2,000	8,200	30	2,500	8,200
35	975	6,500	35	1,800	5,300	35	2,150	8,700	35	3,000	8,100
40	1,080	6,100	40	2,000	5,500	40	2,300	9,000	40	3,500	8,000
45	1,230	5,000	45	2,140	5,650	45	2,700	9,100	45	3,800	7,500
50	1,320	2,200	50	2,220	5,750	50	3,000	9,000	50	4,000	6,700

The foregoing tables show, with quite a degree of accuracy, the wavelength at which a loop of given size and number of turns, with the spacing indicated in Table 1, will operate at maximum efficiency. All these loops were made with No. 20 bare copper wire. Different physical conditions in the laboratory or operating room will, of course, bring about variations in the results obtained, but Table 2 is a very safe guide. Space limitations made it impossible to make tests on larger loops, but few experimenters are so fortunately situated that they can have more than an 8-foot loop. The efficiency decreases rapidly below the maximum efficiency wavelength given in Table 2. Above these values the efficiency drops off slowly, the curve being much more steep for loops of few turns.

To determine the size of loop for receiving a given wavelength, determine the reception factor for that wavelength with the different sized loops. Select the loop that shows the maximum reception factor for the required wavelength.

SIZE OF WIRE

Although tests were not made to determine the advantage gained by the use of high-frequency cable over solid wire, the results obtained with ordinary inductances will hold for loops as well. These show that, at wavelengths below 1,000 meters, the cable gives a lower resistance. Above 1,000 meters, the resistance is about the same until, above 2,000 meters, solid wire is superior to cable, even though a size as large as 3 x 16 No. 38 is used.

TUNING CIRCUITS FOR RECEIVING

During these tests all tuning was done with only a variable condenser shunted across the loop. The circuit for ordinary reception should be that used for the secondary of a loose coupler, replacing the secondary coil by the loop. The condenser should be of the 0.0005 mfd. type, certainly not over 0.001 mfd.

The insulation of the condenser is of particular importance in loop reception, for a leaky, low-resistance condenser reduces the efficiency of the loop, the sharpness of tuning, and the voltage applied to the grid, which reduces the signal strength.

For uni-lateral direction finding a small coil should be put in series with one lead from the loop to the condenser. This is for coupling with a coil connected to a regular antenna and ground, as explained in the November-December issue of EVERYDAY.

BALANCING OUT DISTORTION

Because of the interference from buildings and other objects, a loop does not always give a true directional reading. This is also due to the antenna

(*Continued on page* 451)

Digitized by Google

Equipment for the Radio Station

A Standardized Panel Receiver, and an Interesting Type of Transmitter for 200-Meter Work

By Stuart D. Dimond and John A. Hall

THE receiving set shown in the accompanying photographs was constructed along lines suggested by articles which have previously appeared in EVERYDAY ENGINEERING. The builder has followed certain suggestions which appeared in several editorials to the effect that all raw materials, parts, and instruments used, be those regularly carried in stock by most dealers in radio goods. This idea, it is argued, if generally followed by amateur experimenters would benefit both the dealer and the buyer. The advantages of standardization are self-apparent.

GENERAL

The units shown in the pictures were built one at a time and each section, beginning with the tuner, was put into service as soon as completed. This immediately demonstrated the value of the standardized panel idea. The only radio apparatus the writer had when the set was started was a crystal detector, single slide tuner and head phones, so upon completion of the tuner panel it was immediately connected up and used. The condenser panels were then completed and put into service, the sec-

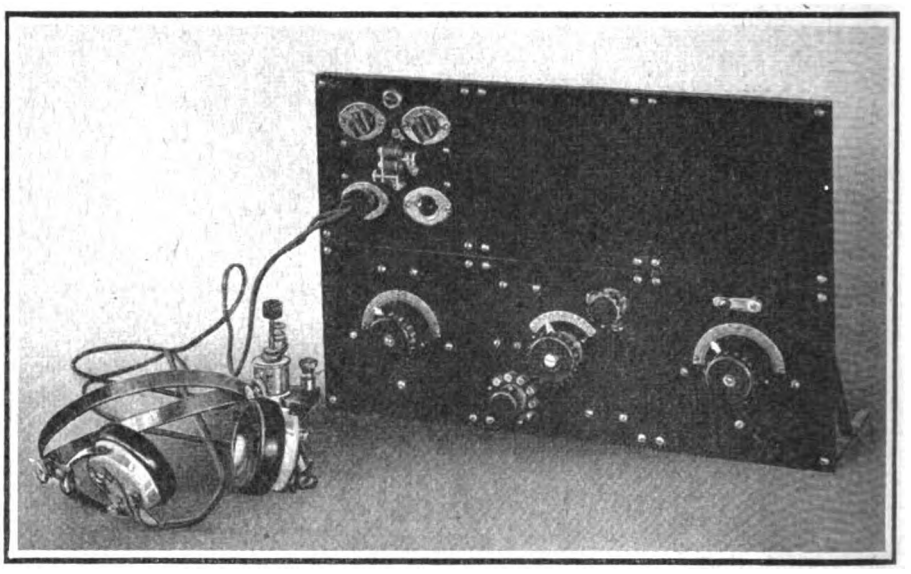


Fig. 1—The two blank panels are to be used later for an audion detector and amplifier

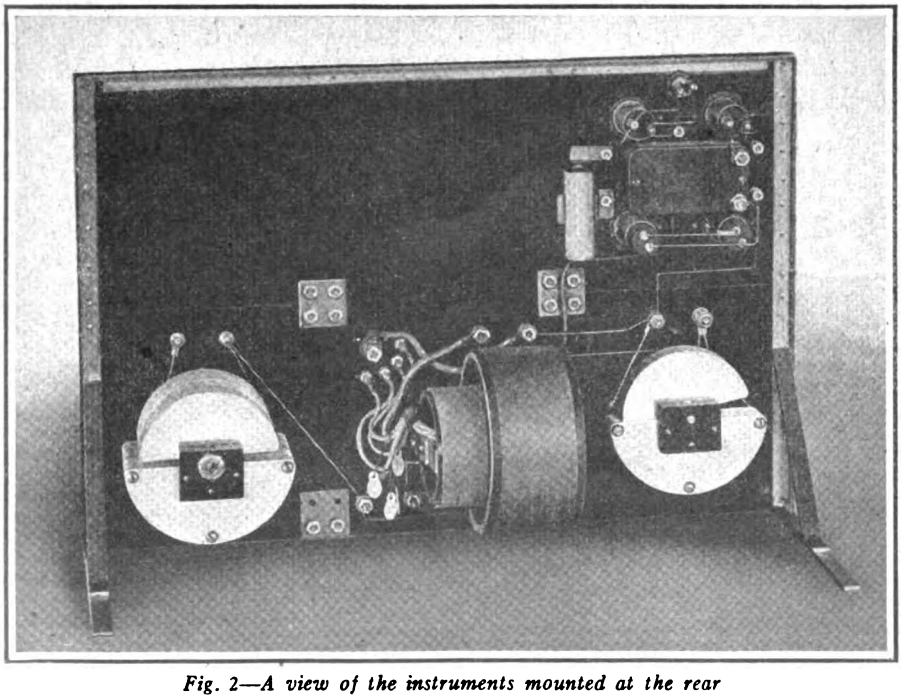


Fig. 2—A view of the instruments mounted at the rear

tion with the buzzer test, phone connections, and fixed condenser being completed last. It was thought that six panels would be enough for some time to come so supports were made to take care of this number. Since the photos were taken one of the blank panels has been made into an audion detector unit, very much like that shown in the June number for use with the Heterodyne Wavemeter. It differs from the one mentioned in that the knob of the Paragon rheostat was replaced by one of the type used on the panels shown in the photographs, and the window for the audion is a vertical slot about an inch long by an eighth wide having an oval brass plate over it with a slot in it coinciding with that in the panel. This plate is fastened to the bakelite with two 2-56 R. H. brass machine screws.

The connections between panels are made with No. 14 bare copper wire as can be plainly seen in Fig. 2.

The set has been in use since last December with very satisfactory results.

THE PANELS AND METHOD OF MOUNTING

The standardized panel idea is that already set forth in previous numbers of this Magazine, with a slight change in the method of joining the units. The panels are all 5 x 5 x 1/8" bakelite. The holes for the supporting screws are drilled 1/4" from each edge at the corners. The drilling was done accurately by means of a small template of sheet brass.

Pieces of heavy sheet brass exactly one inch square, with four holes all drilled the same distance from the corners, are used to join the panels. The holes were drilled with the same template used in drilling the corner holes in the bakelite panels. This insures accurate alignment with no spaces between the panels, making for neat appearance. These pieces show clearly in the photograph. They are interchangeable and can be used at either the center or edge of a group or panels No. 6-32 R. H. brass machine screws, 1/4" long, are used to bolt the panels together.

The supports are made of bus bar copper 3/8" wide soldered together to form an angle, and braced and bent as shown. Holes are drilled and tapped at the proper points to coincide with those in the panels. Number 6-32 screws are used.

Digitized by Google

Tuner Panel

The tuner is the popular de Forest Signal Corps type of coupler, and the primary and secondary switches are of the same make. No further description will be given, as these parts are familiar to all experimenters.

Condenser Panel

The secondary condenser is an eleven plate Illinois variable. This condenser comes with the shaft drilled and tapped for a 6-32 machine screw making it an easy matter to use either an Army or Navy type of knob in place of the one regularly furnished with the condenser. A condenser of larger capacity was at first used across the secondary of the tuner, but as the set is only used on amateur wavelengths the smaller condenser is now used with better results.

The primary condenser is a 42 plate Murdock of the panel mounting type and is provided with a Midget switch so placed that closing the switch short-circuits the condenser. It was necessary to drill and tap the shaft of the rotor of this instrument, so that a knob similar to the others used in the set could be applied.

The condenser dials are those usually furnished with unmounted condensers and are fastened to the bakelite with 2-56 R. H. brass machine screws. The stops for the pointers are brass furniture nails driven into holes in the bakelite a trifle smaller than the nails themselves.

Phone Connection and Buzzer Test Panel

The details of this unit may not be of interest to the majority of readers who are probably using audions, but the amateur using the crystal detector may find points of interest.

The buzzer is the Century type, removed from its base and fastened directly to the panel. Below the buzzer are two sockets taking bayonet plugs of the type used on the lighting systems of automobiles. These plugs and sockets are for the head-phone connections, and have proven very satisfactory. They do not cost as much as the plug and jack arrangements used in expensive sets but give as good service as any others. Above the buzzer are two switches, companions of the plugs and sockets. One of these is turned on to close the buzzer circuit continuously while locating the required sensitive spot on the crystal; the other, is to connect and disconnect the small fixed condenser, mounted on the rear of the panel, connected in parallel with the head telephones. The small push button above the switches is for the usual buzzer test during operation of the set. A small flashlight cell is mounted on the rear of the panel in spring brass clips. This cell furnishes the current for the buzzer test.

The connections used with the crystal detector are of the usual sort, but it is understood, of course, that the panels shown can be connected in whatever manner the builder chooses, this being one of the advantages of the standardized panel type of construction.

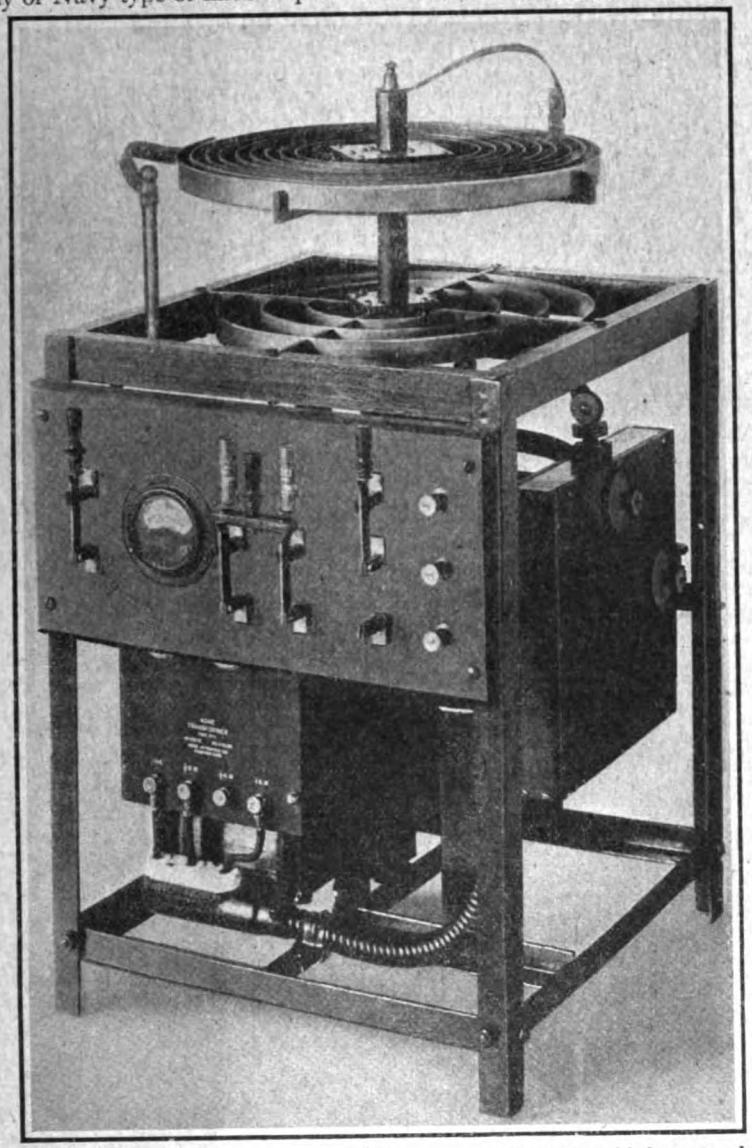


Fig. 3—There is very little about this set to suggest the old home-made apparatus experimenters used to make

The 200-meter Transmitter

The 200-meter transmitter, shown in Fig. 4, will be of interest to those who are considering the construction of a set which is semi-portable, compact, and which requires a minimum of table or floor space. This set recently took first prize in the amateur apparatus building contest held by the St. Paul Radio Club at the local Y. M. C. A.

The frame is made, with the exception of the top cross pieces, entirely of angle iron, enameled black. The legs or corner pieces are of 3/16- x 1-in. angle iron about 26 in. in length. The square in the bottom is of 1/8- x 1-in. angle iron, bent into a 15-in. square, after sawing three-cornered pieces out of one side to enable it to be bent. The corners were then welded and the square drilled and bolted to the legs. 1/4-in. machine bolts were used throughout. The square top of the frame is made of hard wood with a cross section of 7/8- x 2-in. It is needless to remark that a closed iron circuit here would absorb a great deal of the energy in the primary circuit.

The transformer used is a 1 k.w. Acme, type H 1, which gives a secondary voltage of approximately 15,000. There is a cross piece in the bottom of the frame on which two of the legs of the transformer rest, the other two resting on the side of the frame.

A Thordarson oil-immersed, bakelite dielectric condenser is used. It is held by straps made of 1/16- x 1/2-in. copper, in the rear left hand corner of the frame.

The rotary gap motor used is one which the writer believes is the best for this use which can be had. It is an Emerson variable speed universal motor, 1/25 h.p., 110 volts, 4,500 r.p.m. At highest speed this motor is slight-

Digitized by Google

ly overloaded as it draws 1.3 amperes on test, being rated at one ampere, but does not heat appreciably until it has run continuously for fifteen or twenty minutes. The disc used is an 8-tooth Thordardson, with the electrodes widened out to 5/8 in. by riveting 1/4-in. pieces of aluminum on both sides and filing to the shape of the electrodes. Since the bore of the disc was only 3/8-in., and could not be enlarged due to the construction of the brass hub, the motor shaft which was originally 1/2 in. was turned down to fit. The disc is enclosed in a case made of 1/4-in. black sheet bakelite. The inside dimensions are 9 x 9 x-1 1/4 in. The case is mounted on the pulley end housing of the motor, by machine screws which pass through the back of the case, then through spacers made of 3/4-in fibre rod 3/4-in. long, and into threaded holes in the motor housing. A hole in the back of the case is made a driving fit on the bearing box of the motor which projects conveniently about one inch from the housing. The fixed electrodes are of 1/8- x 5/8-in. copper bus bar and slide in slotted bakelite blocks which, in turn, are screwed on the sides of the case, 90 degrees apart. A set screw in the side of these blocks clamps the electrode in any desired position. The fixed electrodes are each fitted with four copper cooling flanges, and are tapped at the end for a machine screw which clamps the connection strip between 1-in. copper washers. Directly opposite the sparking points, a 2-in. hole is cut in the front of the case. These inspection holes are normally closed with bakelite discs which are clamped in place by threaded knobs on projecting studs.

The oscillation transformer is wound with 7/8- x 1/32-in. brass ribbon on 1/4-in. bakelite supports, with a spacing of 1 1/2 in. in the primary and 3/4-in. in the secondary. The primary has three turns and the secondary eight. The secondary slides on a 1-in. hard rubber rod and may be clamped to any desired coupling by a large bakelite knob carrying a threaded stud which passes through a block in the secondary hub.

The leads are of 1-in. Belden copper braid in the primary, and 3/4 in. in the secondary circuit. Where they connect to condenser, spark gap, and oscillation transformer, 1-in. copper washers are used.

The radiation ammeter was originally a Roller Smith 0 to 2 1/2-ampere hot-wire instrument with a suitable shunt enabling the meter to indicate up to 5 amperes. While satisfactory, it has since been replaced with a meter having a scale reading to 10 amperes. It is a model 425 Weston thermo-ammeter which came to hand after the set had been completed. It is of practically the same size so the panel needed no altering.

The switchboard is of 3/4-in. slate with a dull black finish. It is mounted on the front of the frame with machine screws. It carries a single-pole, single-throw knife switch for shorting out the radiation meter when no reading is desired, a radiation ammeter as described above, a double-pole, single-throw switch with 20-ampere cartridge fuses for the main a. c. line, a single-pole, double-throw switch for changing from 1/4 to 1 k. w., and three binding posts for power and key connections.

The wiring for the motor circuit is of No. 14 lead-covered duplex, with the lead covering grounded. Leads from switchboard to transformer are No. 10 rubber-covered wire in 1/2-in. flexible metallic conduit, with suitable condulets at the terminals. The conduit is also grounded.

Such a combination of transmitter and receiver makes an excellent equipment for 200-meter communication.

The Radio Department

A Discussion of Current Topics of Interest to Manufacturers and Experimenters

COL. W. A. BISHOP, lecturing to the Cadets in one of the American flying schools, said, "Get all you can from what others teach you. When you go on the other side, you will forget it all, and learn for yourselves."

This is applicable as well to the process of developing new devices or methods. The successful man, after learning the principles involved, studies the work of others. Then, putting that aside, he starts on a new course, basing his work on the fundamentals, and guiding his course by the results of other investigators.

The inventor of the linotype machine, for example, studied typesetting methods to learn what was required. Then, instead of making a new sort of composing stick, or working out an improvement in type cases, he envolved a new principle, a system of casting type to order, it might be called.

Altho it is far more difficult, the latter method of inventing is generally more successful than attempts to improve the results of others. Experimenters will increase the net value of their work if they bear this principle in mind.

TELEPHONE jacks and plugs are coming into very wide use. So much so, in fact, that it is time for someone to bring out a less expensive type of plug than those now on the market. If a man pays five dollars for a pair of telephones, and excellent ones can be bought at that price, he does not like to spend nearly three dollars for a plug and jack to connect them.

The fact that the ordinary types have been used for many years, does not mean that a less expensive and equally good type cannot be made. One dollar is enough to pay and the company that markets a plug and jack at this price will find the demand enormous.

Some departure from the usual design will probably be necessary. The great difficulty in making the ordinary plug is due to the concentric construction of the terminals. This can be overcome by a change in design. If this is done, a different style of jack will be required, but one operating on the same general principles.

Experimenters are rapidly learning that many circuits can be used and operated by changes effected by the insertion or removal of the telephone plug. The A. H. Grebe Company has gone farther than the others in this respect. They not only control the plate circuits of their amplifiers but the filament circuits as well by the plug and jack method.

TWO months ago, there appeared an article in EVERYDAY on the standardization of apparatus design. A number of companies wrote, in response, that they were interested in the idea, and would like to be informed regarding any developments.

That is rather characteristic of radio men. The appeal of the article was for ideas, and not simply interest. Perhaps the experimenters can help, for they are the ones to be pleased, ultimately.

Consider the binding post. There are innumerable ways of making connections, but 99 percent of them have outstanding disadvantages. They turn when the thumb nut is tightened, or the thumbnuts are lost, or they do not grip the wires, or do not hold more than one wire securely. Posts which do not have these faults are extremely expensive. Is there no one who can submit a design which will be labelled "OK" by experimenters, and which the manufacturers will not veto as being too difficult to make? The switch, such as is used for inductance control, is another detail that has never been worked out in a satisfactory manner. Someone must have a solution.

Other parts need the same treatment. EVERYDAY would like to publish some of the ideas which its readers must have if they will only submit them.

Digitized by Google

A Radio Telephone Operating On Six Volts

The De Forest Company Calls This a Buzzer Radiophone, Tho the Name Seems Misleading Until You Understand the Set

THE elimination of the B battery has been the dream of many an experimenter who has gone thru the usual hardships which accompany the use of a high-potential battery for the plate supply of an audion. Tests made on the buzzer radiophone seem to indicate that still another step forward has been made. And there will be many a radio man who will reproach himself for not having thought of it before.



No motor-generators or high potential batteries are needed to operate this set

In a few words, this new set is fitted with a buzzer transformer, operating on 6 volts, which gives a very high voltage on the secondary. The alternating current produced in this way is rectified by means of two tubes, smoothed out thru choke coils and applied to the transmitting tube.

The set is shown in the accompanying illustration. At the top, the tuning inductance is barely visible behind the panel. In the left-hand corner the transmitting tube, marked OSC, is mounted. Two tubes, indicated by RECT, are located on either side of the antenna condenser which controls the wavelength of the set. It is interesting to note that ordinary three-element tubes are employed as rectifiers. The grid and plate of each tube are connected together to form one side, while the filament serves as the other.

The grid condenser, on the lower part of the panel, is adjusted for maximum modulation, or the clearest speech. A hot-wire ammeter indicates the radiation.

In operation, after the preliminary adjustments have been made, the switch at the right is pushed up to talk. This connects one battery to the buzzer, which vibrates at a low and steady pitch as long as the transmitter is in use. To listen-in, the switch is put down, stopping the buzzer and changing the antenna and ground to the receiving apparatus.

With two 6-volt storage batteries, this complete set weighs only 60 pounds.

Many advantages of this set will appeal to those who use radio for other than purely experimental work. Under conditions where a motor-generator is out of the question, this method of supplying plate voltage offers no disadvantages. A high potential can be obtained from the buzzer with a correspondingly heavy plate current, yet only a small storage battery is needed. The weight and space of the buzzer are, of course, much smaller than of a motor-generator.

One of the great objections to radio apparatus on motor boats has been that no current supply was available on board, or that only low-voltage direct current was obtainable from the generating system. With this equipment, however, batteries can be carried aboard readily, or the ship's current can be used to charge the batteries.

For portable work, also, the buzzer radiophone is well adapted, and can be employed under many conditions where other types of equipment would be out of the question.

A suggestion given in connection with this set will be helpful for other portable installations, too; namely, that a heavy spike, driven into the trunk of a green tree, makes an excellent ground for radio apparatus when used in the field.

CONCRETE RADIO MASTS

Believed to be the highest concrete masts in the world, the towers of the new Japanese stations are 660 feet high. They are being made at Tomicka-cho, where the stations for which they are to be used will operate with the United States. The estimated daily capacity of these stations is 8,000 words each way.

Within the next two years, if all the present plans for commercial radio are carried out, an amount of traffic never dreamed of ten years ago will be handled by the high-powered stations.

USING VARIOMETERS

Variometers are rapidly increasing in popularity, especially for short wave receivers. Experimenters do not seem to understand, however, that, as a method of varying inductance, the variometer is quite limited, unless the usual proportions are greatly increased.

It is not practical, for example, to replace a tuning condenser by a variometer to give the close adjustments between taps on a coil, unless the taps are taken off at very short intervals.

With the ordinary methods of construction, the variation of inductance obtained does not exceed the inductance of one of the variometer coils.

Digitized by Google

A New Development in Tuning Inductances

Designed on a New Principle, the G. A. Standardized Inductances Represent a Distinct Advance in Coil Construction

By K. H. Stark

IT is very doubtful if Faraday or Henry would recognize the inductances now used for radio reception. Many men have contributed to the development of these coils, carrying them thru from the long, single-layer types to the present low resistance, low capacity, concentrated coils.

There are certain factors which must be considered in designing coils for radio receivers. The most important are listed below in the order of their value, looking at the subject from the point of view of the manufacturer of radio equipment for experimenters.

1. Price.
2. Possibility of quantity production.
3. High frequency resistance.
4. Mechanical dimensions.
5. Distributed capacity.
6. Ease of mounting.
7. Novelty of appearance.

Others, possibly, would put them in a different order. Certainly price and quantity production come first. Then the popularity of a coil will depend upon its efficiency, its adaptability to various uses, and its general appearance.

Thus it can be seen that the development of a new inductance of commercial value is no small problem. In any coil all the factors cannot be met entirely, but an average must be struck.

The new coils, described in this article, were designed to meet, as fully as possible, the various requirements, with particular reference to efficiency, because radio experimenters are rapidly developing an extreme fastidiousness in the selection of their equipment.

The first problem is to get a maximum inductance from a given length of wire. Decreasing the size of the wire makes the turns per inch larger, and increases the inductance, but it also makes the resistance higher. Winding coils in a multilayer form makes the inductance large, and the resistance and capacity as well. Spacing the turns, as is done in the different types of cross-wound coils, brings down the capacity—and the inductance, while the resistance goes up, for a given inductance, because more wire is needed. Another source of loss is due to the insulation and binding varnish. A perfect coil would be one in which the layers are separated entirely by air.

It seems like an affair which is best settled by shaking it up and taking out what comes to the top. Here, however, is a solution.

The G. A. Standardized inductances are a development of the ordinary single layer solenoid, which, in electrical efficiency, is equal to any of the other types, and superior to most of them. On this basis, the attempt was made to put a 2-ft. solenoid in a 1-in. space without sacrificing the electrical efficiency, and gaining the mechanical advantages of a small, self-supporting coil.

How this was done can be seen from the accompanying illustrations. This coil is merely a telescoped solenoid, the sections of which are separated by an air dielectric. This means that, with the turns of each section close together, the inductance per section is high. The total inductance, because of the close interlinking of the fields of the sections, is many times greater than that of an equivalent single-layer solenoid. There is practically no capacity, because of the spacing between sections, and because of the low dielectric constant of air. However, since air is a perfect insulator, there is no loss, indicated by an increased high frequency resistance, as in the case of coils wound with paper between the layers, or unspaced coils where the bare wires are separated only by silk or cotton insulation. Moreover, the losses due to varnish are greatly reduced because only the outer surfaces are coated lightly. The crossing of one wire over another is reduced to eleven times per turn, making a further decrease in electrical losses, and also in the possibility of short circuits. This

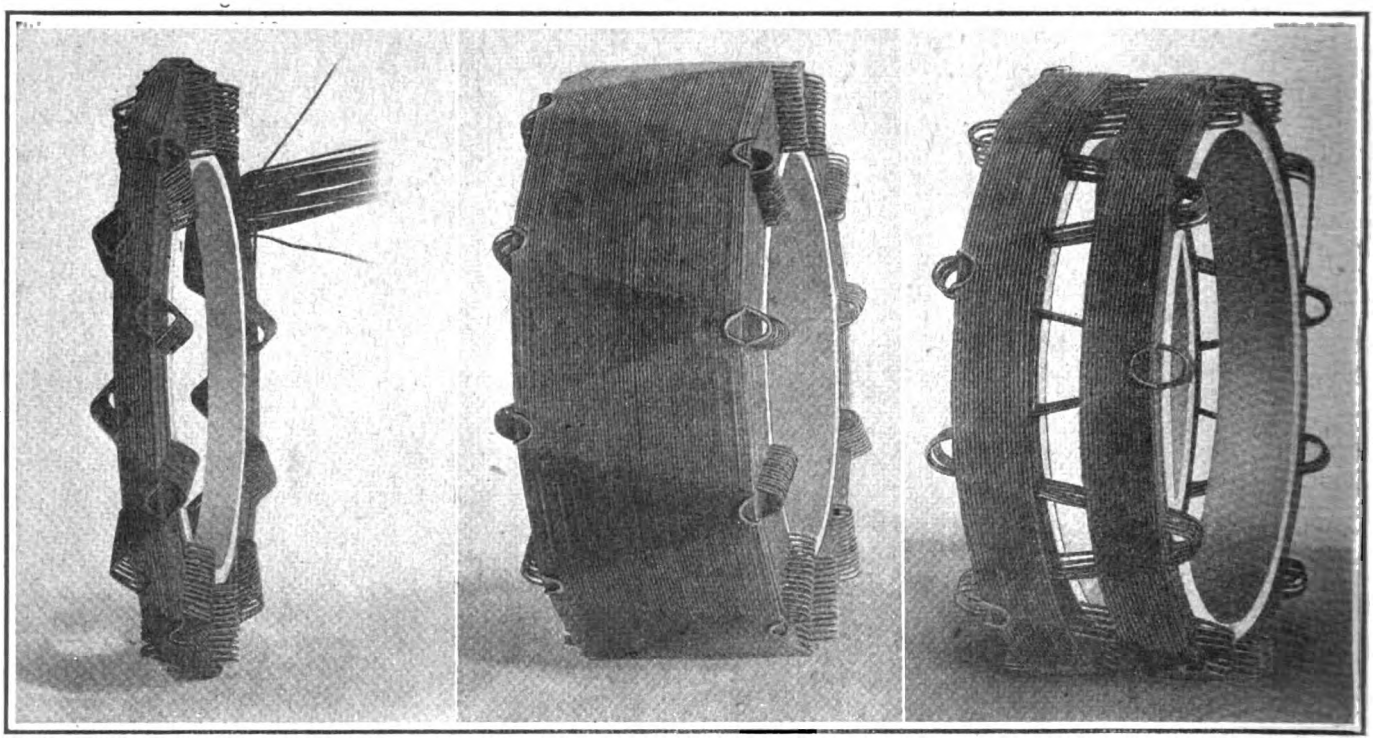


Fig. 1—A coil only 0.2 in. wide, tapped at every layer

Fig. 2—A high inductance coil, not tapped

Fig. 3—This type can be fitted with a shaft to rotate it

Digitized by Google

latter defect is guarded against, too, by using double silk covered wire.

The actual method of winding these coils is as follows:

First the supporting tube is slipped on a mandrel, in the winding machine. Then, by the manipulation of a lever on the machine, two sets of pins, one on each side of the tube, are sprung out, fitting snugly against the ends of the tube. When the end of the wire has been fastened, and the machine started, the mandrel is rotated for one turn, during which time the wire is wound back and forth around the pins. Next, the mandrel is revolved at a higher speed, and one layer of wire wound across the tube, over the cross winding. Subsequent sections are wound

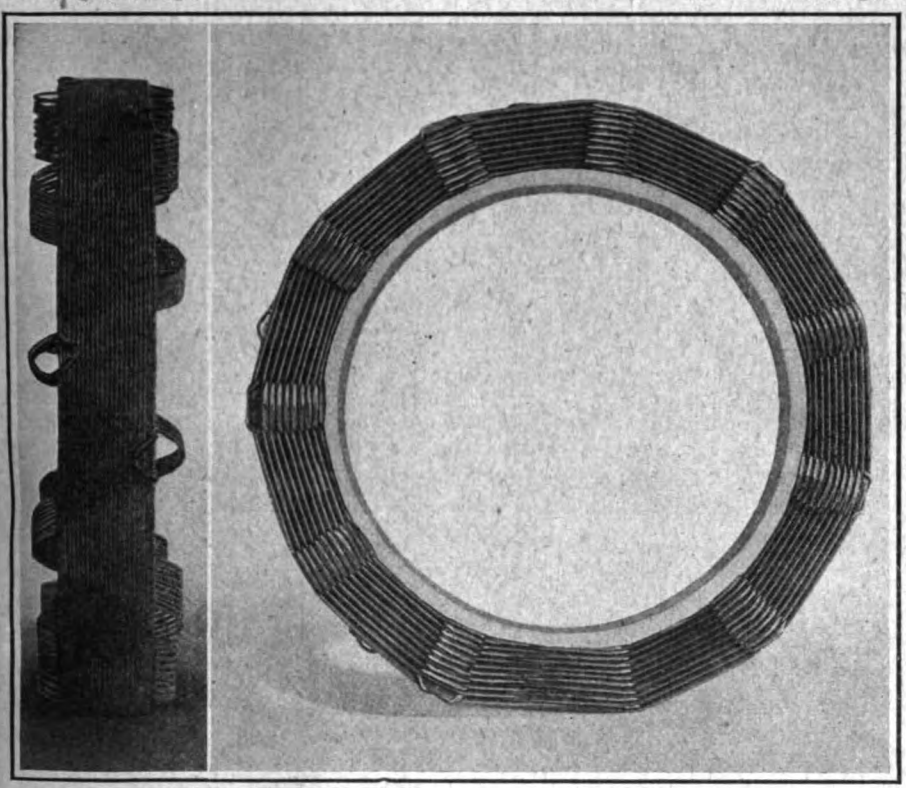


Fig. 4—Front and side views of the "telescoped solenoid" inductance

in a similar manner, first the cross, and then the straight winding. Upon completion, the pins are drawn in, and the coil removed from the mandrel.

The illustrations show the projecting cross wires where they were put around the pins, and make clear the method of spacing the sections by means of the cross windings. Due to the binding effect of each section upon those beneath, these coils possess great mechanical strength. By turning over the loops under the outside section, the turns are effectively prevented from becoming loose. A coat of thin varnish, on the outer surfaces of the coil, completes the work.

In the patent application a modification is described, of the type shown in Fig. 3. This is to take a shaft, so that the coil can be rotated, as in the case of a loose coupler secondary or a variometer. An advantage of the construction is that less space is required when the coil is rotated on a shaft, than when it is swung from a support at the side.

Several ways of mounting the coils are employed. The simplest, when rods are used as supports, is to set a wooden disc inside the tube. Another method is to set two bakelite discs, of a diameter equal to that of the tube, at each end of the tube, and draw them together with machine screws. The discs fit inside the loops of the cross winding. Other means, not ready for publication, are also employed.

The Selection of Inductance and Capacity Valves

ACCOMPANYING this article is a table showing the wavelengths obtained with various capacities from 0.00001 to 0.002 mfd., and inductances of 0.02 to 200 millihenries. This is very useful in determining the inductance and capacity required for a given wavelength.

It should be noted that coils for radio work, unless it is otherwise stated, are rated at their effective inductance, and allowances must be made, in accurate calculations, for the distributed capacity. With these new coils, for all ordinary design purposes, this effect can be disregarded. To determine the distributed capacity of a coil, the following proceedure will be found simple, tho for small capacity measurements the instruments must be very accurately calitrated.

1. Connect the coil to a small capacity, about 0.0002 mfd., and measure the wavelength of the circuit.
2. Increase the condenser to about 0.001 mfd., and measure the wavelength.
3. Substitute the wavelength and condenser capacity found in 2 in the equation $\lambda^2_2 = 3552L\ C_2$.
4. Substitute the wavelength and condenser capacity found in 1 in the equation $\lambda^2_2 = 3552L\ C_2$.
5. Subtract the equation in 4 from the equation in 3.
6. Solve for L. This gives the true inductance of the coil.
7. Substitute the value of L in the equation

$$C = \frac{\lambda^2_2}{3552L} - C_2,$$

and solve for C. This gives the value of the distributed capacity.

For example, a coil, connected with a condenser of 0.0002 mfd., gives a wavelength of 7,299 meters. With 0.001 mfd., it gives 13,380 meters. Substituting in 3,

$$195{,}440{,}400 = 3553 \times L \times 0.001$$

or $195{,}440{,}400 = 3.552L$

Substituting in 4

$$53{,}245{,}401 = 3552 \times L \times 0.0002$$

or $53{,}245{,}401 = .7104L$.

Subtracting 4 from 3

$$195{,}440{,}400 = 3.5520L$$
$$53{,}245{,}401 = .7104L$$
$$142{,}194{,}999 = 2.8416L$$

Then $L = 50{,}000{,}000$ cms.

To find the distributed capacity, substitute the value of L in 7. Then

$$C = \frac{7{,}2992^2}{3552 \times 50{,}000{,}000} - 0.0002,$$

$$C = \frac{53{,}245{,}401}{177{,}600{,}000{,}000} - 0.0002,$$

$$C = 0.0003 - 0.0002,$$

or

$$C = 0.0001,$$

which is the distributed capacity of the coil.

When inductance is measured by the wavemeter method, the capacity across the inductance being measured should be large. Otherwise, the distributed capacity will make a considerable error in the inductance value found. To show this, let us use the foregoing example. With the coil described above, the wavelength, with a condenser of 0.0002 mfd., was found to be 7,299 meters. The apparent inductance would be

$$L_{app.} = \frac{\lambda^2_1}{3552C_1}$$

$$= \frac{53{,}245{,}401}{3552 \times 0.0002}$$

$L_{app.} = 75{,}000{,}000$ cms.

which shows an error of 50% in the apparent inductance. With the larger capacity value, however.

$$L_{app.} = \frac{195{,}440{,}400}{3552 \times 0.001}$$

$L_{app.} = 55{,}000{,}000$ cms.

which is an error of only 10%.

Digitized by Google

Wavelength, Inductance,

C	0.02	0.025	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.14	0.16	0.18	0.20
0.00001.....	27	30	33	38	42	46	50	53	57	60	65	71	75	80	84
0.00002.....	38	42	46	53	60	65	71	75	80	84	92	100	107	113	119
0.00003.....	46	52	57	65	73	80	86	92	98	103	113	122	131	139	146
0.00004.....	53	60	65	75	84	92	100	107	113	119	131	141	151	160	169
0.00005.....	60	67	73	84	94	103	112	119	126	133	146	158	169	179	189
0.00006.....	65	73	80	92	103	113	122	131	139	140	160	173	185	196	207
0.00007.....	71	79	86	100	112	122	132	141	150	158	173	187	200	212	223
0.00008.....	75	84	92	107	119	131	141	151	160	169	185	200	213	226	238
0.00009.....	80	89	98	113	126	139	150	160	170	179	196	212	226	240	253
0.00010.....	84	94	103	119	133	146	158	169	179	189	207	223	238	253	267
0.00012.....	92	103	113	131	146	160	173	185	196	207	226	244	261	277	292
0.00014.....	100	112	122	141	158	173	187	200	212	223	244	264	282	299	315
0.00016.....	107	119	131	151	169	185	200	213	226	238	261	282	302	320	337
0.00018.....	113	126	139	160	179	196	212	226	240	253	277	299	320	339	358
0.00020.....	119	133	146	169	189	207	223	238	253	267	292	315	337	358	377
0.00025.....	133	149	163	188	211	231	249	267	283	298	326	353	377	400	421
0.00030.....	146	163	179	206	231	253	273	292	310	326	358	386	413	438	462
0.00040.....	169	188	206	238	267	292	315	337	358	377	413	446	477	506	533
0.00050.....	188	211	231	267	298	326	353	377	400	421	462	449	533	565	596
0.00060.....	206	231	253	292	326	358	386	413	438	462	506	546	584	619	653
0.00070.....	223	249	273	315	353	386	417	446	473	499	546	590	631	669	705
0.00080.....	238	267	292	337	377	413	446	477	506	533	584	631	674	715	754
0.00090.....	253	283	310	358	400	438	473	506	536	565	619	669	715	759	800
0.00100.....	267	298	326	377	421	462	499	533	565	596	653	705	754	800	843
0.00110.....	280	313	342	395	442	484	523	559	593	625	685	740	791	839	884
0.00120.....	292	326	358	413	462	506	546	584	619	653	715	772	826	876	923
0.00130.....	304	340	372	430	481	526	569	611	645	680	744	804	859	912	961
0.00140.....	315	353	386	446	499	546	590	631	669	705	772	834	892	946	997
0.00150.....	326	365	400	462	516	565	611	653	690	730	800	864	923	979	1,032
0.00160.....	337	377	413	477	533	584	631	674	715	754	826	892	954	1,011	1,062
0.00170.....	348	389	426	491	550	502	650	695	737	777	851	920	983	1,042	1,099
0.00180.....	358	400	438	506	565	619	669	715	759	800	876	946	1,011	1,073	1,131
0.00190.....	367	411	450	520	581	637	687	735	780	822	900	972	1,041	1,102	1,162
0.00200.....	377	421	462	533	596	653	705	754	800	843	923	997	1,066	1,131	1,192

C	2.5	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	18.0	20.0	25.0
0.00001.....	298	326	377	421	462	499	533	565	596	653	705	754	800	843	942
0.00002.....	421	462	533	596	653	705	754	800	843	923	997	1,066	1,131	1,192	1,333
0.00003.....	516	566	653	730	800	864	923	979	1,032	1,131	1,221	1,306	1,385	1,460	1,632
0.00004.....	596	653	754	843	923	997	1,066	1,131	1,192	1,306	1,410	1,509	1,599	1,686	1,885
0.00005.....	663	730	843	942	1,032	1,115	1,192	1,264	1,333	1,460	1,577	1,686	1,788	1,885	2,108
0.00006.....	730	800	923	1,032	1,131	1,221	1,306	1,385	1,460	1,599	1,727	1,846	1,959	2,065	2,308
0.00007.....	789	864	997	1,115	1,221	1,320	1,410	1,496	1,577	1,727	1,866	1,995	2,116	2,230	2,493
0.00008.....	843	923	1,066	1,192	1,306	1,410	1,509	1,599	1,686	1,846	1,995	2,133	2,262	2,384	2,665
0.00009.....	894	979	1,131	1,264	1,385	1,496	1,599	1,696	1,788	1,959	2,116	2,262	2,399	2,529	2,827
0.00010.....	942	1,032	1,192	1,333	1,460	1,577	1,686	1,788	1,885	2,065	2,230	2,384	2,529	2,665	2,980
0.00012.....	1,032	1,131	1,306	1,460	1,599	1,727	1,846	1,959	2,065	2,262	2,443	2,612	2,770	2,920	3,264
0.00014.....	1,115	1,221	1,410	1,577	1,727	1,846	1,995	2,116	2,230	2,443	2,639	2,821	2,992	3,164	3,526
0.00016.....	1,192	1,306	1,509	1,686	1,846	1,995	2,133	2,262	2,384	2,612	2,821	3,016	3,199	3,372	3,770
0.00018.....	1,264	1,385	1,599	1,788	1,959	2,116	2,262	2,399	2,529	2,770	2,992	3,199	3,392	3,576	3,998
0.00020.....	1,333	1,460	1,686	1,885	2,065	2,230	2,384	2,529	2,665	2,920	3,154	3,372	3,576	3,770	4,214
0.00025.....	1,490	1,632	1,885	2,108	2,308	2,493	2,665	2,827	2,980	3,264	3,526	3,770	3,998	4,214	4,713
0.00030.....	1,632	1,788	2,065	2,308	2,529	2,732	2,920	3,097	3,264	3,576	3,863	4,129	4,379	4,617	5,161
0.00040.....	1,885	2,065	2,384	2,665	2,920	3,154	3,372	3,576	3,770	4,129	4,460	4,768	5,057	5,331	5,960
0.00050.....	2,108	2,380	2,665	2,980	3,264	3,526	3,770	3,998	4,214	4,617	4,987	5,331	5,654	5,960	6,663
0.00060.....	2,308	2,529	2,920	3,264	3,578	3,863	4,129	4,379	4,617	5,057	5,462	5,840	6,192	6,529	7,299
0.00070.....	2,493	2,732	3,154	3,526	3,863	4,172	4,460	4,731	4,987	5,462	5,900	6,306	6,693	7,052	7,885
0.00080.....	2,665	2,920	3,372	3,770	4,129	4,460	4,768	5,057	5,331	5,840	6,306	6,741	7,152	7,539	8,429
0.00090.....	2,827	3,097	3,576	4,000	4,379	4,731	5,057	5,364	5,654	6,192	6,693	7,152	7,587	7,996	8,940
0.00100.....	2,980	3,264	3,770	4,214	4,617	4,987	5,331	5,654	5,960	6,529	7,052	7,539	7,996	8,429	9,423
0.00110.....	3,125	3,424	3,953	4,420	4,842	5,230	5,591	5,930	6,251	6,848	7,396	7,909	8,386	8,810	9,880
0.00120.....	3,264	3,576	4,129	4,617	5,057	5,462	5,840	6,192	6,529	7,152	7,724	8,261	8,761	9,233	10,320
0.00130.....	3,398	3,722	4,298	4,805	5,264	5,685	6,109	6,449	6,796	7,444	8,040	8,594	9,119	9,611	10,750
0.00140.....	3,526	3,863	4,460	4,987	5,462	5,900	6,306	6,693	7,052	7,724	8,344	8,922	9,459	9,973	11,150
0.00150.....	3,650	3,998	4,617	5,161	5,654	6,109	6,529	6,902	7,299	7,996	8,637	9,233	9,794	10,320	11,540
0.00160.....	3,770	4,129	4,768	5,331	5,840	6,306	6,741	7,152	7,539	8,261	8,922	9,536	10,110	10,660	11,920
0.00170.....	3,885	4,256	4,915	5,495	6,020	6,502	6,949	7,373	7,771	8,511	9,196	9,828	10,420	10,990	12,290
0.00180.....	3,998	4,379	5,057	5,654	6,192	6,693	7,152	7,587	7,996	8,761	9,459	10,110	10,730	11,310	12,640
0.00190.....	4,108	4,500	5,196	5,809	6,365	6,872	7,384	7,796	8,215	9,000	9,721	10,410	11,020	11,620	12,990
0.00200.....	4,214	4,617	5,331	5,960	6,529	7,052	7,539	7,996	8,429	9,230	9,973	10,660	11,310	11,920	13,330

Digitized by Google

and Capacity Table

0.25	0.30	0.40	0.50	0.60	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	C
94	103	119	133	146	158	169	179	189	207	223	238	253	267	0.00001
133	146	169	189	207	223	238	253	267	292	315	337	358	377	0.00002
163	179	207	231	253	273	292	310	326	358	386	413	438	462	0.00003
189	207	238	267	292	315	337	358	377	413	446	477	506	533	0.00004
211	231	267	298	326	353	377	400	421	462	499	533	565	596	0.00005
231	253	292	326	358	386	413	438	462	506	546	584	619	653	0.00006
249	273	315	353	386	417	446	473	499	546	590	631	669	705	0.00007
267	292	337	377	413	446	477	506	533	584	631	674	715	754	0.00008
283	310	358	400	438	473	506	536	565	619	669	715	759	800	0.00009
298	326	377	421	462	499	533	565	596	653	705	754	800	843	0.00010
326	358	413	462	506	546	584	619	653	715	772	826	876	923	0.00012
353	387	446	499	546	590	631	669	705	772	834	892	946	997	0.00014
377	413	477	533	584	631	674	715	754	826	892	954	1,011	1,066	0.00016
400	438	506	565	619	669	715	759	800	876	946	1,011	1,073	1,131	0.00018
421	462	533	596	653	705	754	800	843	923	997	1,066	1,131	1,192	0.00020
471	516	596	666	730	789	843	894	942	1,032	1,115	1,192	1,264	1,333	0.00025
516	566	653	730	800	864	923	979	1,032	1,131	1,221	1,306	1,385	1,460	0.00030
596	653	754	843	923	997	1,066	1,131	1,192	1,306	1,410	1,509	1,599	1,696	0.00040
666	730	843	942	1,032	1,115	1,192	1,264	1,333	1,460	1,577	1,686	1,788	1,885	0.00050
730	800	923	1,032	1,131	1,221	1,306	1,385	1,460	1,599	1,727	1,846	1,959	2,065	0.00060
789	864	997	1,115	1,221	1,320	1,410	1,496	1,577	1,727	1,866	1,995	2,116	2,230	0.00070
843	923	1,066	1,192	1,306	1,410	1,509	1,599	1,686	1,846	1,995	2,133	2,262	2,384	0.00080
894	979	1,131	1,264	1,385	1,496	1,599	1,696	1,788	1,959	2,116	2,262	2,399	2,529	0.00090
942	1,032	1,192	1,333	1,460	1,577	1,686	1,788	1,885	2,065	2,230	2,384	2,529	2,665	0.00100
988	1,083	1,250	1,398	1,531	1,654	1,768	1,875	1,977	2,165	2,339	2,500	2,652	2,795	0.00110
1,032	1,131	1,306	1,460	1,599	1,727	1,846	1,959	2,065	2,262	2,443	2,612	2,770	2,920	0.00120
1,075	1,177	1,359	1,520	1,665	1,798	1,922	2,039	2,149	2,354	2,543	2,718	2,883	3,039	0.00130
1,115	1,221	1,410	1,577	1,727	1,866	1,995	2,116	2,230	2,443	2,639	2,821	2,992	3,154	0.00140
1,154	1,264	1,460	1,632	1,788	1,932	2,065	2,190	2,308	2,529	2,732	2,920	3,097	3,264	0.00150
1,192	1,306	1,509	1,686	1,846	1,995	2,133	2,262	2,384	2,612	2,821	3,016	3,199	3,372	0.00160
1,229	1,346	1,554	1,737	1,904	2,056	2,198	2,332	2,457	2,692	2,908	3,108	3,297	3,475	0.00170
1,264	1,385	1,599	1,788	1,959	2,116	2,262	2,399	2,529	2,770	2,992	3,199	3,392	3,576	0.00180
1,299	1,423	1,643	1,837	2,012	2,174	2,324	2,465	2,598	2,846	3,074	3,286	3,485	3,674	0.00190
1,333	1,460	1,686	1,885	2,065	2,230	2,384	2,529	2,665	2,920	3,154	3,372	3,576	3,770	0.00200

30.0	40.0	50.0	60.0	70.0	80.0	90	100	120	140	160	180	200	C,
1,032	1,192	1,333	1,460	1,577	1,686	1,788	1,885	2,065	2,230	2,384	2,529	2,665	0.00001
1,460	1,686	1,885	2,065	2,230	2,384	2,529	2,665	2,920	3,154	3,372	3,576	3,770	0.00002
1,788	2,065	2,308	2,529	2,732	2,920	3,097	3,264	3,576	3,863	4,129	4,379	4,617	0.00003
2,065	2,384	2,665	2,920	3,154	3,372	3,576	3,770	4,129	4,460	4,768	5,057	5,331	0.00004
2,308	2,665	2,980	3,264	3,526	3,770	3,998	4,214	4,617	4,987	5,331	5,654	5,960	0.00005
2,529	2,920	3,264	3,578	3,862	4,129	4,379	4,617	5,057	5,462	5,840	6,192	6,529	0.00006
2,732	3,154	3,526	3,863	4,172	4,460	4,731	4,987	5,462	5,900	6,306	6,693	7,052	0.00007
2,920	3,372	3,770	4,129	4,460	4,768	5,057	5,331	5,840	6,306	6,741	7,152	7,539	0.00008
3,097	3,576	4,000	4,379	4,731	5,057	5,364	5,654	6,192	6,693	7,152	7,587	7,996	0.00009
3,264	3,770	4,214	4,617	4,987	5,331	5,654	5,960	6,529	7,052	7,539	7,996	8,429	0.00010
3,576	4,129	4,617	5,057	5,462	5,840	6,192	6,529	7,152	7,724	8,261	8,761	9,233	0.00012
3,863	4,460	4,987	5,462	5,900	6,306	6,693	7,052	7,724	8,344	8,922	9,459	9,973	0.00014
4,129	4,768	5,331	5,840	6,306	6,741	7,152	7,539	8,261	8,922	9,536	10,110	10,660	0.00016
4,379	4,057	5,654	6,192	6,693	7,152	7,587	7,996	8,761	9,459	10,110	10,730	11,310	0.00018
4,617	5,331	5,960	6,529	7,052	7,539	7,996	8,429	9,230	9,973	10,660	11,310	11,920	0.00020
5,161	5,960	6,663	7,299	7,885	8,429	8,940	9,423	10,320	11,150	11,920	12,640	13,330	0.00025
5,659	6,529	7,299	7,996	8,637	9,233	9,794	10,320	11,310	12,210	13,060	13,850	14,600	0.00030
6,529	7,539	8,429	9,233	9,973	10,660	11,310	11,920	13,060	14,100	15,090	15,990	16,860	0.00040
7,299	8,429	9,423	10,320	11,150	11,920	12,640	13,330	14,600	15,770	16,860	17,880	18,850	0.00050
7,996	9,233	10,320	11,310	12,210	13,060	13,850	14,600	15,990	17,270	18,460	19,590	20,650	0.00060
8,637	9,973	11,150	12,210	13,200	14,100	14,960	15,770	17,270	18,660	19,950	21,160	22,300	0.00070
9,233	10,660	11,920	13,060	14,100	15,090	15,990	16,860	18,460	19,950	21,330	22,620	23,840	0.00080
9,794	11,310	12,640	13,850	14,960	15,990	16,960	17,880	19,590	21,160	22,620	23,990	25,290	0.00090
10,320	11,920	13,330	14,600	15,770	16,860	17,880	18,850	20,650	22,300	23,840	25,290	26,650	0.00100
10,830	12,500	13,980	15,310	16,540	17,680	18,760	19,770	21,650	23,390	25,000	26,520	27,950	0.00010
11,310	13,060	14,600	15,990	17,270	18,460	19,590	20,650	22,620	24,430	26,120	27,700	29,200	0.00120
11,770	13,590	15,200	16,650	17,980	19,220	20,390	21,490	23,540	25,430	27,120	28,830	30,390	0.00130
12,210	14,100	15,770	17,270	18,660	19,950	21,160	22,300	24,430	26,390	28,210	29,920	31,540	0.00140
12,640	14,600	16,320	17,880	19,320	20,650	21,900	23,080	25,290	27,320	29,200	30,970	32,640	0.00150
13,060	15,090	16,860	18,460	19,950	21,330	22,620	23,840	26,120	28,210	30,160	31,990	33,720	0.00160
13,460	15,540	17,370	19,040	20,560	21,980	23,320	24,570	26,920	29,080	31,080	32,860	34,750	0.00180
13,850	15,990	17,880	19,590	21,160	22,620	23,990	25,290	27,700	29,920	31,990	33,720	35,760	0.00180
14,230	16,430	18,370	20,120	21,740	23,240	24,650	25,980	28,460	30,740	32,860	34,850	36,740	0.00190
14,600	16,860	18,850	20,650	22,300	23,840	25,290	26,650	29,200	31,540	33,720	35,760	37,770	0.00200

Digitized by Google

The Uni-Control Receiver

A Set, Built By the Wireless Improvement Company, Which Is Controlled By a Single Adjustment

THERE is an inherent disadvantage in the usual type of radio receiving apparatus in that, while listening in, only such stations are heard as may be transmitting on the wavelength to which the receiving is tuned. To overcome this difficulty, Mr. Roy E. Thompson of the Wireless Improvement Co. designed the uni-control set described in this article.

As may be implied from the name the uni-control receiver is designed to be operated by the adjustment of a single handle, shown in Fig. 1, at the lower left-hand corner of the panel. For listening in, this handle is continuously revolved by a motor connected thru a worm gear and flexible shaft to the single adjustment. When the motor is started the set is slowly tuned over a range of 300 to 3,000 meters. When a station is heard, the operator merely switches off the motor and makes a close adjustment of the tuning by means of the handle.

This summarizes the operation of the uni-control receiver.

There are several distinct advantages in the use of a set of this type. In the first place, it assures the reception of any call which is transmitted at a wavelength in the range of the receiver. If equipment of this sort were generally adopted, the disadvantage of a single calling wave would be overcome, with the result that interference would be greatly reduced, as a station could call on a wave which another station, also sending, was not using and the calling operator could depend upon the reception of his signals. While it may not be advantageous to reduce the responsibility of the radio operator to too great an extent, it is certain that this type of set would increase the effectiveness of an operator inclined to be indifferent in carrying out his duties.

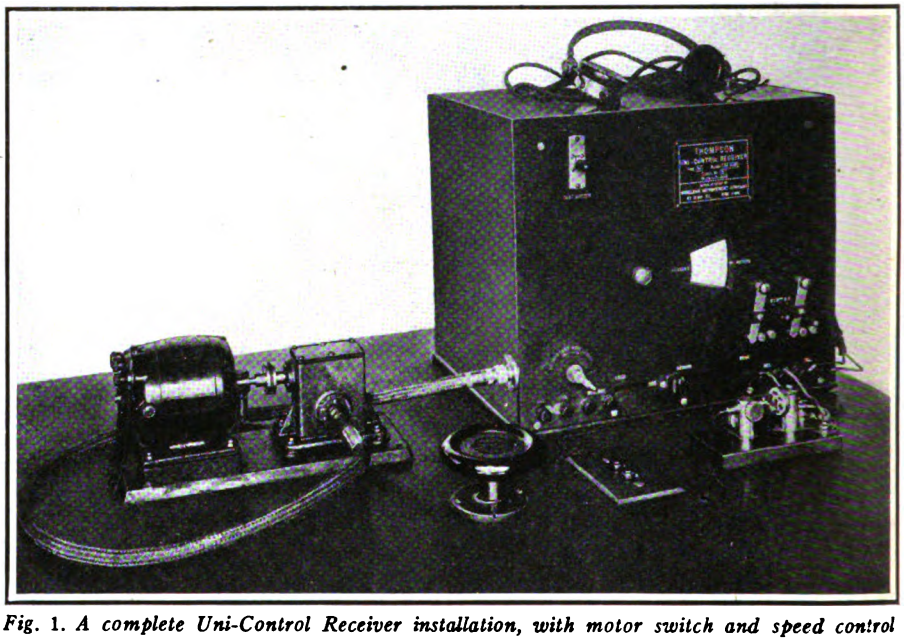


Fig. 1. A complete Uni-Control Receiver installation, with motor switch and speed control

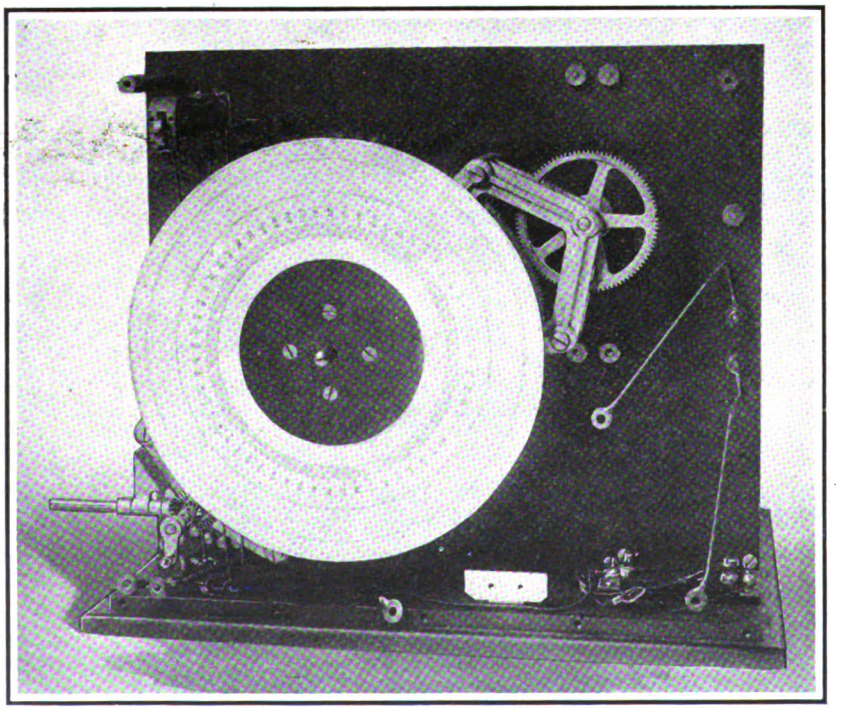


Fig. 2. The main panel removed, showing the arrangement on the sub-panel

Detailed views of the uni-control receiver are shown in Figs. 2, 3 and 4. Fig. 2 shows the front of the set with panes removed; Fig. 3 is a top view, and Fig. 4, the front, with the wavelength indicating dial removed.

The circuit employed with the set is of the untuned secondary type. The primary inductance is divided into two sections, one with twenty-six taps brought off at short intervals and the other with nine larger steps. The latter coil is broken by four dead-end switches. A coupling control is provided between the secondary and the primary coils, so that the signal's strength can be varied.

On the shaft which carries the wavelength indicating dial there is a switch which moves over two concentric sets of segments which are connected to the large steps on the inductance. A small sector of the inner circle goes to the variable condenser and on to the small step switch mounted at the rear lower left-hand corner of the sub-panel. Both the condenser and small step switch are continuously rotated as long as the wavelength indicated dial shaft is being turned. The condenser, however, is only used for short wave reception when the switches are in a position for minimum inductance. When this point has been passed—that is, the wavelength increased from the minimum to the maximum value obtainable with the full capacity of the condenser—the inductance is increased by cutting in more turns of the small section. The wavelength is still further increased until the end of the small step

Digitized by Google

switch is reached. At this point it moves on to zero, but the first large step of inductance is cut in. Again the small step switch is rotated until it passes from maximum to minimum

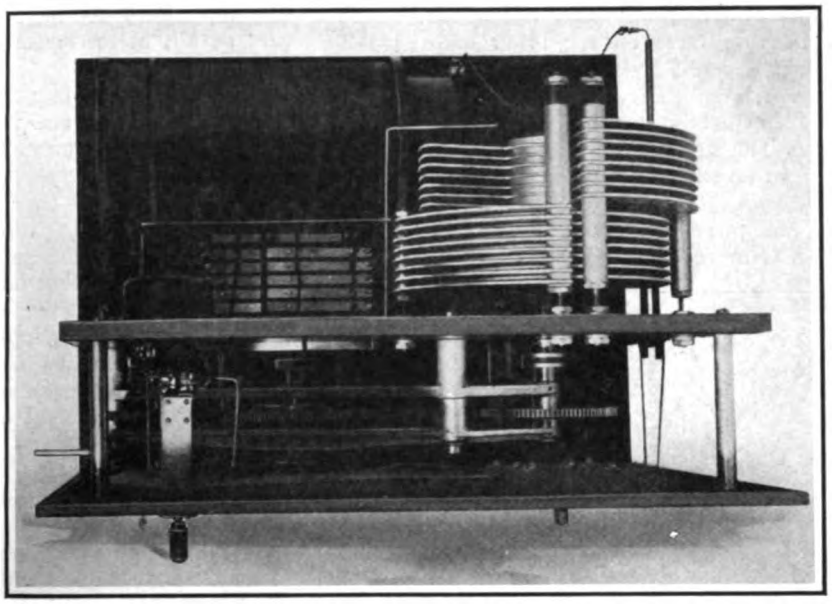


Fig. 3. Looking down on the top of the set, the inductance, dead-end switch, and condenser can be seen

as another large section of the coil is brought into circuit. In this way a continual variation from the low wavelength obtained by the use of the series condenser is slowly accomplished until all of the small steps and all the large steps of inductance are in use.

In Fig. 4 the large gear is clearly shown. At the upper right-hand corner is the gear which rotates the variable condenser. Down in the left-hand corner there is a set of beveled gears, to one of which is secured the flexible shaft from the motor. The other beveled gear is on the shaft which drives, thru a spur gear, the large controlling gear. On this shaft, also, is the switch arm for the small step switch, the points of which are just visible below the beveled gear.

Fig. 3 illustrates the tuning inductance and dead-end switches; it also makes more clear the relation of the driving gears.

Fitted to the shaft carrying the large gear is a dial divided into 300 sections, opposite which a calibration can be made after the receiving is set up with a particular antenna.

The manual control of the wavelength adjustment is rather interesting; by pushing in the handle, the beveled gear is disengaged from that on the flexible shaft, so that the motor is not rotated when the adjustment is controlled by hand.

LOOP ANTENNAS

(*Continued from page* 441)

effect of the loop; that is, signals are received electrostatically, as with an ordinary antenna, as well as electromagnetically, due to the true loop action.

This effect can be overcome, except in extreme cases, by the use of a condenser made with two opposite semi-circular plates and one semi-circular movable plate. By turning the shaft, the movable plate is brought over either stationary one. The movable plate is connected to the ground, one fixed plate to one terminal of the loop and the other plate to the other loop terminal. By adjusting the position of the movable plate with respect to the fixed ones, the antenna effect and resulting distortion can be balanced out.

Transmitting with a Loop

The usual sending apparatus can be used with a loop. The primary of the oscillation transformer should be in series with the condenser and spark gap, with the spark coil across the gap. The secondary of the oscillation transformer goes to the terminals of the loop, with a small condenser in one of the leads. This should be adjustable, by some means, for sharp tuning. A satisfactory method is to make up a variable air condenser having a large separation between the plates and heavy insulation. This can be shunted around the fixed condenser.

When an audion transmitter is employed, the loop can be tapped at the middle and connected in a manner similar to that employed for the heterodyne wavemeter, described in the June, 1920, issue of Everyday Engineering. Other circuits are shown in "Radio Hook-Ups," by M. B. Sleeper.

Heavy wire is needed for the loop winding. Using two or more wires in parallel has been found satisfactory.

THE RADIO REGISTRY

All kinds of opportunities are coming up in radio work, not only in the United States but in foreign countries as well. Men to fill these positions cannot be located readily, but they will be found through the Radio Register. The following information, clearly written, is needed for proper registration:

Name. Address. Engineer or Experimenter. Age. Experience. Special qualifications. Radio station owned, if any.

Address your letters to the Radio Department, Everyday Engineering.

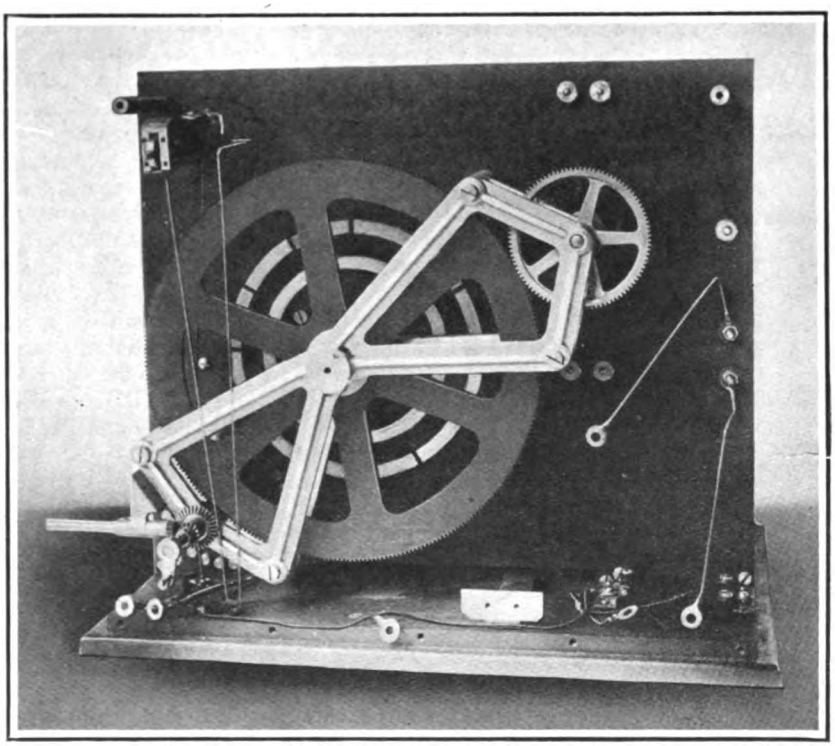


Fig. 4. With the indicating dial removed, the switch segments are visible

Digitized by Google

An Interesting Type of Pneumatic Drill

THE immense value of model making to engineering development was probably never better illustrated than in the case of the designing of the very novel and interesting type of pneumatic drill illustrated herewith and described in a recent issue of the *Model Engineer and Electrician* of London. The inventor and patentee is Mr. Charles Desoutter, whose name will be remembered as the constructor of several successful compressed air and CO_2 power driven model aeroplanes just before the war. It was from experience gained in making the small single and two cylinder engines for these models that Mr. Desoutter realized the possibilities in the improvement of the design of the pneumatic drills in general use.

The power of these small motors was remarkable, bearing in mind the small bore of the cylinders and light weight. The same characteristics apply to this new drill. It weighs only one pound, fourteen ounces, and the cylinders, of which there are five, are 7-16th in. bore, yet there is sufficient power to enable one to penetrate a ½-in. mild steel plate with a ¼-in. drill in 28 seconds.

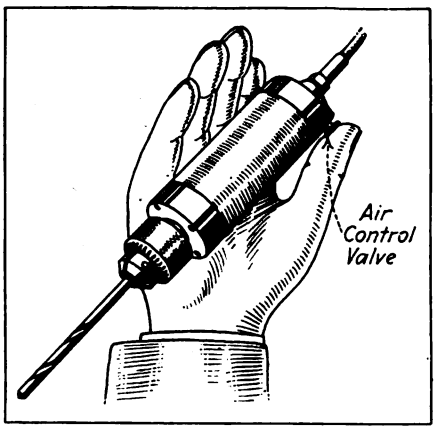
The machine takes the form of a cylinder 4 ins. long by 1⅝ ins. diameter, from which the chuck protrudes. This is grasped in the palm of the hand and the air is controlled by a press button placed in the head of the drill. Being so light and operated by one hand it proves to be an enormous time and labor saver for all types of constructional work where it is inconvenient or impossible to employ a bench drilling machine or the usual form of breast drill. For the same power, the electric or usual type of pneumatic drills generally require two hands to operate and consequently a second man is often needed on the job to hold and adjust the work being drilled.

The drill is wonderfully efficient where the consumption of air is concerned, taking only four cubic feet per minute at a pressure of 80 lbs. per sq. in. It requires only a small diameter feed tube and is practically vibrationless.

The drill essentially consists of the casing, control, actuating mechanism, bearing and drill chuck. The casing is a steel tube within which the parts are assembled, leaving only the control button, the air connection and the chuck protruding. This casing is knurled for convenience of handling. The control consists of a slide valve actuated by a press button, which has automatic return to the off position.

The actuating mechanism consists of a block of five cylinder of 7-16th in. bore and 1⅛th in. stroke, disposed symmetrically with respect to a central axis, and with their bores parallel to one another (see Fig. 1). Within each cylinder is a hollow piston, which has two working faces on the lower end. These fit a specially shaped cam, to be described later. The working faces or slides are cut spirally on a special machine. The design of these pistons is shown in accompanying plate.

The cam, shown at 3, is machined from one piece of steel; incorporated with it is the conical extension for the



Cut showing small size of pneumatic drill

chuck; the central members of the ball race; the double spiral working face which produces the rotary motion; a groove, the purpose of which is explained later, and a keyed drive for the valve. The cam is mounted so as to rotate about the central axis, partly inside the recessed portion of the cylinder block. The pistons are operated in succession, and controlled by a distribution valve. It will be seen that on the down stroke (which takes place whilst the pistons are on the left-hand spiral side of the cam) the cam will be given a rotary motion in the usual direction for drills. The pistons on the other, or right-hand, spiral face will be pushed upwards, the exhaust being operated by the distributing valve.

This valve is of the rotary type and is illustrated at 6. It works on the circular valve face in the centre of the cylinder head shown at 11. As each piston reaches the top and then the bottom of its stroke, the valve automatically admits air in the first case, and permits the exhaust to take place when the bottom of the stroke is reached. This occurs with each cylinder in succession. There being five cylinders and pistons, a continuous motion is thus given to the cam. At the bottom of each stroke two small ports are exposed in each cylinder, which allow oil to be blown on to the cam face and ball race. The purpose of the groove previously referred to is to accommodate a pin protruding from the extension of each piston. If the drill is rotated by hand these pins cause the pistons to follow the contour of the cam. If the pins were not there the pistons would be left at the top of the stroke.

The cylinder heads, valve face, inlet and exhaust ports are all in one piece, shown at 11. As previously mentioned the valve is of the rotary type, thus doing away with the loss of time inseparable from reciprocating valves. The only working parts of this rotary valve are the actual distributing faces, and the wear on these parts is minimized by the special device described later. As explained, the valve works in the cylinder head, and uneven wear is prevented by making it integral with a long stem reaching the length of the cylinder block. The lower end of the center stem is a sliding fit in a sleeve which is keyed to the center of the cam. The drive from the sleeve to the valve stem is through a mechanical lifting device which is balanced by the pressure on the valve. This practically eliminates friction on the valve face and consequent wear.

The cam rotates in a large ball bearing of which it forms the central member. Two large diameter outer races fitted with balls of ample size complete the essentials of the bearing, which hard practical testing has proved to have an ample margin of strength and wearing qualities for the work demanded of it. The thin steel ring shown at 5, is a distance piece clamped between the outer races and forms the only adjustment required. These are in varying thickness by .0005 in. and if the bearing requires adjustment a thinner or thicker one is put in as the case may be. Thus it will be seen that the race can be taken apart and put together again with a minimum of trouble and no risk of mal-adjustment.

The internals of the drill are kept in place by the screwed control valve housing, 9, and the screwed disc, 10. These screw at the top and bottom of the steel casing respectively. The conical end of the cam protrudes from the lower end of the drill and is fitted with a No. 1 Jacob's chuck. This is kept on by a taper-fit and screw.

A very important factor in the efficiency of the drill as far as air consumption is concerned is the arrangement of employing one valve to control five cylinders, thus reducing leakage to a minimum. Loss of air is also prevented by having the valve parts directly on top of each cylinder. Friction on the valve face is reduced to an insignificant amount because a balancing device is provided. Another important point is the fact that the specially shaped cam gives a longer effec-

Digitized by Google

tive piston stroke than can be produced by a crank.

It will be observed that the form of construction of the cylinder block presents a means of getting the maximum power in the smallest space practicable. As they lie together, the cylinders of course do not occupy anything like the space of a motor of the projecting cylinders type, nor is there any wasted space. The original arrangement of the cylinders gives great strength for a minimum of metal, and the fact that the cylinder heads, valve pockets, and inlet and exhaust parts, are all in one part, together with the employment of hollow

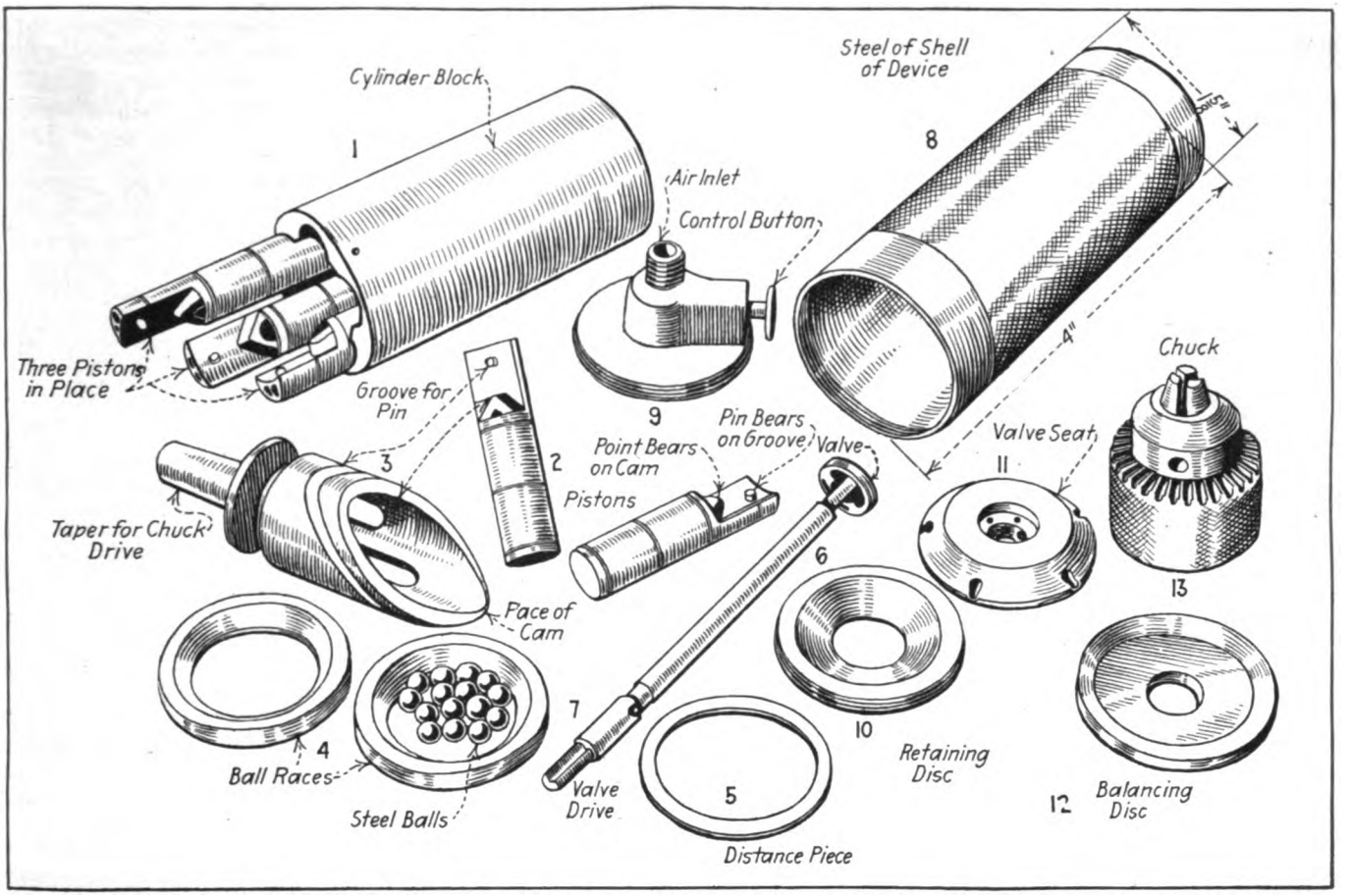
waste air when it is laid down.

Wear on the distributing valve and valve faces is negligible, due both to the balancing device and the combination of metals used. The foregoing description is of one particular machine incorporating the Desoutter Patents in pressure fluid operated drills and other rotary tools. We understand that drills of a larger capacity are now under construction and it is intended to apply the principle to such other tools as pneumatic spanners for motor car erection (with reduction worm drive in the head and reverse), tapping machines, reaming machines, etc.

exists due to the great weight of the water above them.

The diving armor illustrated is made of steel and bronze and is so very heavy that a derrick is required to raise and lower this massive bulk into the water. An eye is provided in the top of the headpiece which engages the hook at the end of the fall line.

With the ordinary form of diving armor the water pressure is resisted by internal air pressure inside of the suit, but as there is a limit to the amount of air pressure that a man can resist, it will be apparent that the depth to which he can go depends entirely upon



The Desoutter pneumatic drill mechanism shows how experience gained in model-making was applied in developing a practical tool

pistons, contributes to this end. Vibration is practically eliminated by using five instead of an even number of cylinders.

Experience has proved that wear is practically negligible. The first experimental model, after two years' hard use, showed no signs of wear on the cam or piston slides, and the circumferential wear on the pistons was not discernible. The control valve is of the slide valve type, controlled by a push button. There is no spring in the control mechanism. The rod of the press button acts as a piston, working through a small leather gland, the working pressure being used to force this outwards, and thus automatically closing the control valve. The drill cannot therefore continue to work and

DEEP-SEA DIVING ARMOR

THE ordinary form of diving armor generally used limits the diver's work to depths where the water pressure will not be great enough to crush the diver's body, which receives but little reinforcement from the rubber material of which the ordinary suit is composed, unless it is distended with compressed air. Many ships carrying rich cargoes have been sunk in water that is much too deep to be invaded by a diver in the usual form of armor, because he cannot work under too high air pressure. New forms of diving armor are being constantly invented which give the operator more protection and which enable him to reach ships that are so far down that a terrible water pressure

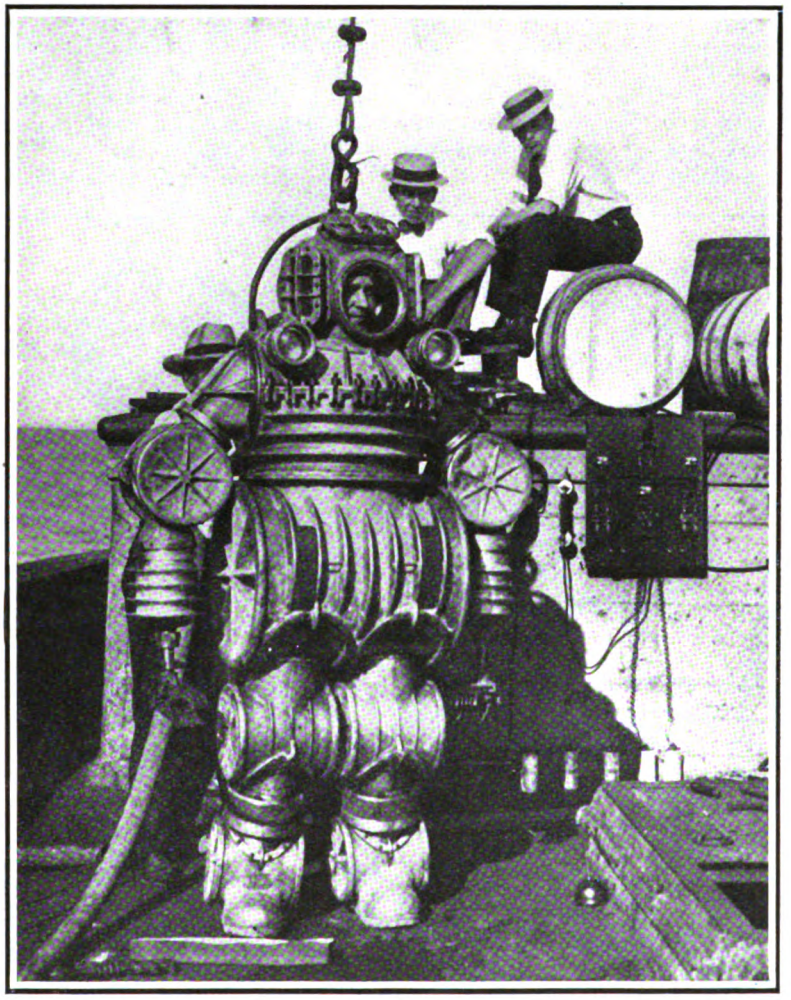
his powers of resistance to the air pressure. If the diving armor itself is structurally strong and can resist the pressure, the diver can be supplied with air at a very slight pressure, not much above normal, that will permit him to work to much better advantage.

The armor shown was invented with the main object in view of permitting salvaging operations on the numerous vessels that were sunk during the war in water too deep to be reached by ordinary means. Special clamps are provided at the ends of the arm containers which are worked from inside of the armor. These are shaped so that ordinary tools may be held and some work done. At each side of the headpiece, above the breast, are two electric lights which are intended to assist

Digitized by Google

in illuminating the parts of the vessel on which the diver is to work.

The armpieces and legpieces are movable, special joints being provided for permitting some movement and at the same time to keep out the water. The suit is ribbed in order to increase its stiffness without correspondingly increasing the weight. As is usual, a telephone is carried inside of the armor with which the diver communicates with the persons above in charge of the air machinery or other apparatus.



Diving armor of great strength makes deep-sea diving practical

SOLUTIONS FOR KILLING FLIES

THE United States Government makes the following suggestion for the destruction of house flies: Formaldehyde and solium salicylate are the two best fly poisons. Both are superior to arsenic. They have their advantages for household use. They are not a poison to children; they are convenient to handle, their dilutions are simple and they attract the flies.

A formaldehyde solution of approximately the correct strength may be made by adding three teaspoonfuls of the concentrated formaldehyde solution, commercially known as formalin, to a pint of water. Similarly, the proper concentration of solium salicylate may be obtained by dissolving three teaspoonfuls of the pure chemical (a powder) to a pint of water.

An ordinary thin-walled drinking glass is filled or partially filled with the solution. A saucer, or small plate, in which is placed a piece of white blotting paper cut the size of the dish, is put bottom up over the glass. The whole is then quickly inverted, a match placed under the edge of the glass and the container is ready for use. As the solution dries out of the saucer the liquid seal at the edge of the glass is broken and more liquid flows into the lower receptacle. Thus the paper is always kept moist.

Other Simple Preventives

Any odor pleasing to man is offensive to the fly and vice versa, and will drive them away.

Take five cents worth of oil of lavender, mix it with the same quantity of water, put in a common glass atomizer and spray it around the rooms where flies are. In the dining room spray it lavishly even on the table linen. The odor is very disagreeable to flies but refreshing to most people.

Geranium, mignonette, heliotrope and white clover are offensive to flies. They especially dislike the odor of honeysuckle and hop blossoms.

According to a French scientist, flies have intense hatred for the color blue. Rooms decorated in blue will help to keep out the flies.

Mix together one tablespoonful of cream, one of ground black pepper and one of brown sugar. This mixture is poisonous to flies. Put in a saucer, darken the room except one window and in that set the saucer.

To clear the house of flies, burn pyrethrum powder. This stupefies the flies, but they must be swept up and burned.

Borax is especially valuable around farms and out of doors. One pound of borax to twelve bushels of manure will be found desirable as a poison without injuring its manurial qualities or farm stock. Scatter the borax over the manure and sprinkle with water.

Lyre, chloride of lime, or copperas (sulphate of iron) dissolved in water, crude carbolic acid, or any kind of disinfectant may be used in vaults.

In Milwaukee, advantage was taken of the heavy ice formation in shallow water for driving piles for port improvement. In the place where they were to be driven, the water was so shallow that to float pile drivers into position dredging would have been required, but in winter the water froze, and where it was but a foot in depth, the ground beneath it also froze. Timbers 12 inches square were laid upon the ice and on these the pile drivers and appurtenances were rolled out into position. A hole for each pile was started through the ice and frozen ground by a steam jet, this operation taking about 6 minutes. The piles were then driven with complete success and with perfect alignment. It is considered that the work done took half the time that would have been required with floating derricks. Some of the piles were driven with a batter of 30°.

Among the German "erasatz" or substitution experiments some of the most value were those involving the use of steel for copper or brass. Promising results are expected for some uses from nitrogenized iron. If iron is exposed at a proper heat to a current of ammonical gas, the hydrogen of the ammonia reduces any oxide of iron which may be present and the nitrogen combines with the iron, producing a metal of distinctive properties which, it is thought, may prove available for steam turbine vanes.

Experiments have been conducted in England with the Brikett regenerative propeller for vessels. Naturally, a propeller inparts a whirl to the water in which it is rotating and the regenerative propeller is a fixed one, which, not rotating, and placed behind the main propeller, takes much of the whirl out of the water, thereby increasing the useful axial thrust of the rotating propeller. The largest vessel it has been tried on so far is of 600 h. p. and it is claimed that as much as 20 per cent of the indicated h. p. may be saved by its use. The regenerative propeller may be somewhat less in diameter than is the main propeller.

Digitized by Google

HARDENING FILES AND RASPS

THE hardening of files is an interesting operation. Files are hardened only, not drawn. They are heated in a lead pot, and in reality there is a certain amount of letting down the temper, for the files are removed from the cooling bath before they are cold. The files before hardening are coated with some preparation to keep the lead from sticking to the teeth. Whiting and wood alcohol is one of the commonest preparations though, due to the present high cost of the latter, water is now used extensively for the mixture—the water dries a little slower. Helpers or boys dip the files in the mixture and stand them up to dry, standing them against heated racks. It is highly important for the safety of the hardeners that there be no trace of moisture on the files when dipped. One of the most efficient arrangements for this work is a conveyor using a wire mesh belt, power driven, with the loading position close to the coating tank and the delivery at the lead pot. During its travel the belt passes through a gas or steam heated oven that is kept at a predetermined heat for the assumed drying of the coating; the speed of travel is also variable if necessary.

The files are suspended in the lead by driving them in handles that in turn are suspended from cross pieces over the pot. The hardener always has a sufficient number ahead to give all a chance to heat thoroughly and slowly. Under the best systems two men work in a team and harden in the neighborhood of 300 dozen medium sized files in a day, one man doing the dipping and the other the straightening. The old fashioned way was for one man to do both these operations, and while he did them well and rapidly the production was far less, due to the extra movements he must make.

The lead, of course, is kept at a red heat. Its surface is covered with pulverized charcoal or other substance to keep it from oxidizing. In connection with the conveyor scheme detailed above, a saving of fuel was discovered in the files being so warm as they were plunged—a file as warm as could be held in the hand would not chill the lead to the extent that one of atmospheric temperature would—the heat required to raise the file to a drying temperature was saved and utilized, making the process one of pre-heating as well as drying.

Salt water is used for quenching the heated files. It is a medium that has not yet been superseded. The brine is made very heavy; salt added to the water until it will absorb no more. This heavy quenching bath cools better than water alone because it does not fly away from the plunged file as does

(*Continued on page* 456)

Why haven't you clipped this coupon?

It takes but a moment—to mark the career of your choice, sign your name, clip out and mail.

Yet that simple act has started more than two million men and women toward success.

In city, town and country all over the world men are living contented lives in happy, prosperous homes—because they clipped this coupon.

In every line of business and industry, in shops, stores, offices, factories, in mines and on railroads, men are holding important positions and receiving splendid salaries—because they clipped this coupon.

Clerks have become sales, advertising and business managers, mechanics have become foremen, superintendents and engineers, carpenters have become architects and contractors, men and boys have risen from nothing at all to places of responsibility—because they clipped this coupon.

You have seen it in almost every magazine you have looked at for years. And while you have been passing it by more than ten thousand men and women each month have been making it the first stepping stone to real success in life.

Will you still turn away from opportunity? Can you still go on, putting in your days at the same grind, getting the same pay envelope with the same insufficient sum, trying to keep up the constant fight against a soaring cost of living, when such a little thing can be the means of changing your whole life?

You *can* have the position you want in the work you like best, a salary that will give you and your family the home, the comforts, the little luxuries you would like them to have. No matter what your age, your occupation, your education, or your means—you can do it!

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation and not a penny of cost. It's a little thing that takes but a moment, but it's the most important thing you can do today. Do it now!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6088-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Show Card Writer
Electric Car Running	Outdoor Sign Painter
Heavy Electric Traction	RAILROADER
Electrical Draftsman	ILLUSTRATOR
Electric Machine Designer	DESIGNER
Telegraph Expert	BUSINESS MANAGEMENT
Practical Telephony	Private Secretary
MECHANICAL ENGINEER	BOOKKEEPER
Mechanical Draftsman	Stenographer and Typist
Toolmaker	Cert. Pub. Accountant
Ship Draftsman	Traffic Management
Machine Shop Practice	Commercial Law
Gas Engineer	GOOD ENGLISH
CIVIL ENGINEER	Common School Subjects
Surveying and Mapping	CIVIL SERVICE
MINE FOREM'N OR ENG'R	Railway Mail Clerk
ARCHITECT	STATIONARY ENGINEER
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE ☐ Spanish
Sheet Metal Worker	Poultry Raising ☐ French
Navigator	Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

WIRELESS MANUAL

No. K-12
Ready May 25

We make a charge of 25c for it issuing a coupon receipt redeemable on a purchase of $5 or more.

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble.

Our 180 page combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments.

MANHATTAN ELECTRICAL SUPPLY CO., INC.

New York—17 Park Place
Chicago—114 So. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.

Digitized by Google

We're Prompt!

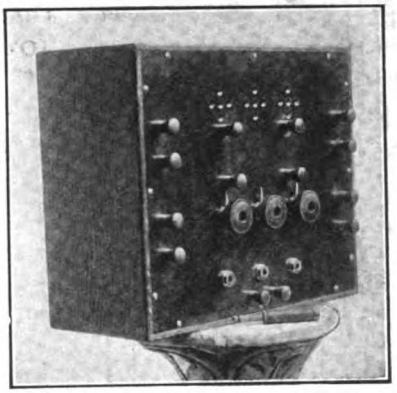
RECO QUALITY

You don't have to wait from three weeks to three months, for the apparatus you order. On everything except apparatus specially constructed to order, you'll have the benefit of

Shipment Guaranteed Within Twenty-Four Hours

Audions and Amplifiers

Audion Control . . $22
Without bulb or B batteries:—
1 Step Amplifier
Without Detector. $28
With Detector . . . $33
2 Step Amplifier
Without Detector. $45
With Detector . . . $50



10-Ampere Reco Key

Mounted on Italian marble base, with solid silver bar contact points, finished in brushed brass or nickel. Absolutely no side play in this Key. A great big special at $6.50 postpaid.

If you want a bright, snappy, monthly bulletin that means something; send us 6c in stamps.
NEW! An Adaptor for Tubular Bulbs—fits any socket; is rugged—simple and 100 per cent. efficient, and positively vibration-proof—Immediate Delivery $1.50

Radisco Agents for the South
C. D. BLAIR
P. O. Box 859
Richmond, Va.

The Radio Engineering Co.
Baltimore, Md.

614 North Calvert Street

ATTENTION AMATEURS



The only practical adapter

Price $1.50

RADISCO AGENCY

We make up sets to specifications

Made by the
AMATEUR WIRELESS EQUIPMENT CO.
1390 Prospect Ave., Bronx, N. Y.

AWE N.Y. CO.

Catalogue sent on receipt of 10c, which may be deducted from first order.

Dealers write for proposition

PACENT ELECTRIC COMPANY

Builders and specialists in Electrical, Radio and Laboratory equipment.

SALES AGENTS
for
DUBILIER CONDENSERS,
DUO-LATERAL COILS,
GREBE APPARATUS,
MAGNAVOX PRODUCTS,
RAWSON METERS,
STANDARD VT BATTERIES,
and other first class equipment.

Telephone Beekman 5810
150 NASSAU STREET, NEW YORK CITY

Recognized as the largest and best

Service Radio School
INCORPORATED

Send ten cents for descriptive catalogue to
Dept. E, 900-902 Penna. Ave., N. W., Washington, D. C.

the lighter medium; it makes better contact with the file just as the liquid lead in the heating pot makes a far better contact than would the coals of a fire.

Files are subject to bending or warping in the cooling bath just as other articles of carbon steel and for the same reasons, though system and quantity production and supervision have eliminated to an extent many of the causes of warping, against which the hardener of a few odd pieces must battle. The straightener has been mentioned and his duties are to correct the worst of the crookedness which occurs after due precautions have been taken in manufacture, delivering a file that is commercially straight.

To the blacksmith, the idea of straightening a piece which is glass hard and not drawn seems an impossibility. It is a trick of the file trade, and so well acquired that the straightener rarely breaks a file. While the file is yet warm, before it entirely ceases to sizzle it is withdrawn and quickly inspected; if a crook shows up, the file is bent the required amount and cooled in a way that will fix this shape permanently. For this purpose the workman uses a flat brush which he dips in a tank of water and applies to the side of the file that he wishes to contract.

Half round files are the most troublesome in hardening because of the unequal area of surface and the back. To overcome this the hardener bends the file slightly before he dips it in the brine, an amount which his experience tells him will be needed to counteract the "draw" of the greater cooling surface on the back. The hardening process leaves a very slight oxidization and there is a little grit left from the coating, all of which must be removed to make a neat appearing file. Stiff brushes are used for some of this work but the great volume of files are cleaned in a steam cleaning device, which shoots a spray of steam, water and a little of the finest sand against the surface of the files.

Rasps are made of a low grade of steel, primarily because steel of higher carbon will not stand the bending and compression which a rasp tooth must without breaking. So low in carbon is this steel that only the thin points of the teeth harden at all, but this is sufficient for the work rasps have to do. They are cut with a round nose chisel—this leaves a half round gouge in the flat surface of the blank and the metal thus thrown up forms the tooth, the end of the chisel making the straight side.

Formerly rasp teeth were cut by hand by the workman, who sat before a bench on which the rasp was strapped down and who used a hand chisel which he drove by a short-handled hammer hav-

(*Concluded on page* 457)

Digitized by Google

ing a peculiar bludgeon-shaped head weighing several pounds. The workman spaced the teeth by eye, a wonderfully regular piece of work. The rasp cutting machine now entirely replaces the handwork. In finishing, the tops of the teeth are evened off by a grinding machine, which passes across the surface of the rasp.—*Canadian Blacksmith.*

ARTIFICIAL GLACIERS IN THE HIMALAYA MOUNTAINS

TO secure a permanent supply of water in the form of a glacial stream, the inhabitants of the Karakorum Range of the Himalayas proceed as follows: A high point in a valley is selected and a species of dam is built across it. Alternate layers of straw, pine tree needles, charcoal and the like are laid across the valley in the summer and just before snow is to be expected a lot of coarse gravel is put on top. The snow which accumulates back of the structure is covered in the early spring with straw and on this a layer of earth is placed. This is kept up for five or six years, and eventually a glacier is formed, which will last for forty years, giving a constant stream all summer long as well as in the winter months, if it is not too cold.

STRANGE USE FOR SHEARS

ONE of the strange aftermaths of the war is noted in a request recently received by an American shearmaker from a firm in Korea for quotations on shears to be used in cutting the tusks of hippopotamus, with the added injunction from them that, as the shears were to be used while the animals sleep, they must be really sharp ones and capable of quick action. The general conclusion of the man in the street would seem to be that the average maker would prefer to manufacture the shears than be called upon to use them.

TESTING THERMOMETERS WITH MOLTEN METAL

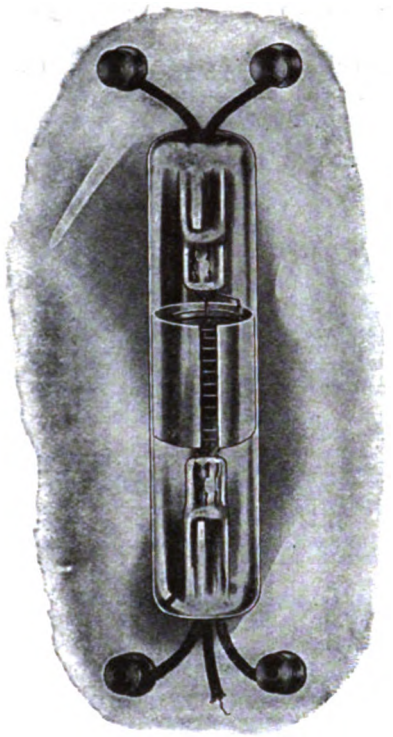
A NEW thermometer comparator has been devised by the U. S. Bureau of Standards that is electrically heated and that utilizes stirred molten metal to secure uniformity of temperature.

The distribution of temperature is uniform to an infinitely small calculation of 0.1 degree C over a length of approximately 35 centimeters, from a point 10 centimeters below the top of the bath.

The thermometers are encased in thin closed-end steel tubes which are dipped into the molten metal. Scientists have pronounced the newly designed comparator as quite efficient for the testing of thermometers in the interval 300 to 550 degrees C. The Bureau of Standards contemplates frequent use of the machine in the pointing and testing of thermometers by manufacturers.

AUDIOTRON

The Original Tubular Vacuum Detector, Amplifier, Oscillator



NOW FREE FROM ALL RESTRICTIONS

Dealers and Amateurs!—

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now licensed under Fleming Patent No. 803684 to be used only for amateur and experimental uses in radio communication. They are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

All patent questions have been definitely settled. Vacuum tube patents are basic and have been sustained by the Federal Courts. Be sure to get genuine AUDIOTRONS. They outclass any other form of detector and are absolutely free from all legal restrictions or difficulties. These new uses make it even more necessary to insist on the genuine. You can always tell a real AUDIOTRON by the name stamped plainly on the glass.

Insist on the name AUDIOTRON on every tube you purchase. Fully guaranteed by the AUDIOTRON Mfg. Co. *(Read the guaranty below.)*

Your last chance for an AUDIOTRON *or double filament* DETECTOR

Manufacturing reasons make it impossible to continue the present hand made AUDIOTRON. This type has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40.

The few thousand that will still be produced, will be of the same standard of excellence that has characterized every AUDIOTRON. Already recognized as the most sensitive detector on the market, these few that still remain, with all restrictions on amateur use lifted, are undoubtedly the greatest opportunity ever offered to amateur radio operators. See your dealer at once or order direct. Be sure to benefit by this last opportunity to secure a hand made super-sensitive double filament AUDIOTRON Detector, Amplifier, Oscillator.

$6.00 each

No Increase in price

The AUDIOTRON Exclusive Guaranty: **Each and every AUDIOTRON is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge. The only tube satisfactory enough to stand a guarantee.**

Dealers—

Get in touch with the AUDIOTRON Mfg. Co. at once. We will give you full information about settlement of all patent difficulties. ***You will also be interested in our new proposition for wide awake dealers.***

After the present supply is exhausted, new types of AUDIOTRON, manufactured entirely by machinery, will be offered for sale. Our extensive advertising during the Fall will establish definitely the superiority of the AUDIOTRON and will create new sales for you. Be sure to take advantage of our full co-operation at once. Prepare to cash in on the AUDIOTRON reputation, established since 1915.

Write us today for full details.

AUDIOTRON MFG. COMPANY Dept. V Lick Building
(Successors to the AUDIOTRON Sales Co.) San Francisco, California

MAKE YOUR OWN REGENERATIVE RECEIVER USE WILCOX VARIOMETER PARTS

SET NO. ONE contains carefully turned wooden parts as illustrated.

Price $2.50 Postpaid



SET NO. TWO contains all parts for variometer including a 3" dial.

Price $5.00 Postpaid

THE WILCOX LABORATORIES, - - LANSING, MICH.

ALL READERS OF EVERYDAY ENGINEERING MAGAZINE KNOW THE REAL WORTH OF THE DISTINCTIVE RADIO ARTICLES WE PUBLISH. WHY NOT TELL OTHERS WHO MAY NOT BE FAMILIAR WITH THEM?

Digitized by Google

RADIO
Mail Order Service

Our claim of "Personal Service to the Consumer" has been more than upheld and we have pleased our many clients by our prompt and courteous attention to their wants.

Our early success along these lines, has prompted us to establish a Mail Order Department, so that out-of-town Radio Men can realize and feel the strength of our service and know that when they order a piece of apparatus they can get it at once and not have to wait until it is manufactured or otherwise secured. We carry a complete stock and list some of the more important instruments below:

AUDION CONTROL PANELS

Radio Craft detector unit	$15.00
Radio Craft 2 step amplifier	50.00
Radio Craft detector and 2 step amplifier	70.00
RORA Grebe detector unit	11.00
RORH Grebe detector unit with batteries	17.00
P 400 De Forest Unit	12.00
P 401 De Forest Unit, with oak finished cabinet	14.75
P 402 De Forest Unit with 40 Volt "B" Battery	22.00
P 500 De Forest Audion, Ultra Audion, complete with 40 V. "B" Battery	25.00

DETECTORS (Crystal)

RPDB Grebe Single	$2.75
D101 De Forest with crystal	2.80
AMCO Crystal Detector	1.75
Tested galena crystals mounted ready for use	.25

GRIDLEAKS

Marconi complete with holder and leak	$1.00
ROCA Grebe Condenser and leak	1.60

LOOSE COUPLERS

Arnold 3000 meter loose coupler	$22.50
CE F673 3000 meter coupler	14.00
Signal No. R21 3000 meter coupler	18.50

OSCILLATION TRANSFORMERS

International TXL-100A	$16.75
Signal R13	16.00

ANTENNA SWITCHES

463 Murdock switch stands up to 1 K.W.	$4.50
F658 Clapp-Eastham, three pole with bakelite antenna post	12.50

AMPLIFIERS

RORE Grebe single step audio frequency amplifier	$23.00
RORJ Grebe 2 step amplifier with cam switch control	45.00
RORG Grebe detector and one step amplifier	43.00
RORD Grebe detector and two step amplifier	65.00
Radio Craft Co. two step amplifier	50.00
Radio Craft Co. detector and two step amplifier	70.00
P200 De Forest two step amplifier with "B" Battery	70.50

BUZZERS

55 Mesco Buzzer	$2.25
Century Buzzer	2.25
251 Nickelplated	.80

CONDENSERS

General Radio 182A	$12.00
C. V. 500 De Forest	6.25
366 Murdock	4.75
367 Murdock	4.75
368 Murdock	3.75
F800 Clapp Eastham	7.50
F800 A Clapp Eastham	9.50

SOCKETS

156 General Radio	$1.75
550 Murdock	1.00
S.I. Radio Service	1.20
R300 De Forest	1.50

HOT WIRE AMMETERS

General Radio No. 127 0-1 or 0-2½ Amperes	$5.00
Roller Smith 0-2½ Amperes	7.00
Extra Shunts .05 Amp	.75

"B" BATTERIES

766 Amer. Eveready 22½ V. 10 Amp		$3.50
7623	Standard 22½ V. "B" Batteries Variable	1.35
7625		2.40
7650		3.25
9280 Cyclone 22½ Volts 5 Amp		1.00
9281 Cyclone 22½ V. 10 Amp		2.00

AMPLIFYING TRANSFORMERS

Acme—specially mounted	$5.00
Acme—unmounted	4.50
Federal 226w	7.50

DUO LATERAL COILS

U. S.	25	$ .90	100	1.30	
	35	1.00	150	1.40	
	50	1.10	200	1.50	
	75	1.20	250	1.60	
			300	1.80	
			400	2.00	
			500	2.20	
			600	2.50	
			750	2.70	
			1000	2.90	
			1250	3.50	
			1500	4.00	

HONEY COMB COILS

L. 25	$1.40	L. 100	$1.70	L. 300	$2.10	L. 750	$2.80
35	1.45	150	1.80	400	2.25	1000	3.00
50	1.52	200	1.90	500	2.40	1250	3.35
75	1.60	250	2.00	600	2.65	1500	3.60

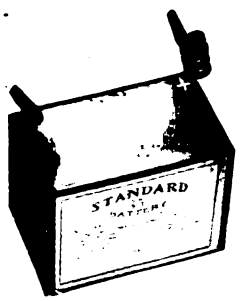
Instruments and parts listed above will be sent postpaid to any part of the United States.

Our word of honor to you is our guarantee. Let us prove it.

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Secretary — J. STANTLEY, Treasurer

Dept. F-6 — 6 WARREN STREET — NEW YORK



No. 7623—Price $1.35

Ask Your Dealer for these "Standard Products"



Miniature Jack and Plug—Price $1.50 Per Dozen

RICHTER & BYRNE, *Manufacturers*

198 Roebling St., Brooklyn, N. Y.

Pacent Electric Co., Inc., Sole Eastern Agents
150 Nassau St., New York, N. Y.

Should you know of a worthy young man desirous of obtaining good technical education and making a good future for himself refer him to our announcement on page 474 of this number.

MAKING PAINT LOOK LIKE ENAMEL

TO make white paint look like enamel; take a piece of caustic soda, the size of marble and dissolve thoroughly in half a wineglassful of spirits of turpentine, and add this to a 2-lb. tin of white zinc paint; stir well, and it is ready for use. When dry, it will be found to have a glossy surface which almost equals enamel.

COMPARATIVE VALUE OF TIMBER CUT FROM LIVE AND DEAD TREES

PREJUDICE exists in certain quarters against the use of timber cut from dead trees, and some purchase specifications insist that only timber cut from live trees will be acceptable. As a matter of fact when sound dead trees are sawed into lumber, and the weathered or charred outside is cut away, there is no method known to the Forest Products Laboratory by which the lumber can be distinguished from that cut from live trees, except that the lumber from dead trees may be partly seasoned when sawed.

All the information available at the laboratory indicates that timber cut from insect or fire-killed trees is just as good for any structural purpose as that cut from live trees of similar quality, providing the wood has not been subsequently injured by decay or further insect attack. If a tree stands on the stump too long after it is killed, the sapwood is likely to become decayed or badly infested by wood-boring insects; and in time the heartwood also will be similarly affected. The same thing is true of logs cut from live trees and not properly cared for. Until the wood becomes affected by these destructive agents, dead tree wood should be just as strong and just as durable as sound live tree wood.

In considering the subject it may be useful to remember that the heartwood of a living tree is entirely dead, and in the sapwood only a comparatively few cells are living. Most of the wood cut from trees is dead, therefore, regardless of whether the tree itself is living or not. Such being the case, purchase specifications, instead of providing that material must not be from dead trees, should state that material showing evidence of decay or insect infestation exceeding a specified limit will not be accepted.

EASY METHOD OF CLEANING A CLOCK

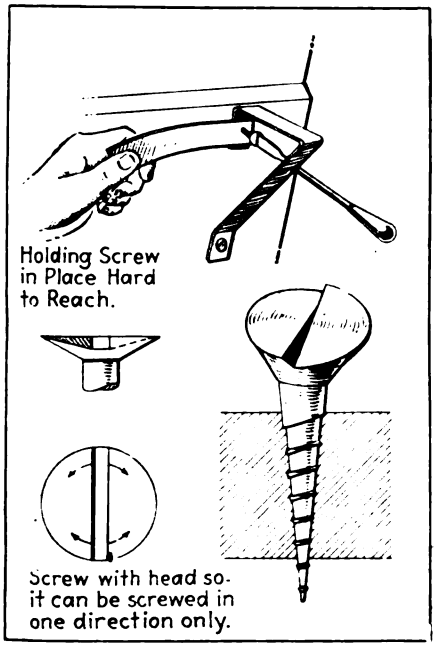
WHEN a clock stops it is a mistake to suppose that it must at once be taken to the workshop for repairs. In most cases clocks cease running because of the accumulation of dust particles which clog the bearings. It is not even needful to take

Digitized by Google

the clock to pieces to clean it if a simple plan outlined in the *Scientific American* is followed which will be found to work very well. Soak a piece of cotton wool in kerosene and place this in a small saucer, a canister lid, or anything similar. Then put this in the case of the clock under the works. Close up, and at the end of twenty-four hours, examine the cotton wool. It will be found to be covered with black specks; these are the dust particles brought down by the fumes of the kerosene. Wind the clock up and it will start away again. Where the works of the clock are in an enclosed case a few drops of kerosene should be poured through the small hole which is present in the metal covering. Turn the clock about a while so that the kerosene is distributed and after an interval, it is extremely likely that the works will commence their normal operations again.

A NON-REMOVABLE SCREW

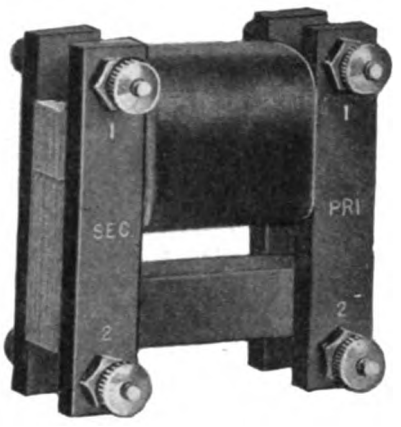
A SIMPLE suggestion is given in the cut for holding a screw in a place inaccessible for the hand. The screw is stuck through a piece of cardboard, such as a strip of a visiting card, and held thus in any corner or other awkward place; it is started with a screw-driver, and the instant it has taken



A simple method of starting a screw shown in upper illustration and a non-removable screw depicted below it

hold the paper is pulled away and the screw is driven home by turning it as usual. Another clever idea is shown in the next cuts, it is a screw which cannot be unscrewed. The slot is filed away, as shown, so that the screw-driver can only take hold in one direction, as shown, this direction is the driving one. An attempt to withdraw it will fail, because the screw-driver will slip around, as it evidently cannot get any grip on the angular faces.

RADIO PROGRESS



Progress in Radio means the efficient elimination of unnecessary, old and inefficient apparatus and in producing instruments full of life and vigor, quality, workmanship and service; something necessary to the modern station of today; something that is an improvement over the old methods: —the

A. R. Co.
Amplifying Transformer

is distinctly a step forward, a step toward the goal of efficiency. In designing this piece of apparatus, particular reference was given to the correct ratio of impedence and turns between primary and secondary.

Another feature which makes this transformer a desirable piece of apparatus, is the simple but very effective mounting of Bakelite strips, supporting the laminated closed core and coil, which allow for quick mounting in case or on panel.

The primary and secondary leads are indicated by engraving on the bakelite mounting strips.

The price does not do justice to the reliability and high service quality of this product.

A-4 Amplifying Transformer, list price $5.00

does not include carrying charges on one pound or duty paid for use in Canada.

RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.

Below are listed a few of the reliable firms who carry Radisco products; A. R. Co. Amplifying Transformers and are our agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace.
ATLANTIC CITY, N. J.
Independent Radio Supply Co.,
118 South New Jersey Ave.
BALTIMORE, MD.
Radio Engineering Co.,
614 North Calvert St.
BEINVILLE, QUEBEC, CAN.
Canadian Radio Mfg. Co.
BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street.
BROOKLYN, N. Y.
Kelly & Phillips Electric Co.,
312 Flatbush Avenue.
BRONX, NEW YORK
Amateur Wireless Equipment Co.,
1390 Prospect Ave.
CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Avenue.
EUREKA, PEORIA, ILLINOIS
Klaus Radio Co.
KANSAS CITY, MO.
McCreary Radio Supply,
Fourth and Delaware Sts.
LOS ANGELES, CALIF.
The Wireless Shop,
511 West Washington St.
MONTREAL, CAN.
J. B. Miller,
1600 Hutchison St.
McKEESPORT, PA.
K. & L. Electric Co.,
427 Olive Street.
NEW ORLEANS, LA.
L. A. Rose,
121 Camp Street.
NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street.
NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave. "8HA"
PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets.
PROVIDENCE, R. I.,
Rhode Island Elec. Equip. Co.,
45 Washington Street.
PITTSBURG, PA.
Radio Electric Co.,
3807 Fifth Avenue.
SEATTLE, WASH.
Northwest Radio Service Co.,
609 Fourth Avenue.
SCRANTON, PA.
Shotton Radio Mfg. Co.,
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.
SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street.
ST. LOUIS, MO.
The Benwood Specialty Co.,
3424 Olive Street.
TORONTO, ONT., CAN.,
The Vimy Supply Co.,
585 College Street.
WASHINGTON, D. C.
National Radio Supply Co.,
808 9th St., N. W.
WICHITA, KAN.
The Cosradio Co.,
1725 Fairmount Ave.

Responsible Dealers: Write for interesting sales proposition on Radisco apparatus

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY : Newark, New Jersey

Digitized by Google

RADIO APPARATUS

Distributors of reliable Radio apparatus for experimenters in every branch of the Radio field!

"Pittsco" The sign of service.

PITTSCO

"Remember" We carry an immense stock.

Honey-Comb Coils

LITZENDRAHT WIRE.		(While they last.)
LL-75	330-1030 meters	$1.60
LL-100	450-1460 "	$1.70
LL-150	660-2200 "	$2.00
LL-200	930-2850 "	$2.10
LL-250	1300-4000 "	$2.30
LL-300	1550-4800 "	$2.50
LL-400	2050-6300 "	$2.80
LL-600	4000-12000 "	$3.00
LL-750	5000-15000 "	$3.20
LL-1000	6200-19000 "	$3.50
LL-1250	7000-21000 "	$3.90

Note:—These are the genuine DeForest litz coils.

Transmitting Condensers

(Dubilier)

Type	Watts	Cap	Price
D-100	250	.007	$19.00
D-101	500	.007	$30.00
D-102	1000	.007	$45.00
D-103	1000 Spec.	.007	$50.00
D-150	For C. W. or spark coil transmitters,	.0024 MF., 8000 volts	$ 5.00

F. D. Pitts Co. Boston, Mass. Transmitting Transformers

(New Type Acme)

Acme	250 Watt	mounted	$16.00
"	250 "	unmounted	$13.00
"	500 "	mounted	$22.00
"	500 "	unmounted	$18.00
"	1000 "	mounted	$33.00
"	1000 "	unmounted	$28.00

F. D. Pitts Co. Boston, Mass. Continuous Wave, Power Transformers

(For Wireless Telephone)

Acme	200 Watt	C. W. Power trans. unmounted	$16.00
"	200 "	C. W. Power trans. mounted	$20.00
"	50 "	C. W. Power trans. mounted	$15.00
"	50 "	C. W. Power trans. unmounted	$12.00

F. D. Pitts Co. Boston, Mass. Modulation Transformers

(For Wireless Telephone)

Acme	A-3 unmounted	$4.50
"	A-3 semi-mounted	$5.00
"	A-3 mounted	$7.00

F. D. Pitts Co. Boston, Mass. Quenched Gaps

Amrad	G-1	1 K. W. type	$29.75
"	G-2	½ K. W. type	$18.85
"	G-3	¼ K. W. type	$13.50

F. D. Pitts Co. Boston, Mass.

Important! Every article sent to any part of the U. S. A. Postage prepaid. We want your business. Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

12 Park Square Dept. F.

BOSTON, MASS., U. S. A.

Indicating QUALITY



The Corwin Indicating Dial

recognized by Radio Men as a popular and needy addition to any set, has been further improved and now comes in two sizes, three inches and three and seven-eight inches in diameter. This larger dial (3⅞ in.) fills the general demand for an indicator to fit the standard one-quarter inch shaft; quality and workmanship better than ever.

3 in. dial only, 75c.
With knob $1.30
3⅞ in. dial only, $1.00
With knob $1.70
Sent postpaid anywhere.

For sale at all Radisco Agencies

Ten cents brings our latest catalog to you, describing the above dial and all standard radio apparatus.

A. H. CORWIN & CO.

Dept. F5, 4 West Park Street

NEWARK, N. J.

"POROX"

"Trade Mark"

High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.

Special Batteries made to order also duplicating of foreign batteries.

Prices on request.

ALBERT MULLER

8758 Queens Boulevard

Jamaica, Long Island, N. Y.

ADJUSTING SPRING DIES

A READER has had difficulty in adjusting spring dies. That is to say, from his description, he tightened up only one of the adjusting screws and so broke the die. He assumes that the adjusting screws should be only tightened up sufficiently to hold the die in collet or stock. There is, however, considerably more in the matter than this, and perhaps a note on how to adjust such dies will be of help to not a few.

There are several types of circular die capable of a fine adjustment, of which the most general is the spring die. This type of die is not an adjustable die so-called. An adjustable die is a spring die having a self-contained adjustment which is generally the subject of a patent. These usually are made so that, when free of adjustment, they spring to under size, and have, therefore, some kind of grub screw, set screw, or bolt, which opens them out to size and maintains them at that size. The device is part of the die. To use such dies it is only necessary to fasten them in a collet, stock, or even a chuck, which in all cases prevents them springing open further under cut, and they can then be removed from the holder and put back again, with the assurance that they will cut to the set size again without any readjustment. This is because they cannot be closed in any further on account of the locking action of their self-contained adjustment.

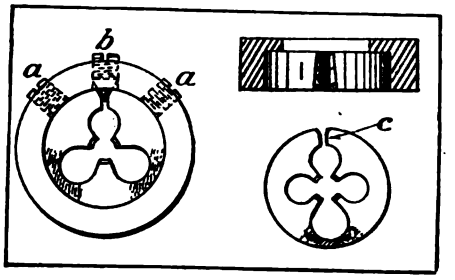


Fig. 1. Diagram showing method of adjusting spring dies

The spring die relies for its means of adjustment on several screws (usually three), which are part of the holder and may be therefore part of a collet, or stock. It is one of these which is under consideration. Fig. 1 is a sketch showing this kind of adjustment wherein, at the top, a section of the collet, stock, or other kind of holder is given, in which the die is shown in edge elevation. The centre view is on the face of a spring die, which is in its holder. This die has three cutting edges, whereas the view at the bottom shows a similar die having four cutting edges, to which the same particulars as to adjustment apply. These dies are made split, as at C in the bottom view, and are hardened and tempered all over to a degree necessary

(*Continued on page* 462)

Digitized by Google

THE G. A. TIME RECEIVER

Has a wave length range from 200 to 2500 Meters

A complete portable crystal receiver furnished in a satin Flemish oak-finished cabinet, with hinged cover, snap catch and carrying handle.

Very sharp tuning for a set of this type is obtained on all wavelengths by using a single layer solenoid type inductance with taps divided to eliminate dead end effects and yet secure selectivity. A nifty universal adjusted detector with a standard Army-Navy type Arlington tested galena crystal puts the signals in the head set with the highest intensity and a permanency of adjustment that is appreciated. A hynote buzzer with push allows detector setting to be easily obtained when set is used in the field. Additional binding posts for a key incorporates the advantage of buzzer code practice. A set that comes to you complete in itself and with materials for a G. A. standardized long range antenna as well as a pair of 2,000-ohm Murdock No. 55 Telephones for

$25.00

SEND 3c STAMP FOR G. A. BULLETIN OF RADIO AND MODEL SUPPLIES

BUY YOUR SUPPLIES AT THE G. A. STORE

G.A.

OPEN UNTIL NINE O'CLOCK EVERY EVENING



Shipping Weight, 10 lbs.

THE GENERAL APPARATUS COMPANY
4310-A BROADWAY AT 183rd STREET NEW YORK CITY

Q. S. T. *de* A C E E

LET'S SING

(TUNE, Battle Hymn of the Republic)

Mine ears have heard the signals
From a dozen different lands,
From Greenland's icy mountains
To Sahara's burning sands;
From the land of cherry blossoms
To where Mount Sorata stands.
And I've learned a thing or two.

CHORUS

Q. R. X., I'm going to tell you,
Q. R. X., I'm going to tell you,
Q. R. X., I'm going to tell you,
How you can get them, too.

This spasm continued next month. Watch our ads, they are "different." So are our instruments. It's to our mutual advantage to get acquainted. "You may pay more, but you can't buy better."

DEALERS: If you don't stock Ace equipment you are missing a good line.

THE PRECISION EQUIPMENT COMPANY
2437 Gilbert Ave., Dept. B Cincinnati, Ohio

Federal Radio Accessories

Are the Recognized STANDARDS for Their Respective Uses.
BULLETIN 102 W.A.
Gives full description. Besides it contains valuable information on
AMPLIFICATION of Radio Signals
Send 6c in Stamps today and receive this Bulletin.
FEDERAL TELEPHONE AND TELEGRAPH CO.
1756 Elmwood Avenue
BUFFALO, N. Y.

That Radio Instrument

When you are looking for some distinct part of a radio station and you have been unable to locate it elsewhere, come to us and you will find it here, anything in radio that is a necessity, we have it.

Apparatus of all responsible manufacturers, whose quality and service have been proven.

Here are some of the Instruments kept in stock:

Filament Ammeters for Radio Work, made by Roller Smith, 0-1, 0-2 Amperes. List Price $8.20, Special $6.96.
Loose Couplers, $5.00, $10.00, $15.00, $19.00.
Tuning Coils, 4,000 Meters $4.75; 1,250 Meters, $3.50.
Murdock Variable Condensers, .001 Mfd. $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 Mfd. 70c; .003, 90c.
Oscillation Transformer (Murdock Type), $5.00.
Lightning Switch, 600 V-100 Amp., $6.94.
Switch Points, 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
White Metal Dials 3", 50c.
Binding Posts, 9c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; DeForest Type, $1.50.
Western Electric Phones, $12.00.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Loads of other Apparatus on Hand.

The above list does not do justice to our complete stock and it cannot be appreciated unless you send for our catalog, which will be sent to all who wish it upon receipt of 10c.

AMERICAN ELECTRO TECHNICAL APPLIANCE COMPANY
DEPT. EM., 235 FULTON STREET NEW YORK CITY

REWINDING A. C. MOTORS

And all methods for connecting and reconnecting are clearly shown in the ELECTRICAL WORKERS FRIEND. 66 diagrams with detailed explanations solving every rewinding and reconnecting problem. Electricians and Experimenters will find this book exactly what the name implies "The Electrical Workers Friend." Price $4.00 Cash with order or (C.O.D.—U.S.A. only).

HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Penna.

A NEW DETECTOR

That can either be used as a Panel Unit, as advocated by this magazine or "on the table," and only one knob is used for Position and Pressure. Instantly adjustable to any spot on the crystal. Price includes tested galena. Base 5 ins. by 2½ ins. $2.50. Base 5 ins. by 5 ins. 3 cups $3.00.

Just write for information and list

THE BARWICK RADIO SUPPLY CO.
80 Britannia Ave. Hamilton, Ont., Can

Digitized by Google

C W
ACME APPARATUS

POWER TRANSFORMERS
MODULATION TRANSFORMERS
FILAMENT HEATING TRANSFORMERS
1½ HENRY CHOKE COILS

ACME C. W. POWER TRANSFORMERS are designed for use with rectifying tubes for supplying D. C. voltage and current and for heating filaments.

200 Watt C. W. Power Transformer, Mounted	$20.00
200 Watt C. W. Power Transformer, Core and Coil Assembled	16.00
50 Watt C. W. Power Transformer, Mounted	15.00
50 Watt C. W. Power Transformer, Core and Coil Assembled	12.00

The ACME A-3 MODULATION TRANSFORMER is correctly designed for Radio Telephony without distortion of speech and for maximum modulation.

A-3 Fully mounted with engraved bakelite panel	$7.00
A-3 Assembled with supports	5.00
A-3 Core and Coil Assembled	4.50

The ACME FILAMENT TRANSFORMER is designed for 110 volts 60 cycles and to deliver current at two voltages of 8 and 10 volts each.

Acme Filament Heating Transformers, 50 watts, Fully Mounted	$12.00
Acme Filament Heating Transformers, 50 watts, Core and Coils Assembled	9.00

ACME 1½ HENRY CHOKE COILS are designed for use in the D. C. circuit when modulating.

1½ Henry Choke, 500 milampere capacity, Semi-mounted	$6.00
1½ Henry Choke, 150 milampere capacity, Semi-mounted	4.00

With two separate coils $2 extra in each case.

DISTRIBUTED BY ALL LEADING DEALERS
PRICES ON LARGER SIZES ON APPLICATION

ACME APPARATUS COMPANY
24 WINDSOR STREET CAMBRIDGE 39, MASS.
Up-To-Date Transformer and Radio Engineers and Manufacturers

To the Radio Engineer
Radio Manufacturer
Radio Amateur

You cannot afford to do without the

PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS

In it, you will find all the latest information on **Transmitters, Receivers, Bulbs, Radio Telephony, Elimination of Strays,** and **every other important radio topic.**

Subscription per year { **$9.00 (in U. S.)** / **9.60 (abroad)** }

Address

Secretary,

INSTITUTE OF RADIO ENGINEERS
COLLEGE OF THE CITY OF NEW YORK

Arnold **Loose Couplers**
Combination Loose Coupler Parts and accessories.
Send 4c stamp for literature which is sure to interest you.
J. F. ARNOLD 2062 Lexington Av., N.Y. Established 1910

RADIO APPARATUS
on the
INSTALLMENT PLAN
Full particulars and the RVA BULLETIN each month sent on receipt of ten cents—stamps or coin.
J. DONALD VANDERCOOK
LOMBARD Box 442 ILLINOIS

ADJUSTING SPRING DIES

(*Continued from page* 460)

for cutting. In addition to this the temper is drawn to a blue or spring temper at the points shown shaded in both views, in order that they may be the more flexible at the springing points, and therefore less likely to snap. The temper colors are not usually preserved, but are polished away to give the die a finish. As shown in the bottom view, the edges of the split are beveled at the outside of die to an angle corresponding to the point of the opening screw (shown at b in the middle view). If, therefore, this screw is driven down, it opens the die out. To check this opening out, two screws, a, are provided on either side of the opening screw. These screws are usually flat on point and only bear against the flat edge (or periphery) of the die. All the screws are usually hardened. The die can be held, therefore, to the extent it is necessary to open it out by means of b up to the point that the edges come into contact with a, a on either side, and it is there held rigid.

Putting such a die in its holder, it will be found that, as made and tempered, it stands, unsprung either way, at about correct size. First, draw all the screws slightly (not right out, of course), but so that the points of a, a are drawn below the inner surface of holder, and the point of b in such position that the die will slip in without being opened out. When it is right home, the screw, b, is first driven until it just holds the die and no more. The screws a, a are then driven till they just hold the die, taking care that both are on its surface with about even pressure. In this position the die should cut to size, but if a test cut shows it cutting oversize, the screw, b, should be drawn slightly and the screws, a, a, set down evenly till they both again bear on the die. This closes it and another test can be made. If, on the other hand, it cuts under-size, the two screws, a, a, are first withdrawn an even distance and the screw, b, driven until it just holds the die rigid, which will result in opening it out.

In the better class of spring die they are made with a taper bevel at the edges of the split, as shown in the top view of Fig. 1. These dies should only be put in the holder one way, and are often polished only on one side, and that the outside, in order readily to distinguish which way they go in. It will be noticed that the smaller end of the bevel goes in first, so that, when the screw, b, is driven to just hold the die, it cannot drop out of the holder unless it be sprung out to allow the inner ends of bevel to clear the point of b. When, therefore, the screws, a, a, are duly adjusted the die can neither turn nor

(*Concluded on page* 464)

Digitized by Google



Two New Vacuum Tube Units



Both units are designed to incorporate the Standard "4-prong" Vacuum Tube. Beautifully engraved Bakelite Panel, Oak Base. Ready for immediate delivery.

DETECTOR UNIT
PRICE $12.00

1-STAGE AMPLIFIER
PRICE $18.00

WE TAKE PLEASURE

In announcing the opening of a branch store of the Atlantic Radio Co., at 15 Temple Street, Portland, Me., under the management of Mr. H. W. Castner. Northern New England amateurs will welcome this opportunity for expedited shipments.

READ THIS LETTER:—

Rochester, N. Y., June 30, 1920.

Atlantic Radio Co.

Gentlemen:—I wish to thank you for the very prompt service which you gave me on my last order and for your ability to deliver at once just what was wanted. Such service as I received is so unusual that I cannot refrain from thanking you. The goods you sent were all perfect and the best of the kind I have yet seen.

Very truly yours,

(Name on request.)

"BULLETIN 14"—108 pages—over 100 illustrations—sent upon receipt of ten cents. A Rebate Certificate good for 10 cents on first dollar order is inclosed.

ATLANTIC RADIO COMPANY

Incorporated

88 Broad St., Boston 9, Mass.

Portland Branch— 15 Temple St., Portland, Me.

COMMERCIAL EXPERIMENTAL wicony RADIO PRODUCTS EDUCATIONAL LABORATORY

A More Comprehensive WICONY SERVICE

The Radio Art has long known *Wicony* to stand for *perfection* as applied to Navy, Army and Commercial radio apparatus.

The Radio Art will now know *Wicony* to stand for *perfection* as applied to specially designed amateur and experimental radio apparatus.

***Radio Dealers, amateurs* and *experimenters* have been freely consulted. Therefore, this new service is really yours—outlined by men who would consider the matter from *your* point of view.**

Watch for further announcements in Radio periodicals.

DEALERS: It will pay you to write us now.

WIRELESS IMPROVEMENT COMPANY

Radio Engineers, Manufacturers and Distributors.

47-B West Street New York City

"Ask anyone who has used it"

Users Are Provers

"I have also asked some of my friends all of whom say, 'BRANDES? Sure, get them: They will positively pay for themselves'". (Name on request.)

Brandes Wireless Headset



"Superior," 2000 ohms, $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOGUE M

C. BRANDES, INC. 32 Union Square, Room 822, New York

Wireless Receiver Specialists

Digitized by Google

DE FOREST



An Inexpensive Radio Receiving Set for Amateurs

FOR the beginner in Radio work or the experienced Amateur, this DeForest Audion-Unit Radio Receiving Station offers an easy and inexpensive way to secure accurate, efficient and expertly designed apparatus of usual DeForest superior quality. The set is complete; Aerial and Ground connections, "Honey Comb" Tuning Coils, Audion Detector, Tuning and Grid Condensers, Head Telephones, all necessary wire, insulators, back-board, base mounting, etc. Full instructions for installing and operating accompany the apparatus. The beginner can secure no better apparatus and with this set will gain practical knowledge and experience.

Our booklet, "How to Set Up an Amateur Radio Receiving Station" explains this and other sets and gives much information for the Amateur. Sent postpaid for 10 cents a copy.

DE FOREST RADIO TEL. AND TEL. CO.

Inventors and Manufacturers of High Grade Radio Apparatus

1415 Sedgwick Avenue, New York City

Lee DeForest Inc., 451 Third St., San Francisco
Western Distributors

DE FOREST

TUBE CONTROL PANELS

of unit size, 5½" High 4½" Wide



Beauty and convenience have been incorporated in the design of these Panels to an unusual degree. The detector panel has a plug connection for the telephones which takes your regular phone tips. The amplifier panel has binding posts making it very easy to connect two of these together as a two stage amplifier. Both instruments will give you the utmost value for your money and the name Clapp-Eastham Co. engraved on the bakelite panel carries with it almost 13 years development experience in the Radio Field. Catalogs mailed for 6c stamps.

Tube Control Detector Panel Z. R. D. . $13.00
One Stage Amplifier Panel Z. R. A. . . . 18.00

Order one or both panels from your dealer to-day

CLAPP-EASTHAM COMPANY

131 Main Street Cambridge, Mass.

No Seals—No Secrets
—BUT SERVICE!

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus. If he doesn't carry it as yet write us for catalogue, mentioning his name.

A. H. GREBE & CO., Inc.

71 Van Wyck Blvd., Richmond Hill, N.Y.

RADIO MEN

THE
Mutual Purchasers Association
will save you money on all
WIRELESS APPARATUS

Write Dept. E10 for details.

Mutual Purchasers Association

2-4 Stone Street, New York

TELEGRAPHY

(Both Morse and Wireless and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low — opportunities to earn large portion. Catalog free.

DODGE'C INSTITUTE 749 C Street, Valparaiso, Ind.

ADJUSTING SPRING DIES

(*Continued from page 462*)

come out. It will be clear now that the use of any two, or only one, screw to hold a spring die is a source of danger, and may easily result in the die splitting. All three screws must be in action, otherwise the contrivance is unsuitable, and the cutting strain of the die put on its spring, which is obviously a mistake.

Some dies, which are usually expensive patterns, are made self-adjusting and locked both ways, so that they could be used in hand without any injury resulting, but spring dies must never be so used. And indeed most of the ordinary patterns of adjustable dies require a holder, as they tend to open out when set to work unconfined. Never put a spring die in a chuck and trust to the holding power of the chuck, as this is likely to result in fracture, the setting not being rigid like that which has been described.—*Model Engineer and Electrician, London.*

GUIDING AIRPLANES BY WIRELESS

IT has been known for some years past that stronger wireless signals could be received when the top and bottom wires of a rectangular aerial were pointed in a direct line toward the sending station, whereas the signals were very much weaker when the aerial was placed so that the top and bottom wires were at right angles, or broadside on to the sending station. At intermediate positions of the rectangle the signals varied in strength from practically nothing, when at right angles, to the maximum strength when directional to the sending station.

The rapid turning about of large aerial in that manner is not practicable; therefore, the Marconi Company erects two independent triangular or rectangular aerials fixed with their planes at right angles, and connects them to the direction-finder box, which may be said to reproduce the external conditions in a small space. Inside the box there are two fixed "field" coils mounted in planes at right angles and connected to the aerial wires. Within these fixed coils is a rotatable "search" coil. This portion of the apparatus combines the signals received on the two aerials so that the movable "search" coil is influenced by them when in a plabe directed toward the sending station, but is unaffected when it occupies a position in a plane that is located at right angles to that direction.

The dial of the finder is calibrated from 0 degrees to 360 degrees, and is arranged so that the direction of the incoming signals is due north when the direction-pointer is at 0 degrees. When signals have been obtained, the apparatus is tuned to the proper wavelength as in ordinary wireless reception.

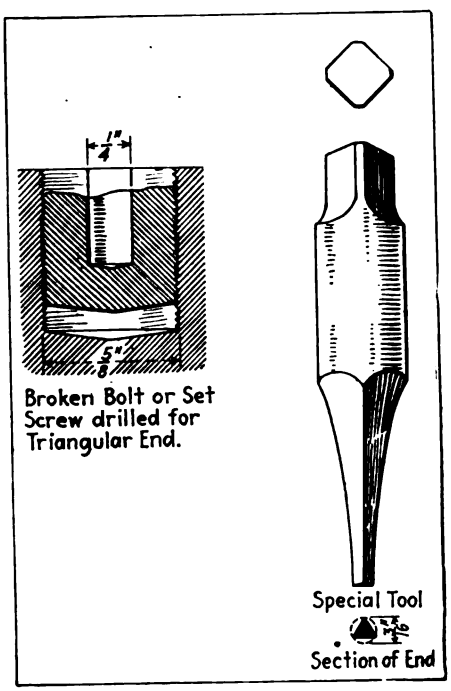
Digitized by Google

By rotating the handle of the direction-finder, the strength of the signals in the telephone headgear will be heard to vary. The maximum strength will be heard at points diametrically opposite on the scale, and between these positions the sound gradually decreases until at two other opposite points, midway between the maximum positions, there is silence.

Since at the present time it is not possible for one direction-finding station to determine from the received signals alone the distance of their origin, but only their direction, it is necessary to make use of two or more stations separated by a considerable distance. Such stations having obtained the directions of the transmitting station, in this case, the airplane, it is only necessary for the control station to plot these directions on the map, when the point of intersection will give the position required.—*Illustrated London News.*

REMOVING BROKEN TAP

THE extraction of a broken tap bolt is a problem occurring sometimes in the machine shop. One way of extracting the piece is to drill a hole in it and to back it out with a left-handed tap. We illustrate a much simpler way. A hole is drilled in the broken bolt



Details of special drift pin or punch for removing broken stud bolts

and to turn it out, a three-cornered punch, such as shown, is employed. This must be well tempered, so as to cut into the sides of the hole and give a good grip. A hole one-third of the diameter of the bolt will suffice. The extracting tool can be made from an old tap or reamer, whose square head gives the hold for a wrench or spanner.



"—That's why I say he knows his trade."

"Look at his tools spread out on that planer bed. Every one's got the Starrett trade mark on it. It's a pretty safe guess that a man with Starrett Tools, knows how to use 'em."

"Guess you're right. I've worked around considerable, and everywhere I've been, I've noticed that the high-class men use Starrett Tools. It's easy to see why. You've simply got to have good tools for first-rate work."

"Starrett's name on a tool is enough for me. I've been using them since I was an apprentice, and I know I can depend on 'em. When I'm on a high-grade job—or just an ordinary one, for that matter—give me a Starrett Tool."

THE L. S. STARRETT COMPANY

The World's Greatest Toolmakers

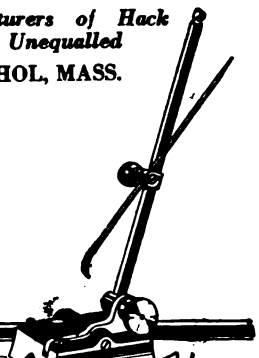
Manufacturers of Hack Saws Unequalled

ATHOL, MASS.

There are 2100 tools listed in the Starrett Catalog—tools of the highest quality. Write for Catalog No. 21 "MB."

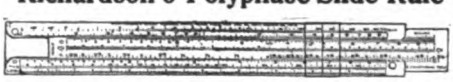


42-68



Starrett Tools

Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $2.00.

An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO., Niles, Mich.

L A S T I N G



THAT'S THE ECONOMY of owning a Union Tool Chest — it outlasts the ordinary chest so many years. The garage man, the auto machinist, the car owner will find the right "house" for his tools in this Union Garage Chest

175 tools can be conveniently packed, carried and locked in it. Don't you want a tool chest that is durable, compact, neatly arranged and of the finest workmanship? Let us tell you more about Union Tool Chests—sold on "Satisfaction or Money Back" guarantee—24 styles to choose from.

WRITE FOR FREE CATALOG

UNION TOOL CHEST CO., Inc.

34 Mill Street — UNION TOOL CHESTS — Rochester, N. Y.

EVERYDAY ENGINEERING MAGAZINE

Is the Only Publication That Meets the Needs of the Experimenter and Home Mechanic. It Tells How to Make and Do Things, and Why Things Are Done. Subscribe Now.

Digitized by Google



DUCK'S No. 14 264 Pages
Electrical and Wireless Catalog
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

YOUR FUTURE IS ON THE SEAS



Be a Ship Officer

Join America's Mighty Merchant Marine

Hundreds of first, second and third mates, masters and captains are needed by the big shipping companies and America's great merchant marine.

Salaries up to $412 per month and living expenses.

Ships flying the American flag pay the biggest salaries of any in the entire world.

Learn Navigation at Home or on Board Ship.

Captain Warren Sheppard's Course on Ocean, Coast and Lakes Navigation is now ready. It is a life time of practice placed before you for quick mastery. Captain Sheppard was instructor for the United States Shipping Board during the war. All of his students received licenses—from third mate to master. Not one failed. He offers this same sure method to you at a very low price. You cannot fail.

Valuable Booklet FREE

Fill out the coupon below and return to us. A 36-page booklet telling how you may become a ship officer at a big salary will be sent you free. Don't delay. Officers urgently needed.

FREE COUPON

.....

World Technical Institute
Dept. 102 Fuller Bldg., Jersey City, N. J.

Gentlemen:—Send to me free booklet, "Your Future Is on the Seven Seas." *(Write Plainly)*

Name .....
Address .....

THE RADIO REVIEW

A MONTHLY RECORD OF SCIENTIFIC PROGRESS IN RADIO TELEGRAPHY AND TELEPHONY

Monthly - Half-a-Crown

Single copies, post free 2s. 9d. Annual Subscription, post paid, 30/- post free.

THE RADIO REVIEW, a new monthly magazine, devoted entirely to the technical side of radio communication.

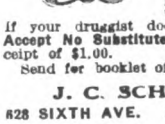
Edited by Professor G. W. O. HOWE, D.Sc., M.I.E.E., assisted by PHILIP R. COURSEY, B.Sc. A.M.I.E.E.

THE RADIO REVIEW is the Authoritative Journal of Wireless Research. Contributions from the pens of the World's leading Radio Scientists are a special exclusive feature.

. . . . . .

Editorial and Publishing Offices
12-13, HENRIETTA STREET
LONDON, W.C. 2

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit and low price. If your druggist does not carry Schnoter's, **Accept No Substitutes.** Sent direct upon receipt of $1.00.

Send for booklet of other styles and prices.

J. C. SCHNOTER CO.
628 SIXTH AVE. Dept. (E) N. Y. CITY

IF YOU NEED SPECIAL INFORMATION WRITE OUR SERVICE DEPT., EVERYDAY ENGINEERING MAGAZINE

METALS WITH RADIOACTIVE PROPERTIES

IN addition to the ordinary radioactive substances, which are all closely related to uranium and thorium, two elements of the lightest atomic weights known, only two of the light metals of relatively small atomic weights, potassium and rubidium, seem to be radioactive to a certain extent. The nature of this latter radioactivity is by no means understood, while a great deal is known as to the character of the ordinary radioactivity. In case of the radium and the other radioactive elements there is certainly a decay of atoms. As regards potassium and rubidium, we have no definite evidence of any decay. In discussing these problems in the *Physikalische Zeitschrift* some time ago, Otto Hahn and the late Martin Rothenbach point out that, while several investigators are convinced that these alkali metals emit beta rays, alpha rays have not been discovered; it is, on the other hand, striking that the potassium suit deposits of Strassfurt are rich in helium.

The radioactivity of the alkali metals might be due to some impurity; but no impurity has been traced, and the radioactivity observed is always proportional to the potassium percentage; e. g., the intensity of the radiation from potassium, which was first observed by N. Campbell at Cambridge in 1906, is very small; yet it was considered to be at least ten times stronger than that from rubidium. Hahn and Rothenbach made their experiments especially on the sulfates of potassium, rubidium and caesium, with the aid of electroscopes of unusually large dimensions. The following are the conclusions at which they arrived: There is no indication of the presence in rubidium of some isotope; the beta rays from rubidium to uranium as 1: 15, and rubidium to thorium as 1:10; the life period of potassium would probably be from three to seven times longer than that of rubidium. Speculations have been made by others as to a possible production of strontium from rubidium, calcium from potassium and barium from caesium; but such speculations appear to be quite arbitrary for the present.

Much disappointment has been experienced in the use of caustic soda (concentrated lye) for cleaning out obstructed sewer pipes. It is recommended to use a hot solution instead of the usual cold one; this will dissolve much which the cold solution will not affect. It may be kept hot in a stopped pipe in many cases by pouring boiling water over the outside of the pipe. This especially may be taken as applying to the cleaning out of a trap.

To attach mica to cast iron, as in stove doors, a cement made of slaked lime mixed with a saturated solution of borax in water is recommended. It should be given plenty of time to dry before being exposed to heat.

Digitized by Google

MORE ABOUT THE HANDLEY PAGE WING DISCOVERY

THOSE who realize the importance of the discovery in wing forms made recently by the Technical Department of Handley Page, Ltd., will be interested to hear that the Airco D. H.-9, fitted with an experimental set of the new wings, has been flown with apparent success. No official account of the experiment has been issued, nor has any information been received from anybody connected with the firm, but as Cricklewood Aerodrome (England) is an air port, and is open to the road, intelligent observers are occasionally able to obtain a glimpse of what is occurring there. According to the account of an eye-witness writing in the *Aeroplane,* the D. H.-9, which, as is generally known, normally leaves the ground at a high speed after a reasonably long run, lifted at about 30 miles an hour with the new wings, and only travelled a few yards before lifting. Also, it seemed to continue climbing at about the same speed. So far as could be seen, it handled quite normally when in the air. Presumably, the experimental flights were made with the machine dead light, but, even so, the low lifting and climbing speed was abnormal. Thus one is led to believe that the initial tests were successful.

A NEW PARACHUTE

RECENTLY tests were carried out at Villacoublay, France, with a new parachute, designed to allow light, delicate and valuable articles to be dropped from aircraft without damage. It has been designed by MM. Bourgecis and Debreuil, and the experiments carried out under Lieut. Robin (of the S. T. Ae.) from a Breguet biplane were perfectly successful.

The parachute in being dropped from the aeroplane falls at its normal speed to about 15 meters from the ground. At this point an antenna, carrying at its extremity a weight of 500 grammes, comes in contact with the ground, thereby relieving the parachute of most of the weight and allowing the actual load to land with the minimum of bump.

TEST IN VACUUM TANK.

AN interesting test was carried out by Lieut. Casale at St. Cyr, near Paris, France, recently by way of preparing for an attack on the altitude record. Entering an insulated cylindrical chamber, the air was gradually exhausted until the atmospheric conditions, as indicated by the barograph, were similar to those at a height of 12,000 meters (39,300 feet). The "ascent" was made in 47½ minutes and the "descent" in 20 minutes. Lieut. Casale started to inhale oxygen at 4,600 meters. During the experiment 1,000 liters of oxygen were consumed.

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.
Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 521 W. Mo. St., El Paso, Texas.

SET OF 11 SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.
672-D Broadway Brooklyn, N. Y.

NOW YOU CAN FLY!
A REAL AEROPLANE AT LOW COST



THE DELERAY D-5 SPORT PLANE
Wing Span 17 ft. Speed 39-65 m.p.h.

Planned by men with many years' experience in designing successful U. S. Government planes. Equipped with 15 H.P. engine (practical engineering made it possible for this biplane to be flown with only 8 H.P.) Use your own motorcycle engine if you wish.

Send $6.00 for complete set of 25 large detailed blueprints, actual duplicates of our shop drawings, showing exactly how each part is made and fitted.

DELERAY AIRCRAFT WORKS
AEROPLANES ENGINES PARTS
FREEPORT, LONG ISLAND, N. Y.

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 749C 431 S. Dearborn St. CHICAGO

Telegraph Pictures
BY ELECTRICITY

A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.



L. J. LEISHMAN CO Dept. L. Ogden, Utah

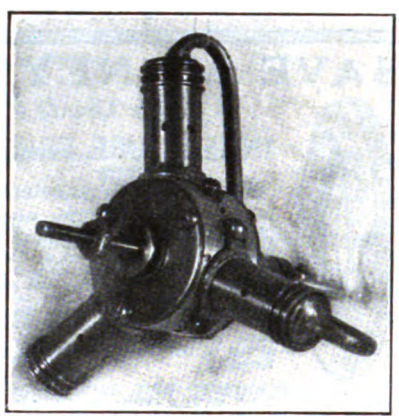
UmakeM Club You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Spad and other Flying Planes; also real Work Benches, Sewing Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 18 Jointed Animals, Doll Furniture and Doll Houses Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.
W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 8th Ave., N.Y.

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand, in lots of 500,000. Motors $1.75 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 37 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46M. E. 12th St., N. Y., U.S.A.

Compressed Air Motors



THE new and improved method of propelling your model aeroplane. Manufactured of the finest materials. Workmanship guaranteed. Special propellers for the above motors. Send stamp for descriptive circular of these wonderful motors. We manufacture everything for the model aeroplane builder. Give us a trial and be convinced.

HEC AEROPLANE CO.
302 East 49th St. New York City

Mathematics Made Easy

The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only $1.00 postpaid. Order today before you forget.



Dept. U, L. J. LEISHMAN CO., Ogden, Utah

UmakeM Airplanes Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.
W.R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 8th Ave., N.Y.

Digitized by Google

It is One Thing to Desire—and Another to Determine

Almost everybody WANTS a good job—but not so many have the WILL TO DO what is necessary to get it.

Ask Yourself These Questions:—

Are you ambitious? Do you like machinery? Do you want an opportunity to qualify for a better job—with prospects of earning MORE MONEY? Would a position with shorter hours interest you? IF YOUR ANSWER IS YES—

We would advise you to see us at once.—

Don't be a misfit

THINK BIG—You can get what you want if you go after it the right way.

KNOWLEDGE—Is the BIG answer to your chance to earn BIG MONEY.

SUCCESS—Is the result of knowing how.

THINK THIS OVER—This is your opportunity.

WE TEACH YOU THE HOW—Of the biggest industry the World has ever known.

AUTOMOBILISM—has no limit as to how BIG an amount of money you can earn.

TAKE THIS OPPORTUNITY—to start yourself on a career of usefulness—make up your mind to BECOME AN AUTO EXPERT—and make yourself what you would like to be—A BIG SUCCESS—If you know how you cannot fail.

If your present occupation offers you no chance of promotion our advice to you is—come at once and LEARN THE AUTOMOBILE BUSINESS.

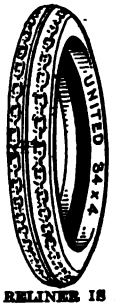
Yours for a big success

BUFFALO AUTO SCHOOL
Buffalo, New York

P.S.—If you cannot call send us your name for full particulars.

SAVE MONEY!

A High Grade



INNER TUBE FREE

6000 MILES Guarantee

Economy Reconstructed Tires made by our new special process are guaranteed to give good service because the best materials are used in their construction. Our tires are guaranteed for 6,000 miles and we give a FIRST quality inner tube free with every tire ordered from us. Our tires are reinforced with extra plies of fabric making them strong so they resist punctures and blowouts.

RELINER IS FURNISHED WITH EACH CASING AT NO EXTRA COST.

THESE PRICES INCLUDE CASING, RELINER AND TUBE.

30x3	$7.15	32x4	$11.00	35x4½	$13.15
30x3½	8.25	34x4	11.25	36x4½	13.50
32x3½	9.00	32x4½	11.75	36x5	14.50
31x4	10.10	33x4½	12.25	37x5	14.50
32x4	10.45	34x4½	12.90		

State with your order whether a straight side or clincher, plain or non-skid tread. Send a deposit of $3 for each casing ordered. Balance C. O. D. subject to examination. 7% discount if full amount is sent with order. References furnished if desired.

UNITED ECONOMY TIRE CO.
295 West 48th Street New York City

SHIP BY TRUCK

Motor Cartage.

One to Five-ton Trucks.

Hauls made to any point in United States and Canada.

Rates by hour, day or contract.

W. H. SQUIRES
1561 Woodward Avenue
Detroit, Mich.

You Can Save $50.00



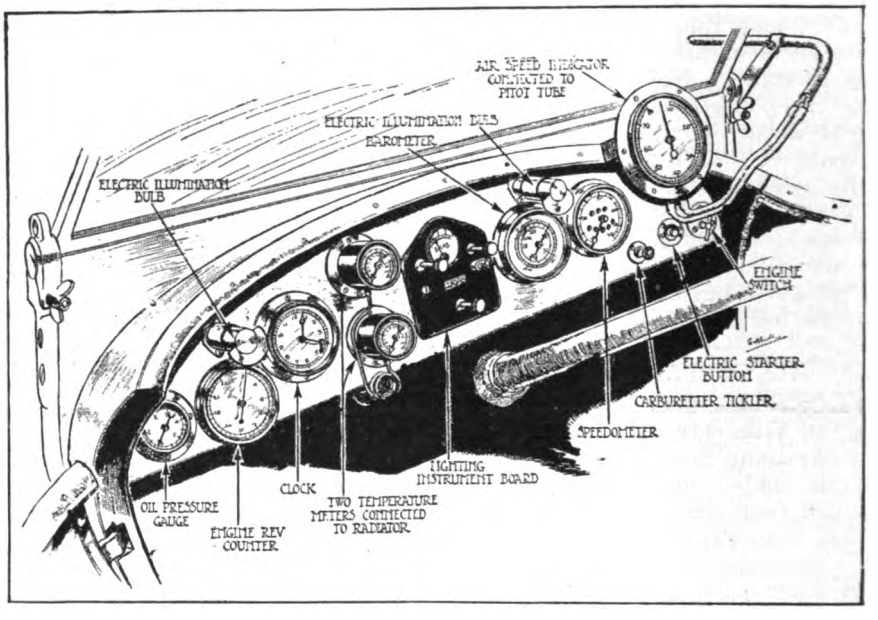
By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

$8.46 and up Parcels Post Paid

LIBERTY TOP & TIRE CO., Dept. E3, Cincinnati, O.

Airplane Instruments on a Car

THE accompanying illustration, which is reproduced from an English motoring print, *The Autocar,* shows a car dash-board that has a collection of instruments not usually found on an automobile, yet which serve their owner's purpose of carrying on various experiments in connection with engine and car performance while the car is in use. In other words, the tests and determinations can be made under actual operating conditions on the road and can be depended on to be of real practical value. The owner of the car so fitted, Captain W. Gordon Aston, is an ardent experimenter and writer on technical subjects, so his reasons for the use of two instruments usually associated only with aircraft should be of particular interest to those of our readers who have an inquiring turn of mind.



Cowlboard of English aviation and automobile enthusiasts' car shows practical use of several airplane instruments

The dash-board equipment is unusually complete and some of the instruments are of real value in the everyday operation of the car as well as for research work. There is an oil pressure gauge, a revolution counter, a clock, an electric switchboard with ammeter, a voltmeter, a discharge ammeter, a tele-thermometer for the top of the radiator, a tele-thermometer for the bottom of ditto, a road speed indicator, an aneroid barometer and, finally, an air speed indicator.

"Most of the people whose eyes are caught by any accessory showroom in the garage seem to be able to understand all the instruments with the exception of the barometer and the air speed indicator: these, for the most part, they look upon as owing their presence solely to the fact that the dials really look rather nice and "set off" the dash-board very handsomely. They are quite surprised when I tell them that I find these two almost as interesting as the rest of the other things put together, for they cannot see what possible use they can be. This attitude is so general that I am in hopes that this short article may not be out of place.

Estimating Gradients

Dealing first with the barometer, this is employed simply as a means of accurately measuring gradients. Since it performs this function very capably, it is to most people extremely disappointing, because it notably fails to record the "miles of one in six" that one hears so freely talked of. The dial is marked with the usual "Inches of Mercury," so that it can be used to confirm one's opinion of the weather, and outside of these figures are calibrations reading down to 20 ft. As a matter of fact, with a little practice one can read down to 10 ft. quite easily, and a closer approximation than this is rarely required. Outside the main dial is a movable annular dial, also finely calibrated, and bearing a zero mark. On one side of this the figures and spacings are red, showing descent; on the other black, showing ascent.

The modus operandi is as follows: At the foot or top of a hill (the car need only be slowed down for this purpose) the speedometer trip and the barometer are both set to zero. The former reads in tenths of a mile, and a certain amount of judgment has to be

Digitized by Google

used in connection with it. For instance, .6 may be shown whilst the car is on the hill, whilst .7 would not be put up until its foot or its crest had been passed by fifty yards or so. Hence it is necessary, at the top or the bottom of the hill, as the case may be, to go on running until the higher figure is shown, and then make a suitable deduction. In the meantime, the aneroid barometer, having been started at zero, has shown the vertical height traversed, so that the calculation is a very elementary one. As an instance, the hill outside Henley (White Hill, I think it is called) is .65 mile long, and rises 220 ft. The gradient is, roughly, therefore, 1 in 16, though as a rule I have heard it described generally as 1 in 12, frequently as 1 in 10, and once or twice as 1 in 8. This shows how deceptive the eye may be.

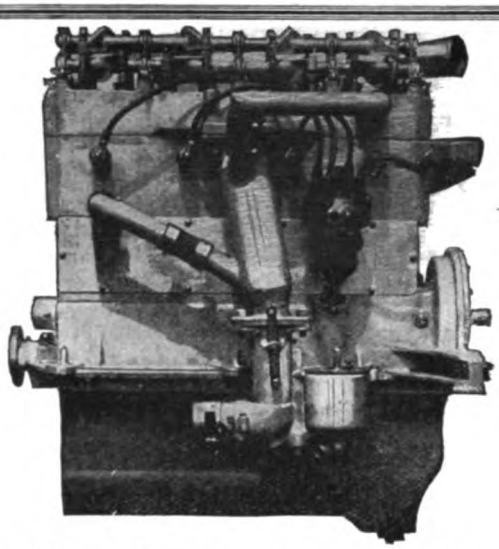
Importance of Wind Resistance

Now for the air speed indicator. The real reason why it is on the car I am not for the moment going to disclose. I will merely say that it is a scientific reason in connection with which research has not yet been started. The air speed indicator being in position, however, I find it so interesting for a secondary reason that, even if I were not going to put it to other uses, I should still consider it well worth dash-board room; although it is somewhat large in dimensions, it is amazingly light in weight. It reads from 10 m. p. h. to 70 m. p. h. It is almost superflous to say that it is dead accurate. I tried it very early one morning when there was not a breath of air stirring and smoke from a cigarette went up vertically, and found that from ten to fifty (and just over!) it read mile for mile with the speedometer (previously checked and adjusted).

Air Speeds and Car Speeds

It is almost a truism that at low and moderate speeds, the atmospheric resistance of a car can be dismissed from serious consideration, but these speeds are air speeds and not road speeds, and it is desirable to have, therefore, a straw or two to show which way the wind blows. How often one is apt to think, "How nicely the car is going," when the fact of the matter is that it has got a twenty-mile wind smack on the back panel, and, conversely, "She does not seem to be pulling so well to-night; never had to change gear so early before on this hill!" when all the time the little engine is battling with a stiff head wind. Now, the air speed indicator tells you the truth about these things. I have not had it on very long, but I have already seen it show fifty when the road speed indicator would only bid twenty-five, and I have seen

(*Continued on page* 472)



"ACE" MOTORS

Are Powerful, Light, Reliable and Economical

Weight 126 Pounds — Forty B. H. P.

These motors embody all the features of engineering that an extensive series of tests proved necessary, and are the product of ripe judgment of practical airmen. The ideal power plant for the man building his own plane.

Descriptive Literature on Request.

HORACE KEANE

Aero HK Planes Inc.

Sales Office
280 Madison Ave.
New York

Factory
North Beach
Long Island



Fits Bearing Surfaces Without Scraping

TIMESAVER Compound is the modern bearing abrasive that turns to a lubricant after a few minutes' cutting. Produces perfect surfaces in any size or type of babbitt, brass or bronze bearing. Contains no emery, carborundum or glass, will not cut or scratch iron or steel and will not injure any part of the motor or machinery. Effects savings of from 500% to 8000%. Send $1.50 for trial can. Money back if not satisfied.

M. T. K. SALES CORPORATION

296 Andrews St. Rochester, N. Y.

Manufacturers, M. K. T. Products Co., Seattle, Wash.

FOR SALE

Rotary-Spark-Gap, with 4 to 6 volt, high speed, compound wound D. C. motor, rotary disc being made of bakelite, $8.00. One unwound transformer with laminations, .80. One-inch spark coil, practically new, $5.00. Ten Edwards buzzers; some high tone, at .50 each. One large buzzer at .35. 12-volt colored bulbs with sockets at .11 each.

JOSEPH F. MATIS
316 E. 89th St. New York City

DRAFTING

Inventions and Ideas Developed!

Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.

COMPETENT DRAFTSMEN AT YOUR SERVICE

A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4530

Digitized by Google

INDUSTRIAL NIAGARA

(*Continued from page* 399)

cutting marble and granite; in the machine shop we find it accomplishing a hundred tasks; in the steel plant we find it grinding rails, armor-plate and armor-piercing projectiles; in the glass factory we find it cutting glass, and even in the dentist's chair we feel it whirring against our teeth as it cuts into them. Of all the wheels of industry, the grinding wheel is probably the busiest. It fulfills a thousand tasks. It is hard for one to realize its importance—its absolute necessity.

Modern industry owes to the grinding wheel what transportation owes to steam and electricity. Without Niagara we would have no modern abrasives. The diamond would still hold its own, and emery, with its poor abrasive qualities, would still be in use. The automobile, as well as the airplane, to which we attached so much importance in the late war, would still be in the embryo state. The modern high-powered gas engine, with its perfect-fitting pistons and high compression, would be an unattainable dream. Ferro-manganese is so extremely hard that it cannot be cut with steel tools, and were it not for the grinding wheel we would not be able to use this valuable material which is employed in many industries.

Aluminum Production

Before the pulsating might of Niagara had been lashed to the service of mankind, aluminum was a metallic rarity. Today aluminum is one of the most common metals and plays an important part in our daily life. The automobile owes much to aluminum. It is used in castings of every description where lightness is sought without any sacrifice in mechanical durability. This makes it particularly adaptable for use on the airplane and it is destined to play a very important part in the development of aircraft. In fact, aluminum is employed on the present-day airplane wherever possible.

Vanadium steel bears the distinction of being the hardest alloy steel known to commerce. Without it our armament would suffer considerably. This material was made possible by a process which employs aluminum as its oxidizing agent. It is fast replacing copper as a conductor in high-voltage transmission lines and it is found to be much more economical. The wonderful welding mixture of thermit would be utterly impossible without aluminum as one of its constituent ingredients. Fifty-five thousand horsepower is used in the electrolytic production of aluminum at Niagara Falls.

Artificial Graphite

A few years ago the world obtained its supply of graphite by mining it. The natural product is very impure and entirely unsuitable for many processes that involve the use of graphite. Today artificial graphite is being produced in electric furnaces at Niagara Falls. Being created under a chlorific influence of 7,500 degrees Fahrenheit, this man-made graphite has a purity that closely approaches 100 per cent, as all the elements which would contaminate it are vaporized in the terrific temperature necessary for its production. Artificial graphite finds many uses and its part in the military establishment of the nation is an important one. One of its important uses at the present time is in the manufacture of smokeless gunpowder, where it is absolutely necessary. The granular product also finds broad use as paint pigment and dry-cell filler. In fact, artificial graphite brought the dry cell from an undependable makeshift to a reliable commercial commodity. Due to its wonderful purity and its unapproachable unctuousness, Niagara-made graphite, when blended with oil, makes a lubricating grease that is one of the most efficient anti-friction compounds ever originated. Graphite finds its most important uses when it is moulded into electrodes for electro-chemical and electro-thermic processes. One of the foremost electro-chemical authorities in the United States once said that the development of electro-chemistry would have been as impossible without artificial graphite electrodes, as the perfection of electric lighting would have been without the dynamo. This is a very true statement and it is extremely difficult for one to realize what it means to the country.

Nearly all of our metals are refined electro-chemically and numerous other elements that are absolutely necessary are products of electrolysis. Before the advent of artificial graphite, platinum was largely used for electrodes, but it is now possible to dispense with it, owing to the great adaptability of graphite. Graphite is employed in most every electrolytic cell in America and previous to the war, it was used in every electro-chemical process in continental Europe.

Chemicals Produced Economically

Benzol is another important product of Niagara. One of the derivatives of benzol is toluene. When toluene is treated with sulphuric and nitric acids, trinitrotoluene is produced. This substance has a much more restless molecule than nitro-glycerine and is far more violent as an explosive. Benzol is an important substance in the aniline dye industry.

Chlorine is produced abundantly at Niagara and can be compressed and stored under pressure in steel bottles in the liquid state. Chlorine has far more humane uses than the suffocating of men on the battlefield. It is important to the arts and sciences, and is also the most powerful bleaching agent known. Without chlorine we would have no white paper to write upon and our white clothes would come back from the laundry a tinted yellow. Chlorine is used in the production of many chlorites and chlorates that are indispensable to the country. Hypochlorite is used in sterilizing the water supply of every city. Carbon tetrachloride is one of the most efficient fire extinguishers ever discovered. Chlorine products are also used in the sterilization and bleaching of surgical cotton.

Niagara produces more alkaline products than any other community in the world. These alkaline substances are used in the manufacture of mercerized cotton, explosives, medicines, dyes and in the refining of oils. Metallic sodium is a Niagara-made product of great importance. Sodium cyanide is necessary in gold and silver refining, and sodium peroxide is used to purify air and increase the oxygen content, especially in submarines. Phosphorus which is produced abundantly at Niagara is used in the manufacture of phosphorus bronze, and it is also used as a deoxidizer in other non-ferro alloys.

A great manufacturer of automobiles contemplated an output of 1000 cars per day during the year of 1917, and it was estimated that if he had been deprived of carborundum, aluminum, high-speed tool steel and oxy-acetylene, which are products of Niagara, that he could not have produced 100 cars per day with the same force of men he employed in making 1000 cars per day. This is a vivid illustration of Niagara's importance to the industry of the country.

Among the other important chemical products manufactured at Niagara Falls are sodium, caustic soda, chlorates of potash and soda, chloroform, carbon tetrachloride, bleaching powder, phosphorus, hydrochloric acid, sodium peroxide, formaldehyde, titanium, ferro-manganese and caustic potash.

STERILIZING AIR BY ELECTRICITY

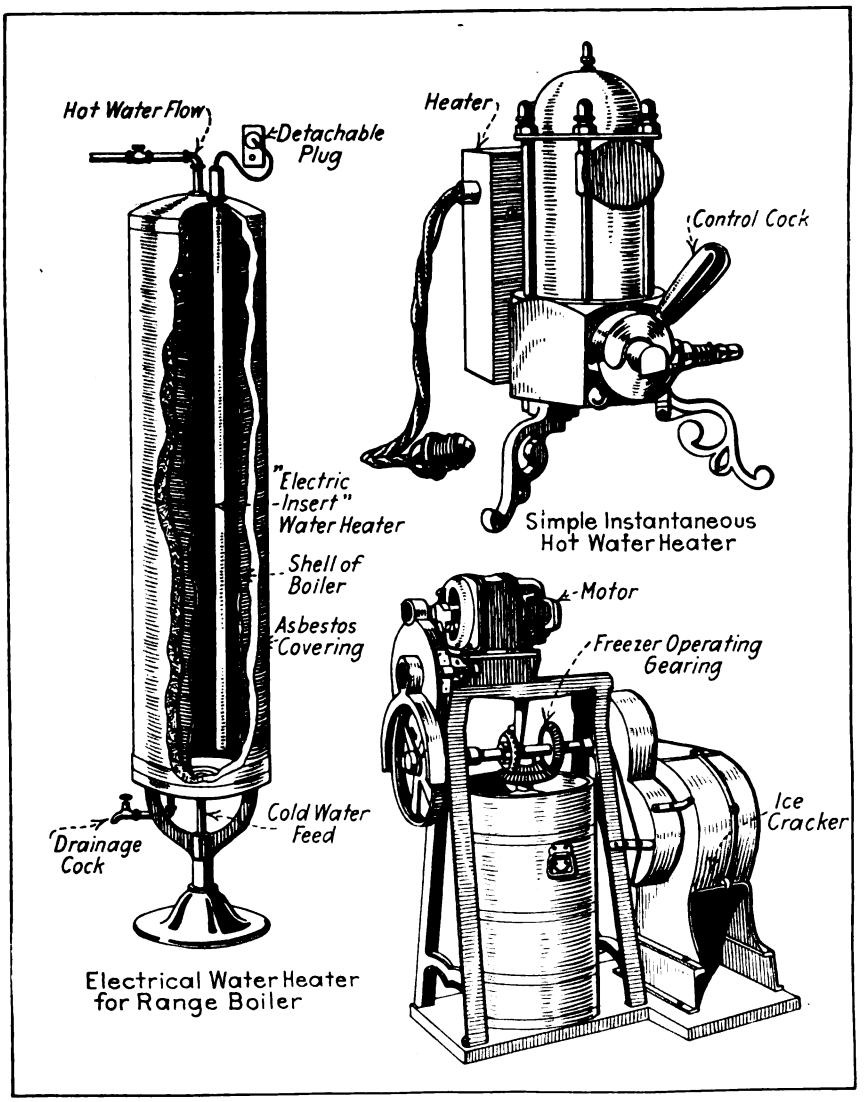
We have already had occasion to note the removal of dust from gases by the use of a highly charged system of conductors hanging vertically in tubes through which the current of gas went. Recent experiments in drawing air through a copper tube in whose axis a wire was maintained at a negative potential of 50,000 volts referred to the potential of the tube showed that the air thereby could be rendered absolutely sterile, so that absolutely no bacteria could be found in it.

Digitized by Google

Useful Electrical Appliances for the Household

ONE of the greatest time and labor savers ever introduced in the household is the electric current and its uses are manifold. Numerous and practical devices are marketed for performing almost any desired household task by the aid of the electric current. The accompanying illustration shows some recently developed appliances that seem to have advantages warranting their use. The insert heater for range boilers permits of obtaining a supply of hot water when it is too warm to operate the coal-burning range, to which such a boiler is usually connected. As there is a tendency in many kitchens to use electric stoves to the exclusion of those burning either solid or gaseous fuel for cooking purposes, the insert heater, which is a small and modified form of resistance heater, would, of course, be used as a permanent installation. As will be apparent, it is a simple matter for the makers to supply heaters suitable for any kind of current or of any desired capacity. This development is along the lines noted in these columns where electric current has been used for generating steam for various purposes by heating boilers, this development being especially notable in Switzerland.

Sometimes only small quantities of hot water are needed and they are required at once, so that the instantaneous electric water heater, which can be put in any ordinary cold water pipe line, should be valuable. The main portion of the heater is a cylinder of porcelain and the body is provided with a series of tubular passages which are connected in series with each other by suitable caps placed at the top and bottom of the pipe. The cold water enters the first passage either from the water pipe or any suitable hose connection, flowing through the different passages where it is heated, and from the last passage it goes to the faucets. All of the passages are provided with metal resistance coils made of non-corrosive material. These are connected in series and the group of heating elements is connected to the current supply sources by a simple switch which is operated simultaneously with the faucet. As soon as the faucet is opened to the hot water position, contact is established and the metal coils quickly become heated and impart their heat to the water passing through them.



Useful electrical appliances for the household

Another appliance that will be voted for enthusiastically by the younger members of the family is the combined ice cream freezer and ice-cracking machine illustrated. The entire mechanism operates by a small electric motor and both the cream freezer and ice-cracking machine are installed on a solid base so that the device will remain rigid in operation. Simple gearing is provided for turning the freezer and ice cracker and a clutch arrangement is incorporated so that either machine may be driven independently of the other. Electric motors supplied can be built to operate on either alternating or direct current, and while the freezer shown is one of larger capacity than would be needed in the ordinary family it can be made in smaller sizes suitable for family use. One of the advantages is that no belts are used, the motor being directly connected to the main power shaft through a series of reduction gears which are well protected.

PREVENTING INFECTION OF SMALL WOUNDS

A SMALL cut or scratch on the hands, if not properly cared for, may become infected and cause serious trouble. If the wound, after being thoroughly cleansed, is sealed with pyroxyline, which may be obtained in liquid form in any drug store, a film is formed over it which prevents infection. Great care should be taken that no dirt or foreign substance is left in the wound.

DO NOT USE STEAM IN AIR BAGS

ONE repair man has asked if it would be all right to use steam instead of air pressure in bags used for sectional repairs to eliminate the necessity of curing on an inside vulcanizer.

It is not advisable to use an ordinary air bag for this purpose for the reason that it is not constructed for use as a steam container. As it has no outlet, condensation would result and water would form in the bag. Never apply the section to an inside patch vulcanizer to finish the cure. The time specified gives 40 pounds steam pressure with Goodyear repair material without the aid of the inside patch vulcanizer.

Digitized by Google



NEW MOTORS

FACTORY GUARANTEED
ALL SIZES
PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v. 10 amp. - - $19.50
15 v., 10 amp $26.50
40 v. 6 amp. - - $31.50
110 v. 2½ amp. $31.50
110 v. 5 amp. - - $52.50
40 v. 12 amp. - - $52.50
110 v. 9½ amp. $67.50
40 v. 25 amp. - - $67.50
110v. 18amp. $116.50
40 v. 50amp. $116.50
110v. 26amp. $156.50
110v. 50amp. $238.50
Moving Picture Arc Generator 60 v., 35 a. $116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R. P. M., Complete with base and pulley.

½ H. P. - $46.50
1 H. P. - $66.50
2 H. P. - $86.50
3 H. P. - $98.50
5 H. P. $116.50
1 H. P. Special Grinding and Buffing Motor - $106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor - $28.50
¼ H. P., 32 v. Washing Machine Motor $28.50
½ H. P. - - $58.50
1 H. P. - - - $82.50
2 H. P. - - $124.50
3 H. P. - - $142.50
5 H. P. - - $218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. induction Washing Machine Motor $28.50
¼ H. P., 110 v. grinding buffing motor - $28.50
½ H. P. induction, full load start - $46.50
½ H. P. repulsion induction For compressor service $54.50
1 H. P repulsion induction, Special Garage Motor - - $74.50
2 H. P. repulsion induction with sliding base - - $126.50
3 H. P. repulsion induction with sliding base - - $146.50
5 H. P. repulsion induction with sliding base $188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c. 2 P., 1750 R.P.M. Complete, cord, plug and pulley



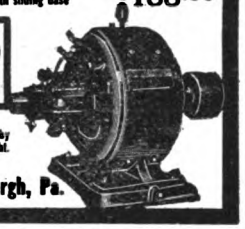
WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each Reg. Val. $34.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.



BIG PROFITS for YOU in HB BATTERY CHARGING

Profits of $100 to $300 a month are easy—hundreds of letters from HB users everywhere prove it. Cost 10c to 15c per battery—customer pays 75c to $2.00. There is a sturdy, reliable, economical HB Charger to fit any size battery business.


HB 8-Battery Charger


HB 16-Battery Charger


HB 32-Battery Charger

Mark a cross (X) on the outfit suited to your needs. Then tear out this ad and mail TODAY for complete information. Small cash payment—balance easy monthly terms. Get busy.

HOBART BROTHERS COMPANY
Box EE 87 Troy, Ohio

AGENTS AND DISTRIBUTORS WANTED

Sparko-Gap is a nationally advertised automobile and motor boat accessory—almost essential with present-day power gas—tested and proved by United States experts, the French Government, electrical engineers and users everywhere.

Can be installed in two minutes without tools or adjustments. Demonstrates its merit in the first five minutes of driving.

Universal market, big profits and chances to establish own business without any investment. Still a few territories open.

We want the right man and don't ask for any guarantee or stock order. Hustle and enthusiasm the only requirements. Write at once for territory still open.

SPARKO-GAP COMPANY
54 West 39th Street, New York City

ALUMINUM CAN BE SOLDERED with SUPREME BRAND ALUMINUM SOLDER

FLOWS AT 500° FAHRENHEIT
REQUIRES NO FLUX

Used by General Electric Company, Worthington Pump Company, Hale & Kilburn Company, Bethlehem Shipbuilding Corp., National Lead Company, and hundreds of other manufacturers and repair shops.

Instructions for using with each bar.
Price $3.00 per Pound in Half Pound Bars.
Send Fifty Cents for 2-Ounce Sample Bar.

VANDAM SPECIALTY COMPANY
Grand Central Palace, Dept. EE, New York City

Barometrical Determination of Heights

A practical method of barometrical levelling and hypsometry. By F. J. B. Cordeiro. Second edition, revised and enlarged, 6 x 4 in., limp cloth, 50 cents.

Buchanan's Tables of Squares

Containing the square of every foot, inch, and sixteenth of an inch between one-sixteenth of an inch and fifty feet. These tables will be found to be of great value to all classes of Engineers, $1.25.

French Measure and English Equivalents

By John Brook. Giving equivalents in inches and decimals of an inch and inches and fractions of an inch (to the nearest 64th + or —) or from 1 to 1000 millimetres, and 1 to 100 metres, and table of fractional parts of an inch with corresponding decimals. 80 pages. 4 x 3 ins., limp cloth, 50 cents, net.

Metrical Tables

By Sir Guilford G. Molesworth.
Fourth Edition, Revised and Enlarged
VIII + 95 pages, 5 x 3 in., limp cloth, 75 cents, net.

SPON & CHAMBERLAIN
120E Liberty St. New York

TWO GOOD BOOKS

Designs for Small Dynamos and Motors

By Cecil P. Poole

186 pages containing designs for machines ranging from 1/6 h.p. to 2 kw. Fully illustrated, cloth.
Price $2 postpaid

Model Making

By Raymond Francis Yates
400 pages, 301 illustrations, cloth
Price $3 postpaid

A postcard puts you on our mailing list.

SWANSON BROS.
Technical Book Service
186 No. La Salle St., Chicago, Ill.

THE SEPTEMBER NUMBER OF EVERYDAY ENGINEERING MAGAZINE WILL MAKE SPECIAL APPEAL TO AVIATION ENTHUSIASTS

AIRPLANE INSTRUMENTS ON A CAR

(*Concluded from page* 469)

it at twenty or so when I was doubling the legal limit. It also indicates very clearly that, if you are wind jamming and you want to save petrol, a good way is to give the road to a big limousine, and then hang on behind as close as you dare. It further shows why sometimes you come in with the radiator very hot, whereas after the same run on other occasions the water is quite cool.

The air speed indicator is of the usual aircraft type employing a pilot head coupled up to the instrument with rubber tubes. The head has to be fixed a little out-board of the car so as not to be subject to interference of air flow caused by radiator, mudguards, and so on, but need not be so far out as to be unsightly, owing to the comparatively low speeds that have to be dealt with. Strictly speaking, of course, the speeds shown on the air speed indicator should be corrected for atmospheric temperature and pressure; but the changes in these are relatively so small that they do not mater, especially as the road speed indicator only shows the rotational speed of the wheel, and not the translational velocity of the car."

OVERHEATING REDUCES STRENGTH OF ANIMAL GLUE

THAT long continued heating reduces the strength of animal glue solutions is demonstrated by the following test made at the Forest Products Laboratory. Solutions of a high grade joint glue and a veneer grade glue were heated for 48 hours at 104, 140 and 176 degrees Fahrenheit, and tested every few hours during this period for strength and viscosity.

In the first 7 hours of heating at 176 degrees the veneer glue lost approximately one-half its joint strength, and the high grade glue joints weakened almost as much. The greatest loss in the strength of the glue joints occurred at this temperature. In the solutions kept at 104 degrees there was a sudden drop in the strength of the joints made with the high grade glue after 31 hours of heating, due possibly to a combination of bacterial and chemical action. The veneer glue joints showed a more gradual decrease at this temperature. The most favorable of the three temperatures tried was 140 degrees, but even at this temperature an appreciable weakening in both glues was noted at the end of 7 hours, and longer heating caused greater loss.

The viscosity of the high grade glue declined more rapidly than that of the veneer glue, but at the end of the heating test the viscosity of the high grade

Digitized by Google

glue still averaged higher than that of the veneer glue. Covered glue pots were used in this experiment. When open glue pots are used the loss in strength caused by the heat is less apparent, since the loss is compensated to some extent by evaporation of the water. On the other hand, the concentration of the glue solution through evaporation is an expensive means of gaining strength.

TO PREVENT RUSTY RIMS FROM DAMAGING CASINGS

IRON rust eats into canvas very quickly and for this reason the rims should be examined and cleaned a few times each season. Assuming that the rim is clean, as it should be when the tire is attached, it may be kept so indefinitely if proper attention is given to keep the rims straight, and if the locking nut on the valve stem is drawn tight so that no water can work in through the hole in the rim. If, on inspection, the rim is found to be rusty, even though merely in small spots, the rust should be sandpapered off and the rim given a coat of graphite or thin shellac. Ordinarily, stove polish, which contains graphite, is also excellent for preventing rust and making it easy to remove a tire in case of an emergency. Any dent or bent in a rim should be corrected as soon as discovered, for if the bend is inward a great strain is brought on the bend and side of the casing. If the bend happens to be outward, there is a fine chance for water, oil and dirt to work in between tire and rim.

RECORDING INSTRUMENT FOR CARS

A DETROIT inventor has patented an instrument to be installed in a motor vehicle that provides a continuous record of every period of use of a car. In brief, it consists of a strip of ruled record paper moved by clockwork. A suitable marking device is attached to the speedometer of the combination. The mark left on the record sheet shows the speed at which the car was travelling at any indicated time, as the paper strip is divided into days hours and minutes. This device is believed to be of value to operators of taxicabs where meters are not required by local ordinances and also to owners of expensive automobiles driven by chauffeurs, not to mention the possibilities in the motor truck field.

Directional wireless stations are being erected in various places along the Pacific Coast from San Diego to Alaska and others are being established to carry ships through the Delta of the Mississippi River to the port of New Orleans.



King of 'em all

Auto-Wheel Roadster

WE BUILT IT for fellows who want something new and better. We found a way to give you two wagons in one. When you want to haul, you need a box wagon. The **Auto-Wheel Convertible Roadster** is ready. Swing sides outward and there's a roomy wagon bed that will carry 1,000 lbs.



Fold the sides toward the center and there's the new model roadster — long, low and built for a race. The only one of its kind made.



Auto-Wheel Coaster

has the same chassis as the **Auto-Wheel Coaster**—the old stand-by. On both these **Auto-Wheel** models you'll find the same smooth-running roller-bearings and the same substantial steel tires and axles that have made **Auto-Wheels** the standard for boys.



Get "*Auto-Wheel* Spokesman"

A monthly magazine that tells all about Auto-Wheel wagons. Gives details of the Auto-Wheel Prize Contests (they are worth entering.) Send names of three coaster dealers telling which handle the wagon with the name "Auto-Wheel" on sides. We'll put your name on mailing list.

In Canada: Preston, Ont.

Export Office: 365 W. 23rd St., New York City.

The Buffalo Sled Co.,
159 Schenck Street,
N. TONAWANDA, N. Y.

EASY to LEARN at HOME

ELECTRICITY
TAUGHT BY A PRACTICAL MAN

This Home Study Course, based on the years of practical experience of Yorke Burgess, who gives personal attention to each student, has placed hundreds of men and boys in better positions. Beginners get employment after taking the Burgess course a short while—over 85% of students now engaged in electrical work.

For BEGINNERS and EXPERIENCED MEN

What You Should Learn and The Way You Should Learn It

Why the Burgess method is best for you—Read what L. E. Watkins, E. E., M. E., of Brockton, Mass., one of the foremost Electrical Engineers in the U. S. and a pioneer in electric railway work, writes of the Burgess school: "It is indeed good that there has been established a school of Electricity on so practical lines Free From The Frills of the general run of correspondence schools."

You TAKE NO CHANCE—so confident are we of your success that **YOUR PAYMENTS CEASE IF YOU ARE NOT SATISFIED—EASY TO LEARN—EASY TO PAY FOR.** Apparatus, instruments, materials, etc., are included in the course. Mr. Burgess has just issued **a new 48 page book, "ELECTRICITY"** that every person interested in electricity or employed in any branch of electrical work should have. Contains valuable information and scores of letters from men and boys who are making a success by the Burgess method.

ELECTRICITY
TAUGHT BY A PRACTICAL MAN

SEND for this Remarkable Book N-8 IT COSTS YOU NOTHING

BURGESS ELECTRICAL SCHOOL
YORKE BURGESS, Supt.
151 E. 42nd St., Chicago, Illinois

UmakeM Outfit No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clown Riders, 10 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a red hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.

W.R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Tycos-

It will be obviously safe for you to follow the lead of prominent engineers in the use of *Tycos* Temperature Instruments — Indicating, Recording and Controlling.

There are *Tycos:*

Indicating Thermometers
Recording Thermometers
Controlling Thermometers
Pyrometers
Pressure Gauges
Time Controls
Hygrometers
Hydrometers
Barometers
Vacuum Gauges
Thermographs
Oil Testing Instruments
Laboratory Glassware
Compasses
Household Thermometers
Altimeters
Actinometers

Details regarding any instruments in the Tycos line gladly furnished.

(HH-1)

Taylor Instrument Companies
ROCHESTER, N.Y.
There's a *Tycos* and *Taylor* Thermometer for every purpose



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. L-35C Chicago



AMERICAN TECHNICAL SOCIETY
Dept. L-35
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

Digitized by Google

BURGESS ELECTRICAL HAND-BOOK

(called THE BURGESS BLUE BOOK, originally in blue-print form)

SHORT CUTS AND TIME SAVERS

Prepared in pocket size especially for practical men and those taking up the study of electricity. **Contains drawings and diagrams of electrical machinery—over 200 formulas for calculation and problems worked out showing how formulas are used.** From the personal note book of Yorke Burgess while on all different kinds of electrical work covering a period of nearly a quarter of a century.

Electrical laws, formulas, methods of calculation, etc. Simplified and made easy to understand and remember. Easy to apply in practical work. **Many valuable stunts not to be found in any other book.** Of value to any electrical man, whether Technical Graduate, Electrical Engineer, Student or Practical Man.

Electricians all over the world are sending for this book. **The most complete and valuable book of its kind published.** Nothing else like it. If you have never seen this book it is impossible for you to realize what you have missed.

Price $1.00

Send dollar bill, money order or check. You take no chance—money back ANY TIME if not satisfactory.

THE BURGESS COMPANY
Consulting Electrical Engineers
YORKE BURGESS, *President*
Engineering Division (Department 109) 750 E. 42nd Street
CHICAGO, ILLINOIS, U. S. A.

Discover Your Talents

What Are You Best Fitted For?

Personal, Mental and Vocational analysis, by Dr. S. S. George, M.A., Ph.D., former U. S. Army expert. Will help you know your mind and what you are best fitted for. Complete course of tests and analysis, with 1,500 vocations classified, will be mailed to you on approval. Send $3.00 for the course postpaid. If it is not satisfactory return it in five days and we will refund your money. Address

The Vocational Guidance Institute
2255 Broadway, New York City



$110 A Month To Start As Railway Traffic Inspector

ONLY THREE MONTHS' spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad-minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today, and they're on the road to still further advancement, so write immediately for Booklet D 68 before you turn this page.

WE ARRANGE FOR A POSITION

Standard Business Training Institute, Buffalo N.Y.

Are You Going to Give Up a College Education

BECAUSE YOU CAN'T AFFORD IT?

Will you allow yourself to go through life handicapped by the lack of technical education, knowing that you can never attain the success that would have been yours if you had gone to college?

NO!

If you have the stuff in you of which success is made you need not think of the cost of going to college, for EVERYDAY ENGINEERING MAGAZINE will pay your expenses at any University, College, Trade School or Correspondence School in the United States.

Everyday Engineering Will Finance Your Education

in return for all or a portion of your spare time. It may seem too good to be true, but it is no less a fact—Four years at college with all the opportunities of learning, with the social life, which, in itself, is of tremendous importance in the life of every man.

To make arrangements for starting this coming fall, write immediately to the "Circulation Department", EVERYDAY ENGINEERING MAGAZINE, stating the name of the University to which you want to go, the course you are desirous of taking and the approximate cost for the scholastic year.

Here is your chance. It is up to you to take this opportunity now.

EVERYDAY ENGINEERING MAGAZINE
2 West 45th Street New York City, N. Y.

BE SURE AND ORDER YOUR SEPTEMBER COPY OF EVERYDAY ENGINEERING MAGAZINE EARLY

IN ADDITION TO ALL THE USUAL FEATURES AND DEPARTMENTS THERE WILL BE SEVERAL SPECIAL ARTICLES DETAILING RECENT DEVELOPMENTS IN EXPERIMENTAL AND COMMERCIAL AVIATION, IN EUROPE AS WELL AS AMERICA. WHY NOT SUBSCRIBE AND BE SURE OF RECEIVING EVERY COPY AS ISSUED? SEE OUR SPECIAL OFFER ON PAGE 388. VALUABLE BOOKS GIVEN AWAY.

Digitized by Google

WHAT A MODEL AERO CLUB DOES

BY BERTRAM POND

Corresponding Secretary

THE war is over, at least for a while, and the war-time crimp put into the model aeroplane world is fast straightening out. As evidence to this fact, let me tell you of a few things which the Illinois Model Aero Club has accomplished in the short space of one year.

A banquet was given last March, a year ago, as a "send off" and to the success of the contests to come. The summer was marked by a world's record passing from Mr. Pease to Mr. Sweitzer, who made a flight R. O. G. of 4029 feet. The usual annual series of contests for the handsome Laird Weaver Trophy was won by Mr. Wm. Sweitzer. Mr. R. Jaros won the amateur duration prize. The prize for amateur distance was won by Mr. J. Kroviak. The famed Villard Trophy, muchly polished and lacquered, is now a permanent part of the I. M. A. C. collection of trophies. The Aerial Age Medals were all won by I. M. A. C. members, and medals formed an important part of the time keeping equipment of the lucky ones.

The winter has been marked by some very important events for the Club. A scale model contest, Aero Show exhibit, exhibitions at Marshall Field & Co. on various occasions, a series of contests for 10" models, a series of lectures on "Model Designing," and a show of a few of our models before a Pathe camera man were the winter's most notable activities.

The annual scale model contest was held Dec. 5th, 1919. Among the models entered were an "Ansaldo 1" and an S. E. 5 and an Albatross C. V. The model making the best duration flight was given 50% and the other models in proportion. The best workmanship was given 25% and the others in proportion. The model constructed most nearly like the drawing or plan of the original machine, which the contestant was required to furnish, received 25% and the others proportionately. S. E 5 took first in workmanship and following the original design, the Albatross flew longest, but the "Ansaldo 1"—judged a close second in all three characteristics—won a handsomely engraved shield given by Mr. Brock by having the highest average for the three points considered. Had these models been constructed in time, I am sure the Aerial Age Cup, for scale models would have had a fine chance of seeing Chicago.

A big boost was given the model game by the Chicago Aero Show, where the models created more of a sensation than the big machines. Members of the I. M. A. C. kept slow flying indoor tractor models circling in the air above the crowds most of the time during the show. The outdoor models and the scale models were hung around above the Club's booth and a large case of accessories of all sorts stood across the booth. New members were secured, and many orders for models were taken.

A series of indoor contests for 10" R. O. C. duration machines, with two prizes for each contest was held from January to April. Along with these contests a series of lectures was given on model designing by as many old flyers as could be found. The last talk, which was a very good one, on the "General Design of Flying Models" will be printed in a later issue.

The Club gave several exhibitions of flying models at Marshall Field & Co. during the Holidays and was rewarded by a fine feed and several new members were attained. The more enthusiastic members of the Club waded out to the flying field some time ago to have a Pathe man make some pictures for Reel Twenty-Six to be shown all over the country. The pictures were quite good considering the mire.

With many of the old members gone, the success of the Club during a very hard year is nothing short of remarkable. The Club remains unchallenged as the foremost model club in the country and the holder of 9/10ths of all the world's records and another cup.

VULCANIZATION OF RUBBER AT VARIOUS TEMPERATURES

IT is found possible to calculate and apply a series of rising temperatures such that the vulcanization time curve for any rubber-sulphur mixture may be made a straight line, the slope of which is dependent on the temperatures employed and the amount of catalyst present (compare this J, 1916, 643). To obtain the best physical properties by vulcanization at constant temperature, sulphur must be present in the mixture in such amount that its active mass is not decreased sufficiently to diminish the rate of reaction appreciably before the desired vulcanization coefficient is attained. With rubber-sulphur mixtures containing 5 per cent or less of total sulphur, the physical properties of the mixture after vulcanization at a series of rising temperatures are inferior to those given by vulcanization at constant temperature; this is true particularly for vulcanization coefficients of 2.8 or more. For Hevea rubber the optimum vulcanization coefficient probably lies between 1.7 and 2.8. The coefficients recommended by various authorities are found to be excessive, and unless the history of the vulcanization phenomenon is fully known it is unsafe to judge samples solely on the basis of their sulphur content.—*Jour. Soc. Chem. Ind.*



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6089-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE ☐ Spanish
Sheet Metal Worker	Poultry Raising ☐ French
Navigator	Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-16

Street and No._____

City_____ State_____

EXPERIMENTAL
· SCIENCE ·
·CHEMISTRY· ·PHYSICS·
·RADIO·

All that its name implies

THE scientific magazine of experimental and practically applied science. Subscribe NOW. $1.50 yearly. 15c a copy at most newsstands. Literature on request.

Experimental Science Publishing Company, 710 14th St., Washington, D. C.

Digitized by Google

THE H. E. BOUCHER MFG. CO.

150 Lafayette Street
NEW YORK CITY

GENERAL MODEL MAKERS
Marine Models a Specialty

BUILD and FLY YOUR OWN MODEL AIRPLANE



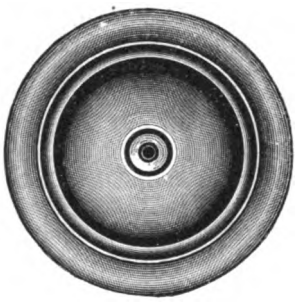
PROPELLERS

Dia.	Weight Propeller	Pitch	Price
6"	1½ oz.	8"	$0.40 each
7¼" Racing	2½ oz.	11"	.45 each
7½" Heavy Load	4 oz.	11"	.50 each
8" Racing	2 to 2½ oz.	18"	.55 each
9" Racing	3½ oz.	16"	.60 each
9½" Heavy Load	6 to 8 oz.	12"	.65 each
10" Racing	3½ oz.	22"	.70 each

Prices include postage.

We can supply propellers either right or left constructed on scientific basis by specially constructed machinery. Guaranteed to work. A trial will convince. Send five cents for catalogue of finished airplanes and parts.

MODEL MAKERS SUPPLY COMPANY
Everyday Engineering Magazine
Box HDH 2 West 45th Street
New York City



WHEELS

No. 22. Aluminum with imitation rubber tires, weight one-third ounce, diameter 1¾". Price—$0.50 pair.

No. 23. Aluminum with real rubber tires, weight one ounce, diameter 2". Price—$0.75 per pair.

THE AMERICAN MODEL SALES AND MFG. CO.

601 Broadway **New York City**

PATTERNS
MODELS
CASTINGS
SHIP FITTINGS
RAW MATERIALS
BOILERS

MAIL ORDERS ONLY

PROMPT SERVICE
TELEPHONE SPRING 3337

WILLIAM VOGEL
INVENTIONS DEVELOPED
MODELS, EXPERIMENTS
Absolute Secrecy Guaranteed
CONSULTATION
Phone Barclay 9134 96 Warren Street
New York City

CELLULOID
SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

NEW BOOKS

TIN, SHEET-IRON AND COPPER PLATE WORKER. A Practical Workshop Companion by Leroy J. Blinn, Master Mechanic; New, Enlarged Edition. 334 pages, 5 x 7¾ inches; cloth binding. 207 illustrations. Published by Henry Carey Baird & Co., Inc., 2 W. 45th Street, New York City.

This volume is a new and enlarged edition of one of the most popular books on metal-plate work ever published in this country. It has helped many to solve their everyday problems in that line and should be within reach of every metal worker for ready reference. With it you need never be at a loss to describe a pattern, to solve a point in practical geometry or to know the right varnish or cement to use, or the strength of any material.

The present edition has been enlarged by the addition of many new pattern problems which deal more particularly with triangulation and modern skylight work. As a result, that department of the book, valuable heretofore, is now considerably improved. As geometrical problems never become obsolete and as pattern cutting is based on that science, the original problems are as correct and useful as ever and have therefore been retained. The following brief summary gives a good idea of the scope of the work:

Rules for Describing Patterns. Practical Geometry. Mensuration of Surfaces. Mensuration of Solids and Capacities of Bodies. Tables of Weights, etc. Tables of Circumferences of Circles to the Nearest Fraction of Practical Measurement; also the Areas of Circles in Inches and Decimal Parts; Likewise in Feet and Decimal Parts, as may be Required. Practical Receipts. Varnishes—Miscellaneous. Lacquers. Miscellaneous Cements. Important Metallic Alloys. Miscellaneous Receipts. Strength of Materials. Tables of Strength of Materials. Supplementary Pattern Problems. Index.

A noteworthy feature is the treatment of metallic alloys and solders which gives to the worker just the information he very often needs; the more important seams or joints used in plate work and the various ways of making them are illustrated and described. There are hints for tempering and for other operations and manipulations for everyday use in the workshop, also numerous useful tables which furnish ready aid and save much time. Valuable receipts of all kinds round out a most complete work. The publisher states that experts have carefully gone over the receipts and tables to insure their accuracy. The book covers a wide field and covers it exceptionally well.

Digitized by Google

BOOK REVIEW

Experimental Wireless Stations, Their Theory, Design, Construction and Operation. By P. E. Edelman, E. E. 390 pages, 5 x 7. 167 illustrations. Published by Norman W. Henley Publishing Co., No. 2 W. 45th Street, New York City.

The new 1920 revised and enlarged edition of this book gives the theory, design, construction and operation, including Wireless Telephony, Vacuum Tube and Quenched Spark Systems. This book tells how to make apparatus to not only hear telephoned and telegraphed radio messages, but also to make simple equipment that works for transmission over reasonably long distances. Then there is a host of new information included. The first and only book to give you all the recent important radio improvements, some of which have never been published.

This volume anticipates every need of the reader who wants the gist of the art, its principles, simplified calculations, apparatus dimensions and understandable directions for efficient operation, as it contains special chapters on: Nature of Wireless Transmission, Aerials, Coil and Sub-Service Systems, Grounds and Lightning Protection, The Transmitter and Resonance, Wavelength, Capacity and Oscillation Circuits, Transformers and Spark Coils, Construction Details, Auxiliary Apparatus, Condensers and Capacities, Inductances, Spark Gaps, Radiation Indicators and Measurements, Advanced Systems. Vacuum Valves and Circuits, Tube Radiotelephones, The Receiving Station, Detectors, Sensitive Indicators for Receiving Sets, Tuning and Interference Prevention, Special Receiving Sets, Receiving Condensers, Construction of Receiving Inductances, Making the Wireless Set Work, Miscellaneous Applications, Time and Weather Signals, Radio-communication, Patent Rights of the Experimenter.

One of the features evident on inspection of this book is the clarity of presentation. The amateur is told how things are done without recourse to abtruse and confusing mathematics and all types of apparatus are illustrated without limitation to any special company types as in non-independent publications. It is a complete understandable treatise of modern radio practice and is especially recommended to those of our readers who are experimenters rather than engineers.

Automobile Starting, Lighting and Ignition Systems. By Victor W. Pagé. 815 pages, 5 by 7½ inches; 425 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City.

This is a revised and enlarged edition of a book on automobile starting, lighting and ignition system practice, written with special reference to the requirements of the reader desiring

MODEL AIRPLANE ENGINES

3 Cylinder Rotary Compressed Air Engines.

⅜ in. bore, ½ in. stroke
½ in. bore, ½ in. stroke
⅝ in. bore, ½ in stroke

6 Cylinder rotary steam engines, steel cylinders, tobin bronze pistons, aluminum crank case.

½ in. bore, ½ in. stroke

Send stamp for descriptive circular.

MODEL MACHINE SHOP CO.
415 East 71st St. New York City

OH—Just What I Wanted Real Model Racing Yachts

Sails Faster Than You Can Walk



Sport for men and boys. Construction Set—complete—30 in. long, with Rigging, Fittings and HEAVY LEAD KEEL, ready to assemble. 5 screws, 20 brads and Yacht is built. Also same Model finished ready to sail. Send 25 cents and your dealer's name and address for book "Model Yacht Sailing," just printed, giving full instructions of the Sport; How to sail, rig, nautical terms, etc., etc.

New York Model Boat & Mfg. Corporation
Dept. EM, 18 Broadway New York City

MODEL ELECTRIC MOTOR YOU

can build this working model. All parts furnished complete with Blue Prints. No Extras required. $2.00. Blue Prints only 25c.

A. F. CASSEL
52 W. 130th Street, New York City



Small Steam Engines & Boilers, Gas & Gasoline Engines ⅛ H.P. and Up. Tanks, Pumps, Model Makers' Supplies. Get our big Catalogue, sent Postpaid for 15c (coin preferred) or Stamps. Refunded first order. 192 Pages, over 200 illustrations.

MODERN ENGINE & SUPPLY CO.
364 Monadnock Bldg., Chicago, Ill.

Speed Lathe $7 Complete Swing 7 ins. 24 in. metal bed

Head has a three step cone. Spindle is hollow. Centers are No. 1 Morse taper shank. Tail stock has a screw feed spindle and No. 1 Morse taper shank center. Spur center is furnished for wood turning. Bearings are of high grade bearing metal and are adjustable to wear. Rest is adjustable to all positions. Lathe is complete at the above price. Longer bed $1.00 per additional foot.

N. & J. SPECIALTY CO.
252 S. Parke St., Pontiac, Mich.

UmakeM Lathe You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $25. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Earn $35 to $100 a Week

BECOME A PROFESSIONAL PHOTOGRAPHER





Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:

MOTION PICTURE—COMMERCIAL—PORTRAITURE

Cameras and Materials furnished free

Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.

N. Y. INSTITUTE OF PHOTOGRAPHY
141 W. 36th St., N. Y. 505 State St., Bklyn.

A Necessity for Every Shop

"The Samson No. 3 Bench Punch," with a powerful leverage of 24 to 1, is intended for work beyond the capacity of the "Samson Hand Punches," and will punch holes from ⅛ to ⅜ in. in soft metal up to 12 Gauge. Extra sets punches and dies size ⅛, 3/16, ¼, 5/16, and ⅜ in. easily inserted and removed. (maximum punching capacity 5/16 in. through 12 gauge soft metal.)

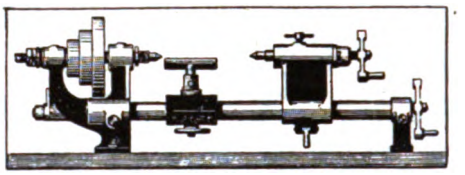


Equipped with 3-16-inch Punch and Die unless Otherwise Specified. Price $15.00 F.O.B. Factory

Catalog of Complete Line Sent on Request.

The Machine Appliance Corporation
351 Jay Street, Dept. Eng. BROOKLYN, N. Y.

THE EXPERIMENTER'S SHOP



SHOP TOOLS AND EQUIPMENT

Rough and machined castings for 6" lathe

DESIGNS FOR MODEL BOATS

Drawings of famous ML-80 British Destroyer

Send stamp for catalog

HUHN MFG. CO., 550 Elm St., ARLINGTON, N. J.

"RICHARDS' MADE"

Boys, you can build and race them. So can "Dad"—Complete construction sets of SAILING MODEL YACHTS. Circular tells the rest.

WM. RICHARDS
747 Tremont Ave., New York City

Mechanical Drafting

EXPERT SERVICE—REASONABLE
INQUIRIES INVITED
E. W. HEANEY & CO.
2105 Monterey Avenue New York City
Telephone Fordham 6249

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing **Lists** St. Louis

Digitized by Google

PATENTS

To the Man with an Idea

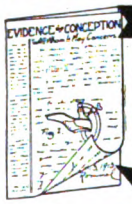
I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model, and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience, and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
144 Owen Building, Washington, D. C.



PATENTS

Before disclosing your invention to anyone, send for blank form, "Evidence of Conception," to be signed and witnessed. Form and information concerning patents FREE.

LANCASTER AND ALLWINE
225 Ouray Building, Washington, D.C.
Originators of the form "Evidence of Conception"

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney
"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost.
Offices
364 University St. Montreal, Canada
920 F St., N. W. Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City
INQUIRIES INVITED

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today

TALBERT & TALBERT 4859 TALBERT BLDG., Washington, D.C.

Professional Assistance and Consultation

We solicit the patronage of inventors and will give prompt, confidential service in the perfection of ideas Complete drawings and plans prepared. Specialists in steam and gas engine appliances.

Correspondence Invited.

Let Us Know Your Problem

Bell & Hoyt
366 Madison Ave. New York, N. Y.

BOOK REVIEWS

easily understood explanatory matter relating to all types of automobile electrical systems. Elementary electrical principles are considered before an attempt is made to discuss the features of the various systems. The basic principles are clearly stated and illustrated with simple diagrams. Over 200 wiring diagrams are presented. All the leading systems of starting, lighting and ignition have been described and illustrated with the cooperation of the experts employed by the manufacturers. Complete data are given for locating troubles in all systems, and full directions are given for making repairs. Various accessories operated by electric current, such as electrical gear shifts, brake actuation, signaling devices, vulcanizers, etc., are also described. An idea of the material presented in the book will be obtained from the chapter heads which are as follows: Elementary Electricity; Battery and Coil Ignition Methods; Magneto Ignition Systems; Elementary Electric Starter Principles; Typical Starting and Lighting Systems; Starting System Faults and Their Systematic Location; Miscellaneous Electrical Devices; Late Ford and Maxwell Electrical Systems; the Hudson-Delco and Two-Unit Delco Systems; The Dodge Brothers' Ignition-Starting-Lighting System; The Stutz-Remy and Mitchell-Remy Systems; Bijur-Roamer Electrical Systems; Design of Electrical Measuring Instruments and Use in Testing; 1917-1918 Wiring Diagrams of Popular Cars; 1919-1920 Wiring Diagrams of Popular Cars, Electrical System Details—1920 Cars. This is a standard work on this subject by a recognized authority and the new edition shows that the author keeps pace with all new developments in the great industry and branch of engineering he represents. This book should be in the hands of anyone interested in automobile repairing, as the diagrams alone are invaluable and worth the cost of the book.

TO PRESERVE FISHING LINES

To preserve fishing lines and the like impregnation with copper stearate is recommended. First soak the line in a five per cent solution of Castile soap in rain water or in distilled water. Rub off the surplus and immerse in a two per cent solution of copper sulphate. The effect is to precipitate the copper stearate in the pores of the fibre and the treatment is said to have a high degree of permanency.

The following is the formula for a metal-cleaning liquid, which has had considerable popularity.

Water	500 parts
Ammonia	50 parts
Castile Soap in Powder	100 parts
Tripoli	250 parts

It may be perfumed with 5 parts essence of mirbane.

PRINCE ALBERT *the national joy smoke*

Our exclusive patented process cuts out bite and parch.

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering. "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 911 Bogue Bldg., Indianapolis

THE
Wireless World
The Official Organ of the Wireless Society of London

Commencing with April 3d, will be published fortnightly in order to adequately deal with the increasing amount of Wireless Experimental and Research Work.

Full of Practical hints and useful information for Wireless Amateurs.

Extensive reports of the Wireless Societies of Great Britain.

Annual Subscription 17s, Post Free
Single Copies 9d, Post Free

To be entirely up-to-date in your knowledge of Wireless you must be a subscriber to The Wireless World.

To the Publisher,
The Wireless World,
12-13 Henrietta St.,
London, WC2, England.

Please enter me as a subscriber to the Wireless World for the period ..... to .....
for which I enclose .....
Name .....
Address .....
Please write distinctly.

Digitized by Google

CLASSIFIED ADVERTISING COLUMNS

HAVE YOU ANYTHING TO BUY, SELL OR EXCHANGE?

Automobile owners, mechanics, model makers, motor boat owners, radio and electrical experimenters and students read these classified columns every month, looking for advertisements of things they need. Are you telling them what you have? The cost is but 7c a word; about 7 words per line. Advertisements should reach us by the first of the month to insure proper classification.

Agents Wanted

MAKE $30.00 NEXT SATURDAY. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Mich.

AGENTS MAKING $200 WEEKLY selling Bull Dog Inner Tires. Double life of tires, eliminate blowout and punctures. Big repeater. Wonderful opportunity to establish independent, permanent, growing business. Write at once. Eastern Auto Specialty Co., Dept. S, Utica, N. Y.

WANTED—Men with Ford cars to work home territory or travel; earn $10 to $25 daily. Write for particulars. Barrett Motor Starter Mfg. Co., 1777 Broadway, New York City.

WOULD YEAR ROUND quick seller interest you? Dept. 51, Martinek Company, 405 Lexington Avenue, New York.

BIG MONEY and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 72, Glen Ridge, N. J.

Automobile Accessories

VULCANIZE RUBBER without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency, E402, Muscatine, Iowa.

STORAGE BATTERIES FOR AUTOMOBILES. We furnish all parts and Moulds for making them. Sample Plate 40c. Foreign Countries 50c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Aviation

CONSULTING AERONAUTICAL and Automotive Engineers. Inventions analyzed and developed. Designs prepared. Tests. Expert advice. Van Muffling & Marx, City College, New York.

Books

BOOKS DELIVERED FREE. Write today for Illustrated Guide to the Latest Books. Wesley Mills Co., Dept. A, 500 Fifth Avenue, New York, N. Y.

Business Opportunities

FREE information regarding large earnings, Raising Canaries for pastime. Birdland, Lynnhaven, Virginia.

SUBSTANTIAL Manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $1,500 necessary. Will allow expenses to Baltimore as explained. Address, Treasurer, 416 N. Howard St., Baltimore, Md.

AMBITIOUS MEN—Grasp this opportunity to make money. You can make $5.00 to $10.00 every day in your spare time at home. Not a cheap scheme, agency or soliciting proposition, but substantial business plans. Investigate this today. Address, Business, Box 175, Fredonia, N. Y.

START a business of your own. 24 plans, $1.00. Joel Tilberg, Proctor, Vermont.

SUBSTANTIAL MANUFACTURING CORPORATION wants capable men to establish branch and manage salesmen. $300 to $2000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

Cameras

SEND favorite negative and 50 cents for a beautifully mounted enlargement, guaranteed to please you or your money refunded by return mail. Western Portrait Co., 2118 Kendall St., Chicago, Ill.

Chemicals

EXPERIMENTAL LABORATORIES, fully equipped—$11.00 to $100.00. Payment Plan or Cash. Descriptions and actual photographs free. Write Dept. E-27, Lions Scientific Institute, "Laboratory Outfitters," Mt. Oliver, Pittsburgh, Pa.

CHART OF CHEMICAL SOLUBILITIES. 375 chemicals listed. Hang it in your laboratory. Useful. Walles. 3118 14th Street, Washington, D. C.

Dogs

SPORTSMEN—Trained beagles, rabbit, fox, coon, skunk, squirrel and opossum dogs, bird dogs, pet and farm dogs, swine, rabbits, pigeons, pheasants, goats. 100 varieties blooded stock. Circulars 10c. Violet Hill Kennels, York, Pennsylvania.

Electrical

INSTANTANEOUS Hot Water Heater, attachable any faucet, valuable hospitals, physicians, and dentists' offices, barbers, and home use. Retail $60. Dealers $45. Victor O. Ford Company, 250 West 54th St., New York.

Ford Owners

FORD SPEED-POWER EQUIPMENT stocked; 4 Speed Forward Auxiliary Transmissions, Doubles Pulling power, increases speed 40 or 20%; 16 Valve Overhead Cylinderhead; speed carburetors; camshaft, piston rings; light pistons, crankshaft counterbalances; high tension magnetos; underslung fixtures; speed power bevel gears; foot accelerators; steering wheels; wirewheels; disc wheels; metal wheel discs; Ford Fire Chemical Hook and Ladder; 15"-30" Double Universal Wheelbase Extension; 1½-2 ton Side Spring Additional Frame Work Units; Complete Line 1½-5 ton Shaft-Chain Drive Units; Racing Body; Complete Racing Cars $500.-$1750. B. V. Ford Speed-Power Equipment Manufacturers, 250 West 54th St., New York.

Formulas

EXPERT CHEMIST will furnish Formulas, Processes and Trade Secrets. All lines. Lists free. W. L. Cummings, Ph.D., 228-230 Gordon Ave., Syracuse, N. Y.

For Sale

MOTOR BOAT POWER PLANT COMPLETE—Four Cylinder, Fifteen H.P. Motor; Rear Starter; Magneto and Carburetor; Clutch and Reverse Gear; Enclosed Type; Spicer Universal Joint. Must sacrifice. Practically New. Price $100.00 F.O.B. New York. Box 10, Everyday Engineering Magazine.

Guinea Pigs

WANTED—5,000 baby guinea pigs 3 to 4 weeks old 60c each. Who will raise them for us? Breeding stock supplied at moderate prices. Western Reserve Animal Industries, Drawer B, Station E, Cleveland, Ohio.

Help Wanted

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 534 St. Louis.

Inventors

INVENTORS—Write for our free illustrated guide book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature free. Highest References. Prompt Service. Reasonable Terms. VICTOR J. EVANS & CO., 748 Ninth, Washington, D. C.

INVENTOR'S MANUAL, HOW TO MAKE A PATENT PAY is a work of special interest to inventors in perfecting their inventions, taking out their patents, and disposing of them. It is not in any sense a Patent Solicitor's circular nor a Patent Broker's advertisement. No advertisements of any description appear in the work. It is a book containing a quarter of a century's experience of a successful inventor, together with notes based upon the experiences of many other inventors. 120 pages. Price $1.25 postpaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

TWO VOLUMES on MECHANICAL MOVEMENTS by G. D. Hiscox are works every inventor should have for reference. If the thing you want has been invented, it is illustrated in these volumes. If it hasn't been invented, then you'll find in it the nearest things to what you want, some movement or device that will apply in your case, perhaps; or which will give you a key from which to work. No books ever published are of more real value to the inventor, draftsman or practical mechanic than this set of books. Price per volume each $4.00 prepaid. The Norman W. Henley Publishing Co., 2 West 45th Street, New York.

Male Help Wanted

SALESMEN—City or Traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association. Dept. 157-K, Chicago, Ill.

DETECTIVES EARN BIG MONEY, Travel, unusual Opportunity. Write Johnson's Detective Correspondence School, Deck 17, 232 Sheldon Ave., Grand Rapids, Mich.

DETECTIVES EARN BIG MONEY. Excellent opportunity. Travel. Experience unnecessary. We train you. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

RAILWAY TRAFFIC INSPECTORS earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Position furnished under guarantee. Write for Booklet CM-36. Standard Business Training Institute, Buffalo, N. Y.

FIREMEN, Brakemen, Baggagemen, $140-$200; Colored Porters by Railroads everywhere. Experience unnecessary. 898 Ry. Bureau, East St. Louis, Ill.

Miscellaneous

FIVE MASTER KEYS and Novel Key Chain $1.00. Open hundreds of different locks and replace hundreds of different keys. Recommended by locksmiths, real estate men, and detectives. Master Key Co., 33 Manhattan Building, Milwaukee, Wis.

SUPERIOR SANITARY CUSHIONS. Sell at baseball parks, race tracks, fairs, circuses, etc. Sample 15c postpaid. Superior Sanitary Cushion Company, 419 Boston Block, Minneapolis.

1000 LETTERHEADS, envelopes, cards, etc., $3.50. Samples. E. M. Orvis, Hackensack, N. J.

I WANT $200.00 to complete model and patent same. This is not a charitable loan, but a strictly business proposition with good returns. A. C. Backer, P. O. Box 97, South Coventry, Conn.

Motion Picture Plays and Supplies

$25-$300 PAID ANYONE for ideas, suggestions suitable for photoplays. Experience unnecessary; complete outline Free. Producers League, 530, St. Louis, Mo.

PHOTOPLAYS WANTED. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175A-10 and 175A-11, Chicago, Ill.

Motorcycles

$25.00 UP, GUARANTEED REBUILT MOTORCYCLES. Henderson, Excelsior, Indian, Harley-Davidson. Bicycles, $5.00 up. Tires and accessories at wholesale. Illustrated bulletin A free. Ash Motor Corporation, 162 N. Clinton Ave., Rochester, N. Y.

Opportunities

AUTOMOBILE OWNERS' FRIEND, labor, money saver $1 guaranteed, Kautch Sales Co., Stockton, Cal.

Patents

PATENTS—Herbert Jenner, Patent Attorney and Mechanical Expert. 622 F St., Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS. Over 70 years' practice; all communications strictly confidential; handbook on patents free on request; special facilities for office consultations. Munn & Co., Patent Attorneys, 641 Woolworth Building, New York. 625 F Street, Washington; Tower Building, Chicago; Hobart Bldg., 582 Market Street, San Francisco, Calif.

PATENTS. In all matters pertaining to invention consult National Institute of Inventors, 118 Fulton St., New York City, having three thousand members. Booklet free.

"INVENTORS RECORD" and "Bulletin" sent without charge. My free blank form for disclosing your invention simplifies procedure. Send sketch or description for preliminary advice. Wm. H. Mulligan, Registered Attorney, 394 Woodward Building, Washington, D. C.

PATENT what you invent. It may be valuable. Write me. No attorney's fee until patent is allowed. Estab. 1882. "Inventor's Guide" Free. Franklin H. Hough, 510 Loan & Trust Bldg., Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers, Washington, D. C.

PATENTS—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years actual experience; full information upon request. B. P. Fishburne, 322 McGill Bldg., Washington, D. C.

DON'T LOSE your rights to patent protection, before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster and Allwine, 237 Ouray Building, Washington, D. C. Originators of the form "Evidence of Conception."

Phonographs

BUILD YOUR OWN PHONOGRAPH—Big saving. We furnish parts and cabinets. Write today for free instructions. Associated Phonograph Supply Co., Dept. V, Cincinnati, Ohio.

Photo Developing

MAIL US 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 283 Bell Ave., Roanoke, Va.

Short Stories Wanted

SHORT STORIES, Poems, Plays, Etc., are wanted for publication. Literary Bureau, 166 Hannibal, Mo.

Stammering

ST-STU-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonald, 103 Potomac Bank Building, Washington, D. C.

STAMMERERS. My course of private lessons is inexpensive and will correct your impediments. Samuel E. Robbins, 246 Huntington Avenue, Boston.

Stamps

APPROVAL 60% discount. Reference, please. Stamps bought. Lang, 1433-J 59th, Cicero, Illinois.

HAVE YOU SEEN THE STAMP HERALD? Finest monthly stamp paper published. Subscription 50c a year. 3 months trial for 10c. Stamp Herald Publishing Co., Dept. E, Indianapolis, Ind.

STAMPS FREE—60 all different for the names of two collectors and 2c postage. 30 Sweden stamps 10c. 20 Denmark stamps 10c. Toledo Stamp Co., Toledo, Ohio, U. S. A.

Telegraphy

TELEGRAPHY (both Morse and Wireless) and Railway accounting taught quickly. Tremendous demand. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalogue free. Dodge's Institute, P. St., Valparaiso, Indiana.

Toys

AMERICAN MADE TOYS NEEDED. Homeworkers on small scale and Manufacturers on large scale wanted to manufacture Toy Soldiers, Army, Navy, Machine Guns, Cannons, War Ships, Indians, Cow-boys, Wild Animals, Whistlers and other toys and novelties. Greatest chance for Industrial people to have an independent business. Enormous demand gives an unlimited field and great future all over the United States, Canada and foreign countries. Experience or tools not necessary. Hundred and more made complete per hour. Casting forms, complete outfit from $3.00 up. We buy these goods all year paying fixed prices. For painted goods we offer attractive prices. Contracts made with reliable parties. We have connections all over the United States and goods made with these Casting forms are badly needed by all wholesale and retail dealers on account of the scarcity in these lines. Greatest opportunity is offered manufacturers of American Made Toys. A strictly business proposition and no one need apply unless he means business. In this case write for booklet and information, furnished free. Toy Soldier Mfg. Co., 32 Union Square, New York City.

Wireless

WIRELESS PARTS, PROMPT DELIVERY. Standard 1¾" switch knob-lever complete 35c. Switch points with screws 25c dozen. State panel thickness. Novotoy Electric, Charlotte, N. C.

Digitized by Google

New Patent of Sherwin Cody's Makes Perfect English Easy

In 15 Minutes a Day

An amazing new method that corrects bad habits in speech and writing at once

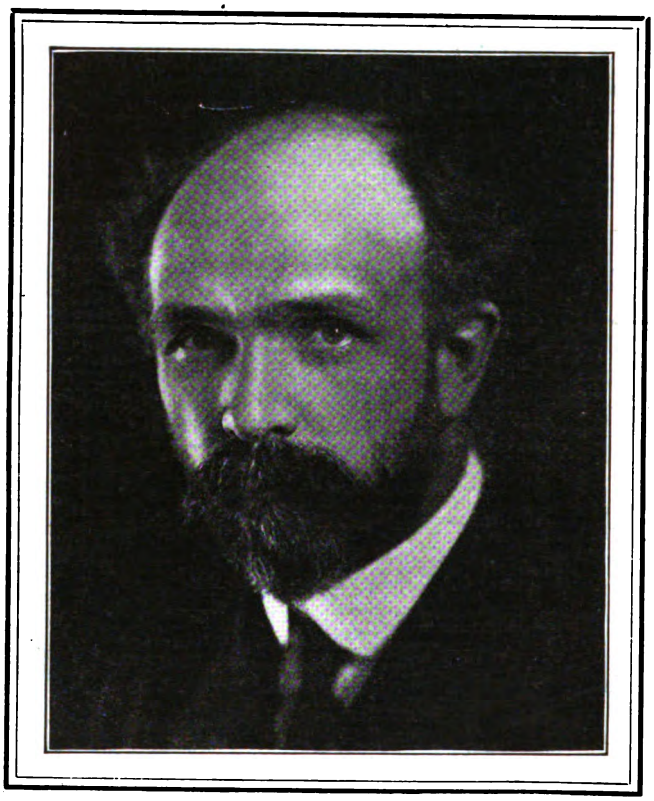
THE tremendous value of good English in everyday life cannot be overestimated. Today the ability to speak and write correctly and forcefully has come to be a commercial necessity. It is the invaluable weapon with which every man who is striving for success must be equipped. Business demands men who can write and talk straight from the shoulder, and straight to the point, without making mistakes in grammar, punctuation, pronunciation, spelling, and without using weak over-used words. *Business demands such men and is paying for them.*

The difference between weak, incorrect English, and crisp, vigorous English is the difference between the high stool and the mahogany desk. When one stops to consider that by actual test the average man in business is 61 per cent. efficient in the vital points of English the *need* for a method of teaching correct English is apparent.

After twenty years of scientific research and study Mr. Sherwin Cody, perhaps the best-known teacher of practical English in the country, has perfected his amazing "100 per cent. Self-Correcting System" and places it at your disposal.

Only 15 Minutes a Day

This astonishing invention upsets all the old standards of teaching. By careful analysis Mr. Cody discovered all the faults embodied in the old methods and has remedied them. Useless rules, hard to remember, impractical definitions, lengthy uninteresting exercises have all been cast aside. The time usually required for a comprehensive study of English has been cut down by several hundred per cent. *Fifteen minutes spare time each day*, gives you a command of language that enables you to compete with men who have spent years in school and college studying for this key to social and business success. You need no longer work under the terrible handicap of poor English—Mr. Cody's great invention places Language Power within your reach.



The 100% Self-Correcting Method

On October 15th, 1918, Mr. Cody was granted a patent on his unique device. He went to great corporations and examined the employees and talked with the employers. He examined the methods in use in schools. From the data thus acquired, he has built his entire system. He has worked on the basis that good English can be taught only by *making the student form the "Habit" of correctness.* The 100 per cent. Self-Correcting system accomplishes this with most astounding effectiveness. It seems almost like magic. You write your lesson, whatever it may be, spelling, punctuation, grammar, letter writing, etc., in the space provided, then you see underneath just how Mr. Cody would correct it. You mark your errors, and try the same lesson later to see how many errors you have overcome. You see at a glance where you have improved. *You know at every step just where you stand.* It is as if Mr. Cody stood at your elbow every minute to correct and help you. Progress is unbelievably rapid. *In recent tests students of Mr. Cody's method improved more in five weeks than students of other methods did in two years.* And the wonderful part about it all is that only fifteen minutes of your spare time each day are necessary.

Good English in Business

A well-known millionaire once said, "I know of no ability more valuable to the business man than the ability to speak and write good English." He knew what he was talking about—Language Power wins every time. All business is a game of buying and selling. Everyone has something to sell, whether it be buttons or brains. What you are selling makes no difference—*you cannot be a good trader unless you tell others what you have in a way that will make them want to buy it.* You must convince the buyer that what you have to sell is worth more to him than the money he is paying for it. Words are the weapons with which you fight your everyday battles. It is the man who uses these weapons that achieves success. The man who by the correctness and energy of his language can sway men's minds at will is the man who gains recognition and position. *He is the man who comes out on top.* Vigorous language, whether written or spoken, is the force that gets things done, it is the force that makes friends and holds them, it is the force that carries men up the road to success.

Good English Is An Investment

The words you use are an advertisement of yourself and your worth. Spoken and written they are the sure index of your character. The use of ordinary words makes people regard you in an ordinary light; to appear at your best, you must use the best language possible. It is by their language that men are judged more than by any other characteristic. The use of precise, epigrammatic, hard-hitting words is the indication of a self-confident, independent, mentally alert man. Remember, people are watching you every minute. The impression you make depends on what you say and how you say it. The impression you make on other people can either be your greatest asset or your gravest liability.

A New Booklet Free

Mr. Cody has written a new book of immense interest. In it he explains his 100 per cent. Self-Correcting Method, shows how and why it was evolved, and gives the results it has produced. He defines Language Power and shows you how you can acquire it in fifteen minutes of fascinating study a day, *and why you should acquire it.* If you want to get ahead, this book will be a revelation to you.

Write to-day. Every day you put it off means an actual loss to you. Don't needlessly handicap yourself by using poor English. Detach the coupon below and mail it *at once*, or just write a postal card, but do it *now.*

SHERWIN CODY SCHOOL OF ENGLISH
258 News Bldg. Rochester, N. Y

Sherwin Cody School of English,
258 News Bldg., Rochester, N. Y.

Please send me at once New Free Book explaining about the "100 per cent. Self-Correcting" Course in English.

Name .....

Address .....

City .....

State .....

Course a Great Help

"I cannot too highly recommend it, and I would advise any young persons who are compelled to leave school at an early age to take this course. They will be greatly benefited by the lessons in Composition, Spelling, and the reading of good literature. I consider the time and money well spent." —Paul R. Snyder, Saugerties, N. Y.

Most Interesting Device for Self-Education

"Your 100 per cent. Self-Correcting Course in English Language is the finest and most interesting device for self-education I have ever tried.

"The system of checking up written work is absolutely infallible for showing up errors, and the student can immediately start in to correct his weak points, for these lessons will show him exactly what they are."—U. G. Fry, Baltimore, Md.

No Others That Compare With Yours

"I am quite familiar with your works and honestly I do not believe there are any other publications in the field that can begin to compare with yours, along the line of plain, simple English composition. — how to make people talk in a straightforward way on paper." — Walter D. Moody, formerly Manager Chicago Association of Commerce, Chicago, Illinois.

No Method Equal To Yours

"I hope you will be very successful in placing your 100 per cent. Self-Correcting Course in English in the hands of a large number of young business people. It would be a splendid thing if it could be studied carefully by an equal number of elder people.

"The ability to use the English language correctly is a fine asset for anyone, and especially those who are engaged in business.

"I do not believe there is anything in which the usual business worker is so deficient as in the power of expression. I know of no method at all equal to this by which that power can be enlarged."—C. R. Hebble, Executive Secretary, Cincinnati Chamber of Commerce, Cincinnati, Ohio.

Digitized by Google

CONTENTS

VOL. 9 SEPTEMBER, 1920 NO. 6

WHAT IS NEW IN AVIATION?..... 491
By Victor W. Pagé, M. S. A. E.

A BATTERY CHARGING OUTFIT..... 493

A 300-WATT ARC LIGHT TRANSFORMER..... 494
By H. H. Parker

UTILIZING AUTO MOTOR POWER FOR DRIVING MACHINERY..... 496

A STEAM TRAVELING CRANE..... 497
By T. S. M. Stirling

A NEW ROTARY STEAM ENGINE..... 499

SHOP PRACTICE..... 500
Screw Driver Stunts—Drill Extension—Combination Gas Burner—Drill Press Kinks—Live Centers—Extemporized Emery Grinder—Porous Conditions after Curing.

OIL-BURNING LOCOMOTIVES..... 502

IMPORTANCE OF BRUSHES..... 503

MODEL STEAM ENGINE AND BOILER CONSTRUCTION..... 506
Part 3
By Wm. A. Helms

REVERSING OSCILLATING ENGINE — A TWIN CYLINDER OSCILLATING ENGINE.....506-507

EVERYDAY MOTORIST..... 508
Simple Valve Grinding Tool—Self-cleaning Spark-plug—A Strong Automobile Lock—Electric Arc Soldering Bit — Supplementary Carburetor — A Foot Brake Accessory—Improvements in Valve Mechanism.

THE ROMANCE OF TUNGSTEN..... 510
By E. W. Davidson

ELECTRICALLY PROPELLED BATH CHAIR—A SIX-WHEELED VEHICLE..... 513

USEFUL AND INTERESTING INVENTIONS..... 514
Sand Mixing Machine—Partial Combustion Type Carburetor — The Web Nut — Electric Motor Scooter—A Molding Machine Which Throws the Sand.

SIMPLE KEYS AND KEYWAYS..... 516
By Kenneth Alton

GERMAN METAL AIRPLANES..... 517

CAUSES OF RACING CAR FAILURES..... 518

THE BIENVENU HEATER..... 519

ELECTRICAL PROGRESS DIGEST..... 520
Electric Dry Type Glue Pot—An Electric Atomizer—Long Distance Transmission Lines—Electrolytic Iron—Non Arcing Oil Switch—Simple Electrical Experiments.

PHOTOGRAPHING PROJECTILES IN MOTION..... 522

HEAT TREATING ALLOY STEELS—PART 5..... 525
By Victor W. Pagé, M. S. A. E.

EUROPEAN SPORT PLANES..... 528
By E. H. Lémonon

MANUAL ARTS AND CRAFTS..... 530
By Chas. E. Muller, M. A. E.
Priscilla Sewing Stand—Slat Furniture.

CHEMICAL NOTES, RECIPES AND FORMULAS..... 532

A TWENTY-FIVE-INCH SPREAD MONOPLANE..... 534

EVERY DAY SCIENCE NOTES..... 536
By Prof. T. O'Conor Sloane

A REGENERATIVE RECEIVER..... 538
By M. B. Sleeper

ENGLISH RADIO APPARATUS..... 540

PRECISION RADIO MEASURING INSTRUMENTS..... 542

TRANSATLANTIC RADIO TESTS..... 544

VARIOMETER AND COUPLING COILS..... 546

THE RADIO DEPARTMENT..... 548

EVERYDAY ENGINEERING MAGAZINE

2 West 45th Street **New York City**

A Dependable, Instructive Digest of Current Mechanical, Scientific, Automotive and Radio Progress.

Managing Editor VICTOR W. PAGÉ
Science Editor PROF. T. O'CONOR SLOANE
Radio Editor M. B. SLEEPER

Contributing Editors
L. M. CLEMENT — *Radio Engineering*
CHAS. E. MULLER — *Manual Arts and Crafts*

Advertising Manager
STEPHEN ROBERTS

Branch Advertising Office
SEARS & IRVING, Peoples Gas Building, Chicago, Ill.

Published Monthly by
EVERYDAY MECHANICS COMPANY, Inc.
New York, N. Y.

Entered as second-class matter November 20, 1915, at the post office at New York, N. Y., under the Act of March 3, 1879.

Subscription price $2.00 a year in the United States and possessions; Canada, $2.25; Foreign, $2.50 a year.

Copyright, 1920, by Everyday Mechanics Co., Inc.

METAL VS. WOOD IN AIRPLANES

WHEN John B. Moisant built his all metal monoplane at Mineola, Long Island, over a decade ago, he little dreamed that he was proposing a method of aircraft construction that was destined to receive serious consideration and practical application in a World War, that even at that time was being thought of by the nation that has made the greatest progress in metal airplane construction. There is no doubt that the commercial airplane of the future will be made largely of metal, just as the ocean liners and modern steam locomotives, passenger and freight cars are, not forgetting the automobile and motor truck.

THE all metal internally trussed monoplane of German construction now being demonstrated in this country, which has made commendable flights, has given the engineer and aviation enthusiast a glimpse of what is possible in real commercial aviation. The performance of airplanes operating on this principle of construction enables one to entirely revise former operating costs, and economical aerial transportation becomes more feasible. The new streamlined all metal monoplanes are just as far ahead of the externally braced wood and fabric biplanes as the automobile is superior to the prairie schooner as a method of transportation.

METAL has many advantages over wood as a structural material in various classes of work. Metal does not swell due to moisture or contract when moisture dries out, as wood does. The new Duralumin or other aluminum-magnesium alloys combine great strength and light weight. Metal is fireproof, wood is not. While metal parts can be fabricated easily, that material cannot be worked rapidly and economically without expensive machinery. When large outputs are involved, metal airplanes will be built cheaper than wood and fabric ones. Steel will be used for many parts now made of wood, and at less cost.

WOOD, however, is a cheap, strong, and easily obtainable structural material that is ideal for experimental and development work, because it is so easily worked with simple tools. No expensive dies or special machinery are required to work it, and wood and fabric as well, can be treated with chemicals so they are practically fireproof. When types and designs change rapidly, wood is a good material for airplane framing. When aeroplanes can be produced in quantities as are motor cars, then metal machines will be justified on the cost basis alone.

Digitized by Google

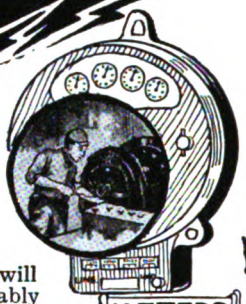
Let Me Send You a Valuable Electrical Outfit FREE!



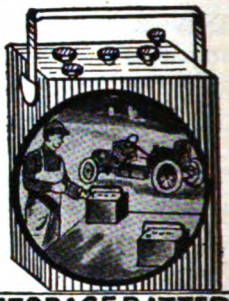
A.W.WICKS
ELECTRICAL ENGINEER

This outfit consists of the same type of standard electrical tools and instruments that I have used in my work as a practical Electrician and as an Electrical Engineer.

Mail the Opportunity Coupon below and I will send you full particulars about this remarkably liberal offer explaining how you can get this standard, working electrical outfit, absolutely free. I will also tell you how you can



METERS



STORAGE BATTERY

Learn Electricity

I Will Teach You Myself—By Mail

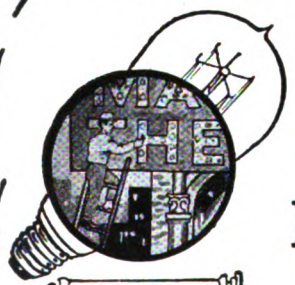
I am a practical Electrical Engineer of twenty-five years' experience. From this practical experience I have prepared a thorough, up-to-date course of home-study instruction which is easy and quick to learn. **I teach you myself.** You are under my personal guidance throughout the entire course. I do **not** turn any part of the instruction of my students over to assistants or employees. And to master this course requires no sacrifice on your part. You don't even need to give up your present job.

By devoting a part of your spare time to pleasant study and practical experimenting right in your own home you should very quickly prepare yourself for a good electrical position or for a business of your own. I have already helped hundreds to get out of small-paying, no-future jobs. C. A. Walker says: "Offered a fine position." J. Obeslo says: "Have a chance to run city electric plant." E. Vogel writes: Successfully installing electrical systems."

I taught and advised **them.** I can give you the same kind of personal instruction—and am willing to boost **you** to a better job and bigger pay just as I have helped and am helping others. Just a little determination on your part, backed up with earnest effort. That's all you need. I'll then see to it personally that you get just the kind of practical instruction that an electrician **must** have in order to succeed. The cost is small—the terms are easy.



TRANSFORMER INSTALLATION



LIGHTING

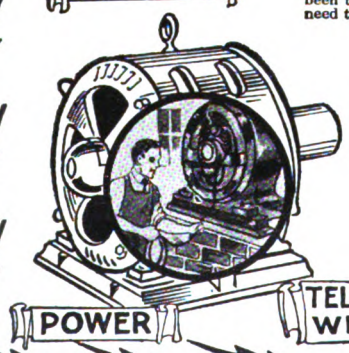


HEATING

Here Is the Opportunity

LOOK AT MY RECORD—Think of what it means to have **An Electrical Engineer** teach you personally—a man who has been through the mill and knows just what you need to win such success as his from years of actual experience in the electrical industry. He knows, too, what points employers are looking for in their men and he tells you how to develop these points.

Here is a certain way to win promotion and big pay: Just spend one hour, at home, each evening with this "easy-to-learn" practical course. You can prepare yourself to operate lighting and power plants, direct electrical construction, install dynamos, motors, switchboards and other types of electrical systems.



POWER



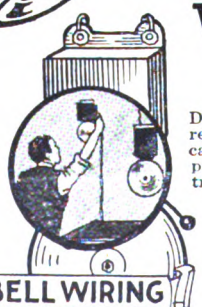
TELEPHONE WIRING

Unlimited Consulting Service—FREE

You can call on me for advice at any time and I will gladly furnish it—free. I will work with you for your success not only while you're my student, but as long as you are in the electrical business. I will help you in landing a job. If at any time you want to go into the electrical business on your own hook I will show you how to go about it—give you pointers on how to pick out a good location, the equipment you will need, how to train men under you, how to figure on contract work and solicit business personally and by mail. In short, I will stand by you to WIN.



SWITCHBOARD



BELL WIRING

WRITE!

This is your chance for a successful future. Don't pass it up. Act. Take the first step toward real success **now.** Mail the coupon or a post card for my free book—it tells all. Also get full particulars about my remarkable Free Electrical Outfit offer. No obligation on you. Act today.

A. W. WICKS, Electrical Engineer
President and Director
Wicks Electrical Institute
431 S. Dearborn St., Dept. 2246, Chicago



A. W. WICKS, Electrical Engineer
President and Director
WICKS ELECTRICAL INSTITUTE
431 S. Dearborn St., Dept. 2246, Chicago

Without any obligation on me, please send me your Free Book explaining the opportunities in Electricity; also particulars about your Course and Free Electrical Outfit offer.

Name.....

Position..... Age.....

Street No.....

City..... State.....

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google



A Bigger Job for You

The very day you are proficient in any branch of engineering, you will find scores of concerns ready to pay you the full value of your services. Never before such a demand for good technical men as now. Not nearly enough men are prepared for the good jobs that are waiting. And—in the hours you ordinarily waste you can soon equip yourself for a "big pay job." Don't put this off—at least send for information about Chicago "Tech" training. Let us give you the facts about the branch you would like to take up. See coupon below. Mark, sign and mail it now.


Contractor


Building Supt.


Auto Expert


Plumber


Aero Expert


Surveyor


Shop Supt.


Designer


Plant Supt.

Master a Paying Profession By Home Study

No longer is it necessary to spend years at college to get a technical education. Home study under the Chicago "Tech" experts will give you the practical training which is wanted in great manufacturing concerns—in engineering and architects' offices—by railroads and contractors—it will make you proficient in the shortest practicable time. Look into this now. Get the facts. Let us tell you about our method and how we can give you the training which means largely increased earning power. Send the coupon—now.

$60 to $150 a Week

"We want the men and we'll pay all they're worth" is what employers say today—and you know what engineering specialists are making. How better could you use your leisure hours than to get in line for one of these high-class positions that are actually begging for good men?

FREE TEST LESSONS

If you select Draftsmanship or Plan Reading we send you *free*, a test lesson which enables you to see how simple, complete and thorough our instruction is and to test it out before you enroll. Whatever course you ask for information on, you get a complete, plainly written catalog which explains every detail. No obligation on you for asking this. Just send the coupon.



Chicago "Tech" Training Will Make You Expert

By the Chicago "Tech" method you train under practical engineers, contractors and experts—men who teach you the methods used in actual work. No time wasted on unnecessary studies. And you get the same courses by mail that you would get if you came to the College. Every lesson is taught, every exercise is read and every examination is corrected individually by members of our faculty. You are kept on the right track, steadily advanced and prepared to take your place among experienced, technically trained men.

NOW!

Learn about this home study method which has put hundreds and hundreds of ambitious men in high positions. Just put X in [ ] opposite the name of the one you want the facts about—and sign and mail the coupon. This simple act may mean a turning point in your career—the start toward bigger things—a better job—a higher position. It costs nothing to get this information—so act now—today.

Chicago Technical College, 949 Chicago "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Surveying	[ ] Plan Reading—Buildings
[ ] Machine Drafting	[ ] Designing	[ ] Estimating—Buildings
[ ] Electrical Drafting	[ ] Contracting—Buildings	[ ] Plan Reading—Machinery
[·] Structural Drafting	[ ] Auto. Engineering	[ ] Plumbing—Estimating
[ ] Sheet Metal Drafting	[ ] Aero. Engineering	[ ] Heating and ventilating
[ ] Topographic Drafting	[ ] Gas Engines	[ ] Steam Engineering

Name .....

Address .....

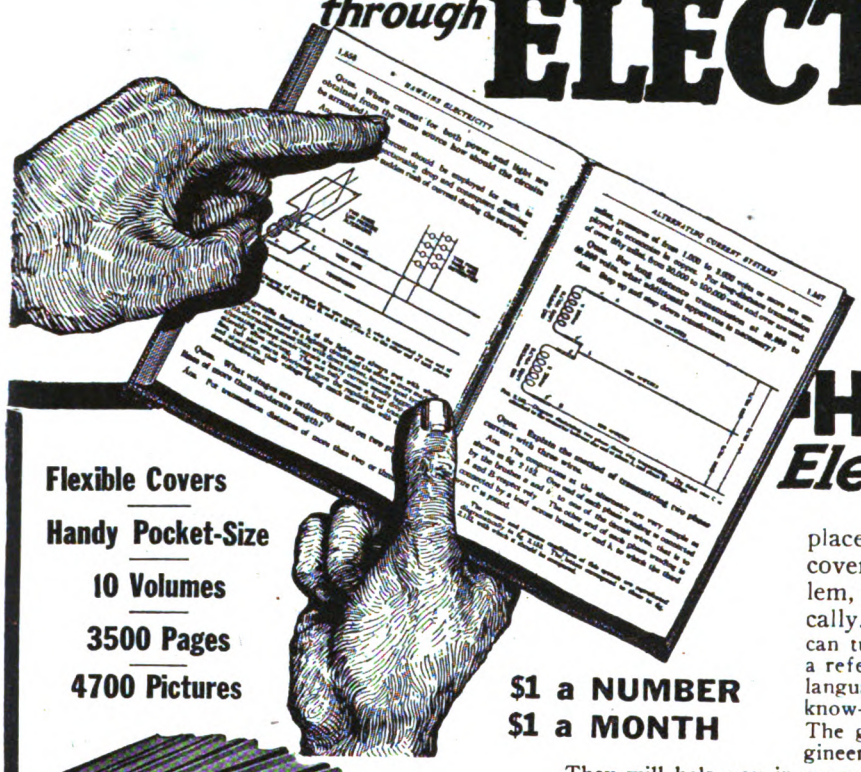
Post Office ..... State .....

Free Trial Lesson Included when inquiry is for Draftsmanship or Plan Reading.

Please mention EVERYDAY ENGINEERING MAGAZINE

Digitized by Google

Get Bigger Pay through ELECTRICITY



by using your set of HAWKINS Electrical Guides Every Day. They tell you just what you need to know.

HAWKINS *Electrical Guides*

Flexible Covers

Handy Pocket-Size

10 Volumes

3500 Pages

4700 Pictures

$1 a NUMBER
$1 a MONTH

place electricity at your fingers' ends. They cover every subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering.

They will help you in every detail of the day's work. You can't ask an electrical question that Hawkins Guides can't give you help on.



The WHOLE SET sent for your inspection FREE

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers — standard cells — current measurement — resistance measurement—voltmeters—wattmeters—watthour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles — alternating current diagrams — the power factor — alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors — induction motors — transformers; losses, construction connections, tests—converters—rectifiers, etc.

No. 6 Contains 293 pages, 472 illustrations. Alternating current systems—switching devices—current breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 315 pages, 379 illustrations. Alternating current wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony — wireless — electrolysis bells — electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro—therapeutics—X-rays, etc.

Also a complete 126 page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

TO EARN MORE—LEARN MORE

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use the coupon to get the books. It will pay you many times over.

What Users Say:

Become a Superintendent

Hawkins Guides are worth double their price. I have been able to secure higher pay and a better position with their aid.
K. W. Monard.
Supt. Erskine Light & Power Plant, Erskine, Minn.

$5,000 Saved

The ten dollars I invested in Hawkins Electrical Guides netted the company by whom I am employed somewhere around $5,000.

The knowledge gained from your books enabled me to save a transformer house, whereas a year ago I should have thought myself in great danger and have run.

Use this letter as you please as I am truly thankful for having the little wonders.
A. L. Foster, Opher, Colo.

Handy to Carry

The great beauty of them is that you can carry them in your pocket. That suits me for I never want to be without them.
F. S. Collins
Richardson Engineering Co., Hartford, Conn.

THEO. AUDEL & CO.
72 Fifth Ave., New York, N. Y.

THIS COUPON BRINGS THE GUIDES

SEND NO MONEY

THEO. AUDEL & COMPANY
72 Fifth Avenue, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Employed by .....

Residence .....

Reference ..... September

SEND NO MONEY- USE THE COUPON

Digitized by Google



Go as High as You Like

No Limit to Salaries in Aviation

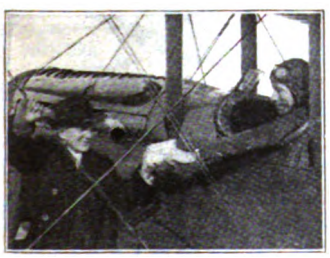
No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men today. Trained men are needed immediately to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in aviation and you have an advantage because you can be trained before you start.



Delivering Newspaper "Extras" by Airplane



A New Seven-Passenger Airplane



A New Job—The Aerial Postman



View in an Airplane Factory

Thousands of Airplane Mechanics Needed

Airplane factories are being built by the dozens. Transportation, passenger carrying, and mail carrying lines are being opened up everywhere. This means men, men, men. Trained men only are wanted—men who know what's what. Ten times the number of men now engaged in this work are needed. Jobs with big pay are waiting for men to fill them just as soon as they are trained. Why don't you prepare for one of these big jobs now?

Here Are a Few Jobs That Will Pay $50.00 to $250.00 a Week:

Aeronautical Instructor — Aeronautical Engineer — Aeronautical Contractor — Airplane Repairman
Airplane Mechanician — Airplane Inspector — Airplane Salesman — Airplane Assembler — Airplane Builder

Learn at Home In Your Spare Time

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man that can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc. Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.



Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

American School of Aviation
Dept. 7496 – 431 S. Dearborn St., Chicago

Mail This Coupon For FREE BOOK

AMERICAN SCHOOL OF AVIATION
Dept. 7496
431 S. Dearborn St.
Chicago

Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

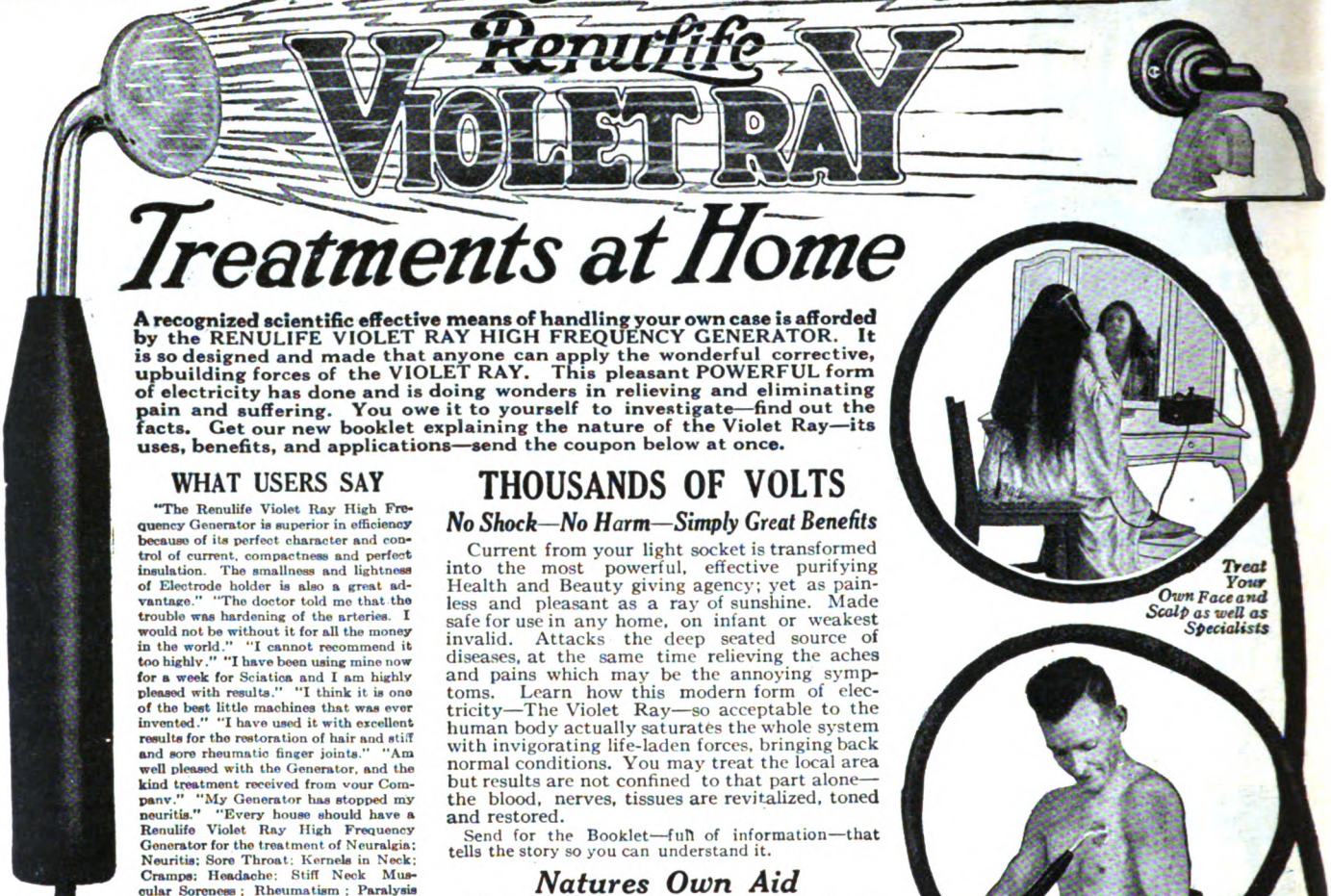
Name.....

Address.....

City..... *State*.....

Digitized by Google

Health-Strength-Beauty Thru Renulife VIOLET RAY Treatments at Home



A recognized scientific effective means of handling your own case is afforded by the RENULIFE VIOLET RAY HIGH FREQUENCY GENERATOR. It is so designed and made that anyone can apply the wonderful corrective, upbuilding forces of the VIOLET RAY. This pleasant POWERFUL form of electricity has done and is doing wonders in relieving and eliminating pain and suffering. You owe it to yourself to investigate—find out the facts. Get our new booklet explaining the nature of the Violet Ray—its uses, benefits, and applications—send the coupon below at once.

WHAT USERS SAY

"The Renulife Violet Ray High Frequency Generator is superior in efficiency because of its perfect character and control of current, compactness and perfect insulation. The smallness and lightness of Electrode holder is also a great advantage." "The doctor told me that the trouble was hardening of the arteries. I would not be without it for all the money in the world." "I cannot recommend it too highly." "I have been using mine now for a week for Sciatica and I am highly pleased with results." "I think it is one of the best little machines that was ever invented." "I have used it with excellent results for the restoration of hair and stiff and sore rheumatic finger joints." "Am well pleased with the Generator, and the kind treatment received from your Company." "My Generator has stopped my neuritis." "Every house should have a Renulife Violet Ray High Frequency Generator for the treatment of Neuralgia; Neuritis; Sore Throat; Kernels in Neck; Cramps; Headache; Stiff Neck Muscular Soreness; Rheumatism; Paralysis —in short, pain of all kinds."—M. D.

"I have been much relieved by the use of your Violet Ray Generator."

"It is fine for insomnia."

"I find it such a help in nervousness."

"I would not part with it for five times the price. It is sure a little wonder."

"I am more than pleased with the Generator, the whole family are using it."

THIS TYPE of Violet Ray instrument makes possible a light, convenient handle and permits large efficient units to be used contained in handsome case.

OUR NEW BOOK

JUST OUT. This latest edition explains in detail, with many illustrations, the uses and benefits of Violet Ray. You should have one. Free for the asking.

SEND FOR BOOK!

THOUSANDS OF VOLTS

No Shock—No Harm—Simply Great Benefits

Current from your light socket is transformed into the most powerful, effective purifying Health and Beauty giving agency; yet as painless and pleasant as a ray of sunshine. Made safe for use in any home, on infant or weakest invalid. Attacks the deep seated source of diseases, at the same time relieving the aches and pains which may be the annoying symptoms. Learn how this modern form of electricity—The Violet Ray—so acceptable to the human body actually saturates the whole system with invigorating life-laden forces, bringing back normal conditions. You may treat the local area but results are not confined to that part alone—the blood, nerves, tissues are revitalized, toned and restored.

Send for the Booklet—full of information—that tells the story so you can understand it.

Natures Own Aid

What is the strange relation between electricity and life? Some declare electricity *is* life. We do not know. But life cells do welcome and respond marvelously to electricity in the form of Violet Rays. It works with nature to restore where many other methods fail. It treats fundamentally and therefore is specified by physicians for a wide range of ailments—for rheumatism, neuritis, nerve and blood disorders—etc., etc.—both chronic and acute. See the list on coupon and ask for full particulars. Blood is brought to area treated—enriched and purified—assimulation and digestion improved—functions restored to normal. Combines the benefits of electricity, vibration, exercise, stimulation, and oxidation. Get the information as to what you may expect from the Violet Ray. Its astonishing low price places it within the reach of all. The Trial Plan *proves* its value, in actual use. Receive full information by return mail.

Renulife Electric Co., Inc.

1909 Marquette Building, Detroit, Mich.

Chicago Office, Room 410, 123 West Madison

Treat Your Own Face and Scalp as well as Specialists



Strengthens—Revitalizes—Builds up



Pain and Ache Eradicator—Without Equal



For Catarrh, Throat, Lungs —also Anemia

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1909 Marquette Bldg., Detroit, Mich.

Please send without obligation, your book **"Health,"** explaining Violet Ray treatments with Renulife Generators, also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

..Abscesses	..Facial Neuralgia	..Obesity
..Anemia	..Failing Hair	..Pat in Abdomen and Chest
..Asthma	..Female Complaints	..Paralysis
..Arteriosclerosis	..Goitre	..Piles
..Baldness	..Gout	..Pimples
..Blackheads	..Haemorrhoids	..Pyorrhea
..Brain bag	..Hay Fever	..Rheumatism
..Bronchitis	..Infantile Paralysis	..Scars
..Bunions	..Insomnia	..Sciatica
..Bruises	..Lameness	..Skin Diseases
..Catarrh	..Locomotor Ataxia	..Sore Throat and Throat Diseases
..Colitis	..Lumbago	..Sprains
..Chilblains	..Nervous Affections	..Toothache
..Dandruff	..Neuralgia	..Weak Eyes
..Deafness and Ear Diseases	..Neuritis	..Wrinkles
..Eczema		..Warts and Moles
..Enlarged Prostate		

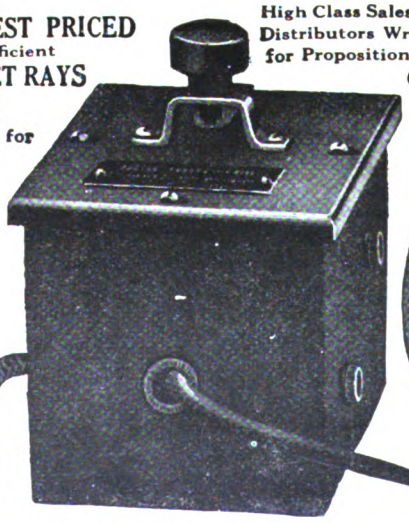
Name .....

Address .....

.....

LOWEST PRICED Efficient VIOLET RAYS

Several Models for Home and Professional Use

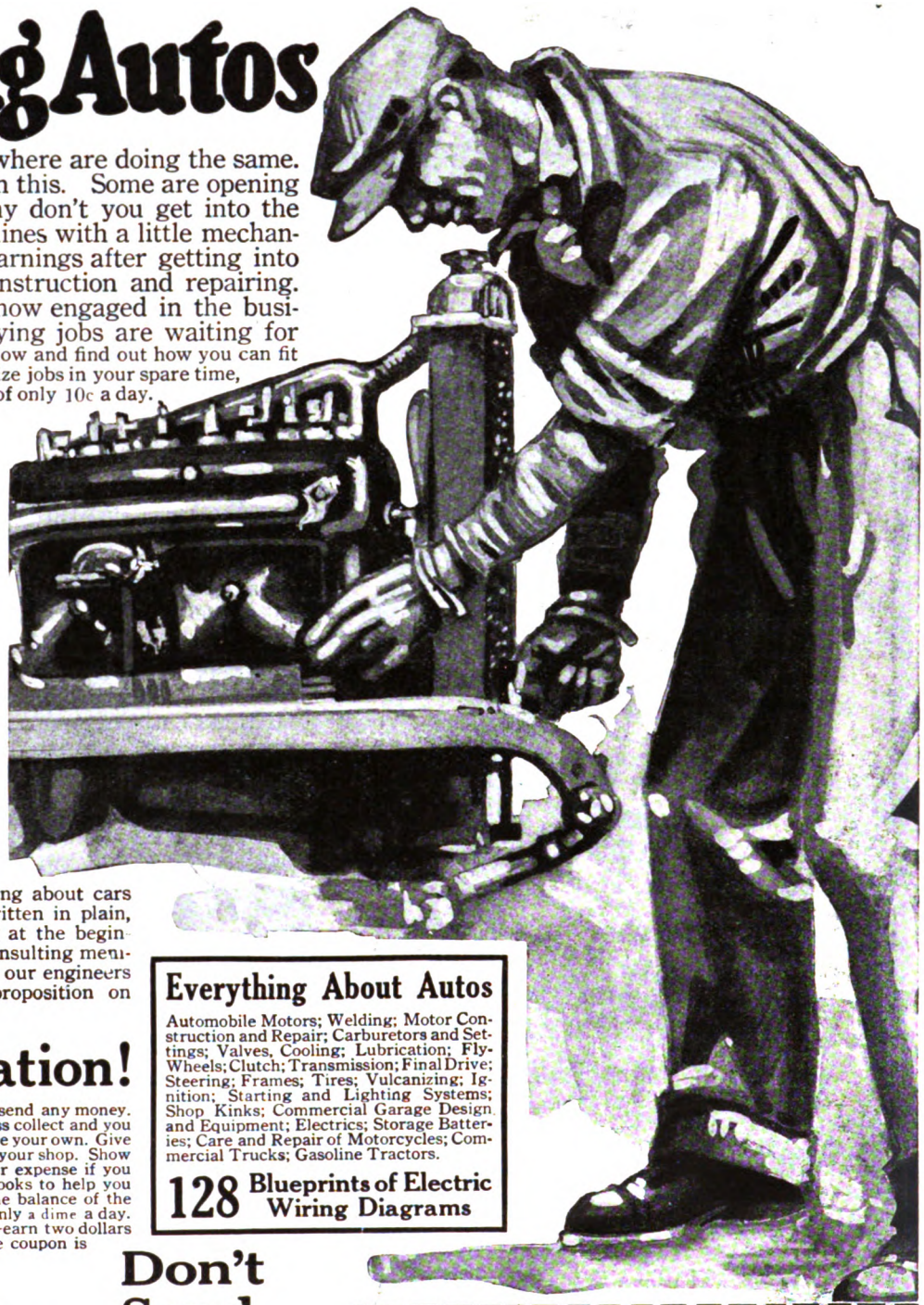


High Class Sales Distributors Write for Proposition

OZONE Inhalations

Digitized by Google

He Earns $50 a Week Repairing Autos



THOUSANDS of men everywhere are doing the same. Many are getting more than this. Some are opening garages of their own. Why don't you get into the auto game too? Men in other lines with a little mechanical ability have doubled their earnings after getting into the fascinating field of auto construction and repairing. Ten times the number of men now engaged in the business are needed. Fine, big paying jobs are waiting for men who "know" to fill them. Read below and find out how you can fit yourself to hold one of these big, man's size jobs in your spare time, without going away from home at a cost of only 10c a day.

Learn at Home

No need to pay for an expensive course that will take you away from home. You can learn the auto game at a cost of one-tenth the expense of going away to school. You don't have to serve an apprenticeship either. Use spare time only and keep right on with your present work. This Library of Automobile Engineering and Tractor Information will make an expert out of you and fit you for the biggest kind of job. It is in six thick volumes, with 2600 pages and 2300 pictures, plans, diagrams and blueprints, etc. Every part of every well known car is explained. They teach you everything the best auto schools teach.

Fifteen great auto engineers prepared these money-making books for men like you. You don't have to know a thing about cars to understand them. Every page is written in plain, everyday language and they begin right at the beginning. With every set we give FREE a consulting membership in our society. You can write our engineers any time and get their help on any proposition on which you get stuck.

Everything About Autos

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Fly-Wheels; Clutch; Transmission; Final Drive; Steering; Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage Design and Equipment; Electrics; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gasoline Tractors.

128 Blueprints of Electric Wiring Diagrams

FREE Examination!

Mail the coupon for free examination. Don't send any money. We will ship the books (all 6 volumes) by express collect and you can have a whole week to use them as if they were your own. Give them every test you can think of. Take them to your shop. Show them to your friends and ship them back at our expense if you don't want to keep them. If you do keep the books to help you earn more, send us only $2.80. You can send the balance of the $29.80 price the same way—$3.00 each month. Only a dime a day. This is your chance to double your earnings—earn two dollars in the same time it takes to get one now. The coupon is your start. MAIL IT TODAY.



Don't Send Money— Just Mail This Coupon

American Technical Society :: Chicago

AMERICAN TECHNICAL SOCIETY
Dept. A-356, CHICAGO, U. S. A.

Please send me the 6-volume set of Automobile Engineering for 7 days examination, shipping charges collect. If I decide to buy I will send $2.80 within 7 days and balance at the rate of $3.00 a month until $29.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will notify you after 7 days to send for them at your expense.

Name.....

Address.....

City..... State.....

Reference.....

Please Fill Out All Lines

Digitized by Google

Everything New About Shop Work!



Examine Them Free

The sixth edition of Modern Shop Practice is now off the press. Let us send you the six volumes for seven days' free examination—not a penny in advance. See how 27 mechanical engineers, designers, and specialists in shop methods have given you the benefit of their vast experience. Read what they say about production, metallurgy, welding, tool making, tool design, die making, metal stamping, foundry work, forging, pattern making, mechanical and machine drawing, speed lathes, planers, metal drillers, grinders, milling machines, stamping machines, die presses, etc. Then after free examination, send the books back unless you are convinced they will raise your pay.

Jump Ahead

The more you know about machine shop practice, the more money you will earn. Don't depend on your hands alone to earn your pay. Make your head work for you. Equip yourself with knowledge that designs machinery, that does the *big* work. These six massive volumes tell everything you want to know about every phase of shop work. Written in clear, non-technical language.

Only a Dime a Day

These six magnificent volumes are flexibly bound in American Morocco, gold stamped. Contain 2300 pages, 2500 illustrations, photographs, drawings, explanatory diagrams, tables, etc. Up-to-date labor saving methods that big manufacturers have spent thousands of dollars to learn. Facts that you can use in your every day work at once. Examine the books free. Then if satisfied, pay for them at rate of 10c a day.

No Money in Advance

Not a cent in advance. See the books in your own home first. Read them for seven whole days before you decide. Make no deposit—assume no obligation. If you are not more than satisfied—send them back and you won't owe a cent. If you are sure they will raise your pay—send only $2.80 within seven days and then $3.00 a month until the special introductory price of $29.80 has been paid. (Regular price $45.00.) With each set we give you Free a year's Consulting Membership in the American Technical Society. (Worth $12.) Mail coupon for the books now. Send no money.

AMERICAN TECHNICAL SOCIETY
Dept. M-356 **CHICAGO, U. S. A.**

AMERICAN TECHNICAL SOCIETY
Dept. M-356, CHICAGO, U. S. A.

Please send me the six-volume set of "Modern Shop Practice" for seven days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within seven days and balance at $3 a month until $29.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine, and fully paid for. If I think I can get along without the books, I will return them at your expense after seven days.

Name.....

Address.....

Reference.....

Digitized by Google



As a matter of fact

Your first R-E-A-L cigarette pleasure will come with Camels!

YOU'LL swing into the Camel procession as easily and as delightedly as any of the thousands of smokers who have found these cigarettes an absolute revelation in quality, in refreshing flavor, in mellow mildness and in body!

Camels are unlike any cigarette you ever puffed. They are a creation—an expert blend of choice Turkish and choice Domestic tobaccos. As sure as you are a foot high you will prefer Camels blend to either kind of tobacco smoked straight!

Camels fit in with your cigarette desires just one hundred per cent! The satisfaction they impart to smokers is simply joyous.

Camels will not tire your taste! And, Camels leave no unpleasant cigaretty after-taste nor unpleasant cigaretty odor.

You'll prove out our enthusiasm when you compare Camels with any cigarette in the world at any price!

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

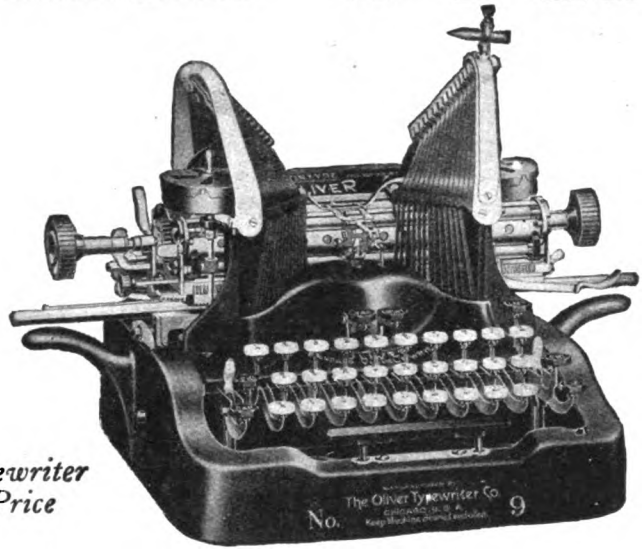
Camel CIGARETTES

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

Digitized by Google

FREE TRIAL

Keep It For $4.00 Per Month



Or Return It At Our Expense

A Finer Typewriter at a Fair Price

Pre-War Price $100 Now $64

The Oliver Typewriter—Was $100—Now $64

The Guarantee of a $2,000,000 Company that it Is the Identical Model

Be your own salesman and earn $36. You get the identical typewriter formerly priced $100—not a cent's alteration in value. The finest, the most expensive, the latest Oliver Model. Old methods were wasteful. Our new plan is way in advance. It is in keeping with new economic tendencies. It does away with waste. Inflated prices are doomed forever.

During the war we learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Brand New—Latest Model

Do not confuse this with offers of earlier models, rebuilt or second-hand. Note the signature of this advertisement. This is a $2,000,000 concern.

We offer new Olivers at half price because we have put typewriter selling on an efficient, scientific basis.

You can now deal direct—sell to yourself, with no one to influence you. This puts the Oliver on a merit test.

You Save $36 Now

This is the first time in history that a new standard $100 typewriter has been offered for $64. Remember, we do not offer a substitute model, cheaper nor different. But the same splendid Oliver used by the big concerns. Over 800,000 Olivers have been sold.

We ship direct from the factory to you. No money down—no red-tape. Try the Oliver Nine at our expense. If you decide to keep it, send us $4 per month. If you return it, we even refund the out-going transportation charges. You are not placed under the slightest obligation. That's our whole plan.

We rely on your judgment. We know you don't want to pay double. And who wants a lesser typewriter? You may have an Oliver for free trial by checking the coupon below. Or you may ask for further information.

An Amazing Book

All the secrets of the typewriter world are revealed in our startling book entitled "The High Cost of Typewriters—The Reason and the Remedy"—sent free if you mail the coupon now. Also our catalog. Order your free-trial Oliver—or ask for further information at once. Canadian Price, $82.00

The OLIVER Typewriter Company

155-C Oliver Typewriter Bldg., Chicago

NOTE CAREFULLY—This coupon will bring you either the Oliver Nine for free trial or further information. Check carefully which you wish

Mail This Coupon Now!

THE OLIVER TYPEWRITER COMPANY,
155-C Oliver Typewriter Bldg., Chicago

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for

My shipping point is.....

This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....

Street Address.....

City..... *State*.....

Occupation or Business.....

Digitized by Google

PRACTICAL MECHANICS FOR EVERYDAY MEN

EVERYDAY ENGINEERING MAGAZINE

IT TELLS YOU HOW TO MAKE AND DO THINGS

VOLUME 9 SEPTEMBER, 1920 NUMBER 6

What is New in Aviation

A Review of Foreign Post-War Airplane Designs Showing the Great Strides Made Toward the Eventual Development of Commercial Aeronautics Abroad

By Victor W. Page, M. S. A. E.

PART I

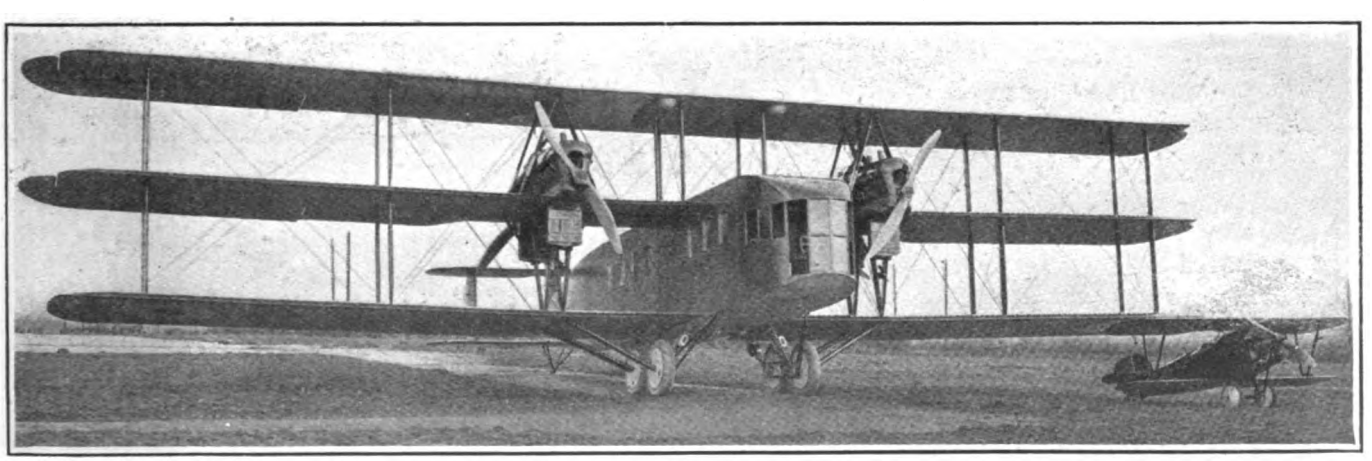
THE airplane development that has been noted during the past year has been mainly of a commercial character, and while no radical changes have been noted in the design there has been a greater realization of underlying aerodynamical principles, so that practically all of the airplanes of modern development show that rules of practice as relates to design are fairly well appreciated by engineers. The airplanes of the present time are good examples of the best engineering practice, and designers are now concerned with problems incidental to making airplanes more efficient. As a result, many excellent machines designed especially for commercial work have been produced by airplane constructors all over the world.

At a recent aero show held in England, only three out of about thirty machines exhibited were military types. Of the number remaining, two were small, single seaters of low power intended for sporting purposes, and one a racing machine pure and simple. Of the remaining craft, over half of the number were provided with enclosed cabin accommodations for the passengers. This indicates that there is a decided tendency towards providing comfort for passengers who may desire to travel by air. It is now an accepted principle of design, that cabins must be provided on commercial passenger carrying machines, but there is considerable difference of opinion as to how these cabins should be arranged. It is not a difficult proposition to design a very efficient cabin on machines having two or more motors mounted between the planes. In such machines practically the entire front and central portions of the fuselage are available for passenger accommodation.

In most of the multi-engine machines, it is possible to extend the passenger accommodations from a point forward of the leading edge of the wing to a point some distance aft of the trailing edge. The quarters for the pilot are usually in the nose of the fuselage. It is not such a simple matter to design a cabin for passenger carrying on machines using but one engine. In one system of construction the pilot can be placed ahead of the passengers, in others he must be placed at the rear. Considering the matter from the pilot's point of view, the forward position is undoubtedly preferred on account of providing superior opportunities for observation.

In the matter of power plants, practically all of the machines that are being offered at the present time for commercial or sporting purposes, use the fixed cylinder engines. While the rotary engine has many good features, it is apparent that it is not as economical in fuel and oil consumption or as enduring as the more conventional types are, so that one need not expect to see the rotary engines widely adopted in civil aviation.

One of the points on which considerable work is being done is in reducing the risks of fire by better power plant installation and by taking precautions, such as using fire-proof tanks and fire-proof bulk heads in fuselages when the engine is installed in that member. The advantage of the fire-proof tank is that it safeguards the possibility of fire following a crash and



The Bristol Triplane Pullman express compared to a small single seater biplane to show its massive size. Its proportions are so good that this comparison is necessary to bring out its large size which would not be evident otherwise

Digitized by Google

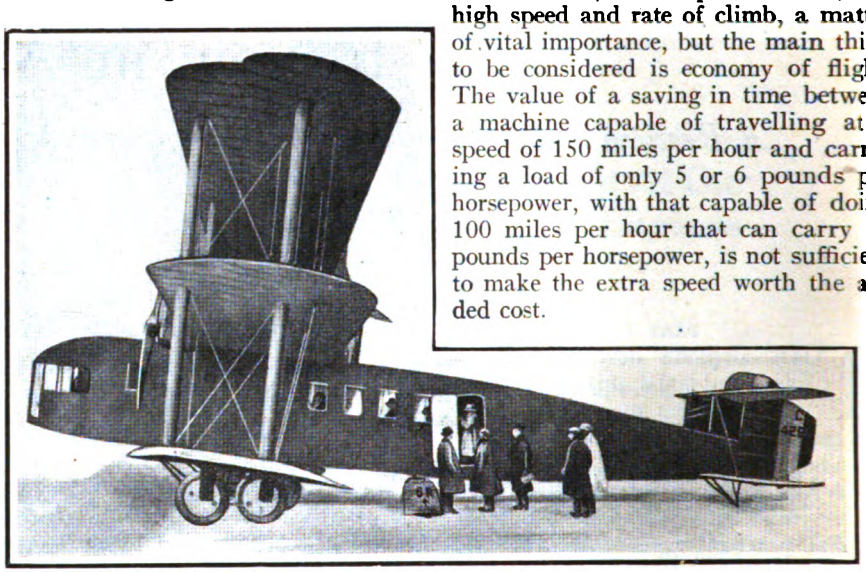
also reduces the liability of the machine catching fire while in the air. Care should be taken with carburetor placing so that any gasoline that may flow out of it will drip clear of the machine and not collect around the power plant. Then again, special pains should be taken in the installation of electric wiring and placing of ignition units. Gauze screens to prevent back-firing of the engine through the carburetor are also installed in the induction manifold.

The newer types of machines show that metal is being more seriously considered as structural material for airplanes as they are commercialized. The work done on the development of all-metal airplanes by the Germans has certainly influenced the designers of other countries to use metal in the construction of various parts of their machines. While it has not been impossible in the past to build machines entirely of metal, the designers have found that in the period of constantly changing designs that the usual wood and fabric structure was better. Another thing that is noted in the newer machines is the attention being paid to the elimination of parasitic resistance by the elimination of struts and wiring bracing and the use of internal braces in fuselages and wing structures.

Another feature that must become more popular as airplanes are commercialized, is the building of airplanes of unit parts as much as possible, so that in event of damage to one part, it will not be necessary to remove or scrap the adjoining pieces. For example, on a one-piece fuselage such as a monocoque construction, any real damage to any part of the fuselage usually calls for a complete new one. If a fuselage was built in two or more sections, as is noted on some of the newer machines, then only that section that is damaged need be replaced. The fuselage may be made in three pieces, the front one being comprised of the engine housing, the middle one, the passenger cabin and the aft portion, the tail end supporting the empennage.

Another thing that can be changed to advantage, is the method of installing the engines, so that many parts must be removed before the engine can be taken out of the fuselage. It would seem that a desirable change in design would be to have the engine compartment so built that it could be released from the fuselage as a unit when repairs were necessary and a new power unit installed in its place so that the machine would not be laid up for extended periods. Engine trouble will undoubtedly be one of the main reasons for putting airplanes out of commission, while if the easily renewable power units were available, any firm using a number of airplanes for commercial work could make the repairs needed at their leisure and install substitute spare power plants to keep the planes in commission.

In studying the specifications of the new machines, we find that the loading per horsepower is gradually growing and this of course will make for more economical airplane operation. In machines intended for speed or war use, a loading of ten pounds per horsepower was considered as an extreme that should not be exceeded. This of course meant that speed and climbing ability increased very much, but that the load carrying capabilities were reduced. In very few instances in commercial work, is such performance, i.e., high speed and rate of climb, a matter of vital importance, but the main thing to be considered is economy of flight. The value of a saving in time between a machine capable of travelling at a speed of 150 miles per hour and carrying a load of only 5 or 6 pounds per horsepower, with that capable of doing 100 miles per hour that can carry 20 pounds per horsepower, is not sufficient to make the extra speed worth the added cost.

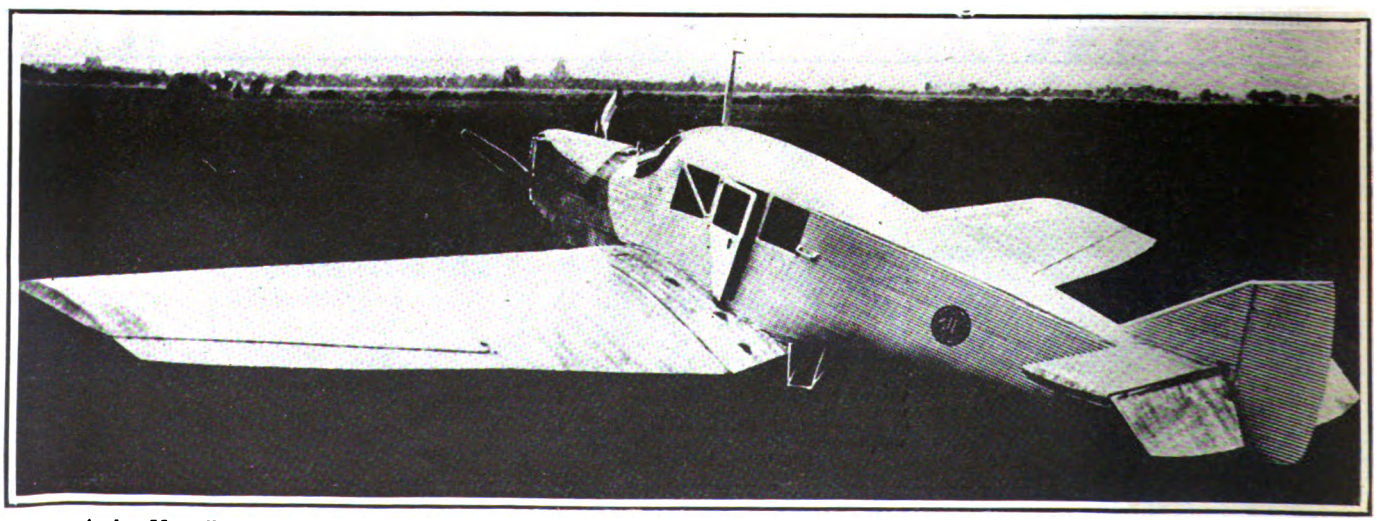


Side view of the Bristol Triplane Pullman express showing door by which passengers enter cabin

It would seem that commercial airplanes that are capable of a speed of 100 miles per hour would be superior to any existing means of commercial transportation, such as locomotives, steamships, or automobiles. The locomotive is the only transportation agent that is capable of carrying passengers continuously at speeds anywhere approaching the airplane and in most cases its maximum average speed is but little more than half the velocity that can be maintained by the airplane.

Commercial aviation can not be ex-

(*Continued on page* 504)

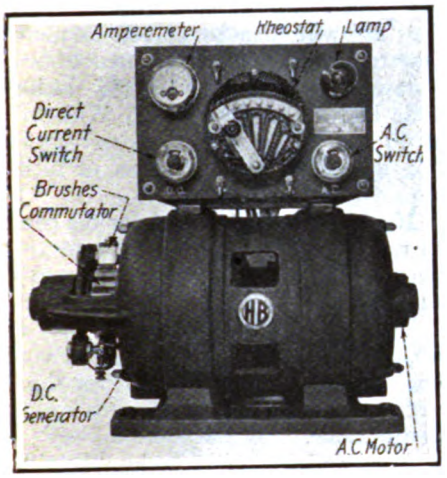


View of the JL6 all metal internally trussed monoplane, an aircraft of German design and development that is recognized as the most efficient and economically operated airplane type yet built for commercial use

Digitized by Google

A BATTERY CHARGING OUTFIT

ALL garage men are interested in battery charging as it is a profitable source of income if a charging appliance can be obtained that is economical to operate in regards to both current consumption and upkeep expense. There have been numerous types of rectifiers made for



Compact battery charging outfit

garage use, all of which have advantages. Many garages are successfully using the motor generator type of charging set and this has been proven to be an economical means of charging batteries. It is stated by makers, that devices of this kind do not need any manipulation or special bulbs as some types of rectifiers do and also that they will charge for extended periods without bulb renewals as are sometimes needed in rectifiers of the bulb type.

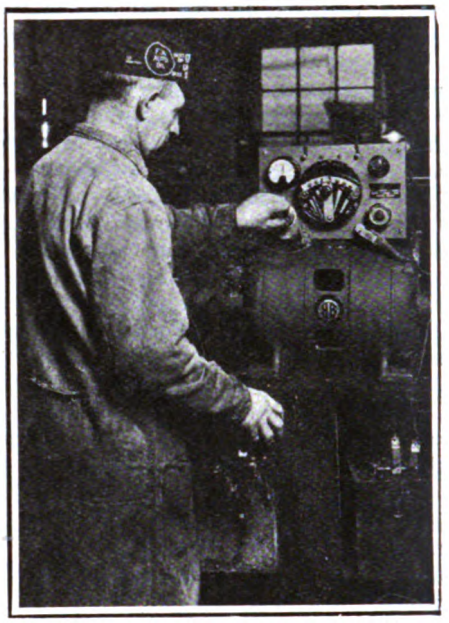
The outfit shown in the accompanying illustration consists of an alternating current motor which drives a direct current generator. The two electrical machines are mounted together on a substantial base and in a casing which insures that both machines will be kept in absolute alignment. The switchboard rheostat is carried above the motor generator unit and carries various appliances, clearly illustrated, these consisting of D.C. and A.C. switches and regulating rheostat, an ampere meter and test lamp.

There are four binding posts or terminals at the switchboard, alternating the current going to the two upper binding posts, this being taken from the lighting or power lines in the garage, while to let forth direct current which is generated by the dynamo, is taken from the two lower binding posts and directed to the charging line. The direct current armature and the A.C. motor rotor are supported at each end by ball bearings, which is a refinement of design of considerable value on equipment that must be continuously operated.

Another illustration shows the simple means of regulating the current supplied to batteries by the rheostat, while the view of the battery room shows a modified form of this battery charging outfit that can be used in connection with a number of rheostats, whenever a large number of batteries are being charged.

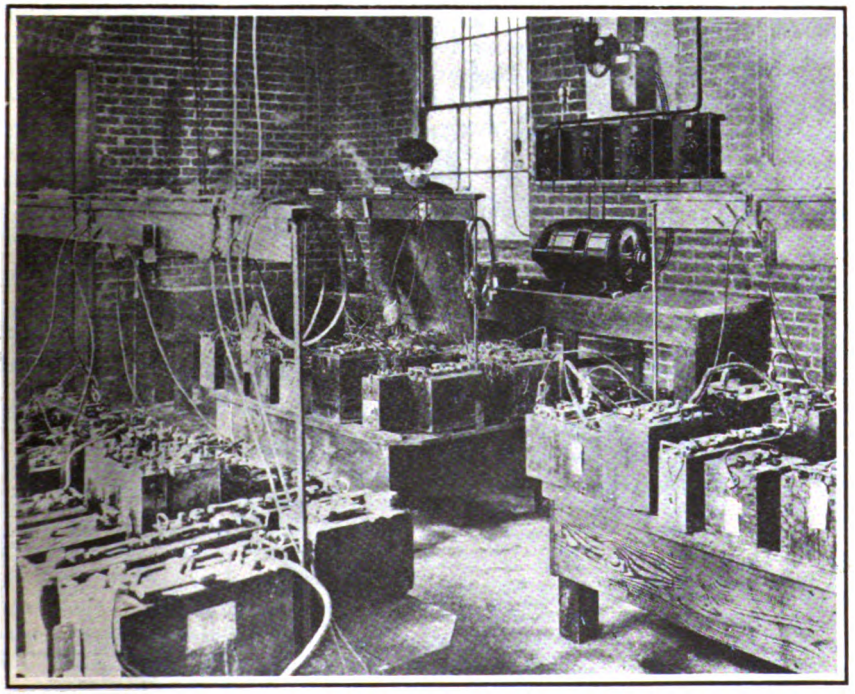
The small outfit has a capacity for charging from one to ten six or twelve-volt batteries. The larger outfit, which is used in connection with the four rheostats and switchboards, will charge 32 batteries. It will develop at the generator end 60 to 70 volts and 30 amperes. The dynamo is driven by a five horsepower A.C. motor.

It will be evident that by the use of one of these sets that absolutely direct current is generated, which battery makers claim is more suited for battery charging purposes. The function of a rectifier is to divide the alternating current so that the battery is really charged in a series of impulses or beats, so that the batteries will last longer when charged by apparatus supplying a continuous direct current, than those in which the alternating current is rectified and which deliver a pulsating direct current to the battery charging lines.



Battery charging current is easily regulated

With a device of the form illustrated, it is claimed that it is possible to charge batteries at a cost of from four to twelve cents each for current. The garage men will readily appreciate that this offers a source of profit inasmuch as the batteries when charged do not require continuous supervision but need only periodical inspection. One of the many features in operating a successful battery charging set is to use dependable charging equipment and the only way one can obtain the best charging results is by careful investigation of the different appliances on the market. Many sets similar to those illustrated have been sold and are now in daily use and are giving good results.



Battery room showing installation of rotary-converter for battery charging purposes

What is claimed as a long distance speed record for airplanes has recently been reported from Italy, where a biplane with a 750 h. p. twelve cylinder Fiat engine carrying two passengers in addition to the pilot, went from Turin to Rome a distance of 388 miles in two hours and 15 minutes, an average speed of over 172 m. p. h. The same machine a few days previously, carrying four passengers and a pilot, was credited with a speed of 161.5 m. p. h. The latter flight was made in an aerodome so that the effect of wind was eliminated.

Digitized by Google

A 300-Watt Arc Light Transformer

By H. H. Parker

Drawings by the Author

THE small magnetic leakage transformer described below was designed to furnish a stepped down voltage of 30 or 60 for experimental work with an arc struck between two half-inch standard carbons, which would cause no undue disturbance on the 110 volt 60 cycle house circuit to which the transformer primary was connected. There will be sufficient current at 30 volts, to operate a small arc and of course a more intense one at 60; the contacting of the carbons to strike the arc causes only a light flicker on a forty watt lamp on the same branch—very much less disturbance than the running of a fractional horse-power induction motor. The windings allow for about five amperes at 60 volts and five or ten at 30, depending upon whether one or two coils are used, in the secondary; this is sufficient for ordinary purposes though the transformer is not of sufficient capacity for an electric furnace or other heavy work. An interesting experiment is to strip the wood off an ordinary pencil, break the lead in half and attach the two pieces to the 30 volt terminals, using a single secondary coil. A small but energetic arc will be struck which will throw off considerable light. Here is a suggestion for the model making enthusiast: a miniature searchlight operated by small pencil carbons should prove most realistic and give an intense light.

The transformer as described is designed for either 110 or 220 volts by connecting the two primary coils in parallel or series; the secondary voltages will be the same in each case. The standard frequency of 60 cycles is provided for; other frequencies require a change in the cross section of the core, as explained later. The secondary winding is in two coils also; they may be connected in series or parallel or used separately.

To start with, we have the well-known transformer equation:

$$T = \frac{E \times 1000000000}{4.44 \times f \times B \times A}$$

Where "T" is the number of primary turns,
"f" the frequency,
"B" the magnetic flux through the core,
"A" the area of core cross-section.

It is assumed that the core will be built of "stove" iron, the most easily obtained material; for such iron, "B" is usually given a value of 40,000. If transformer iron or silicon steel can be obtained, a smaller core may be used, for "B" will then be 60,000 or more. Our core will be given an area of two square inches, making it 1¼ inches wide and 1⅝ inches thick. With "f" at 60 and "B" 40,000 the above equation gives 516 as the number of turns required; we will use 500.

If other material is used for the core, as mentioned above, or a different frequency, the following core areas are suggested:

With "B" at 60,000 and "f" still at 60, "A" will be 1.37 sq. in.; a core one inch wide and 1⅜ inches thick would do. The number of turns would be the same.

At a frequency of 25 cycles, "B" 40,000, "T" 500, "A" would be 4.95 sq. in., requiring a core 2 by 2½ inches.

At 25 cycles with "B" 60,000, "A" would then be 3.3 sq. in. and the core would be 1½ by 2¼ sq. ins.

For a different frequency or value of "B," substitute the values in the above equation, with "T" at 500.

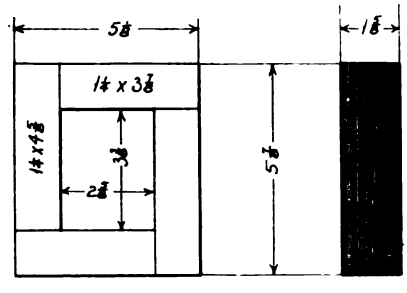


Fig. 1. 60-Core, "Stove" Iron, 0.025 or less, If transformer iron or silicon steel used, cross section may be reduced See Text.

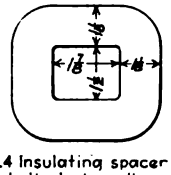


Fig. 4 Insulating spacer fibre or shellacked cardboard. Trim edges after in place and coils wound

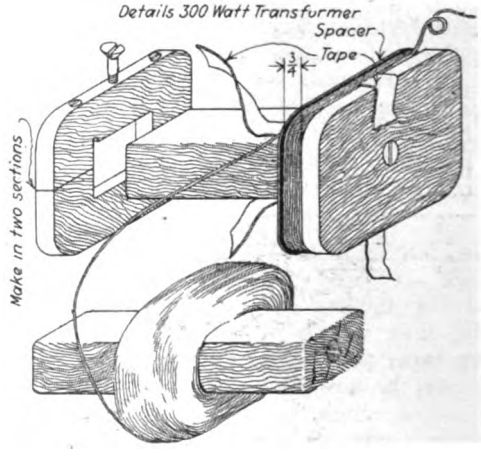


Fig. 3 One section (half coil) wound on mandrel, remainder of wire rewound on another mandrel ready to start second section in opposite direction, when flange is screwed in place

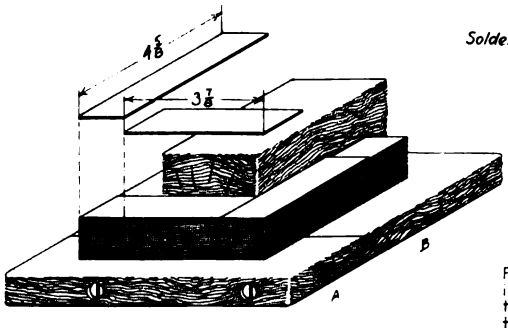


Fig. 2 Assembling the Core How the two legs and one yoke are built up round a wooden form

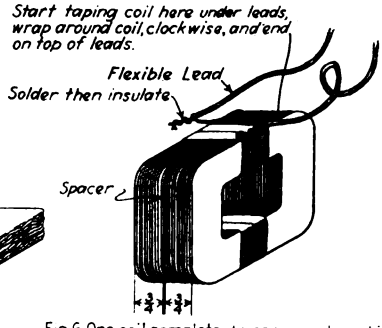


Fig. 6 One coil complete, temporary tape bindings in place and off of mandrel; ready for final tape wrapping. How leads are soldered so as to leave coil in same direction.

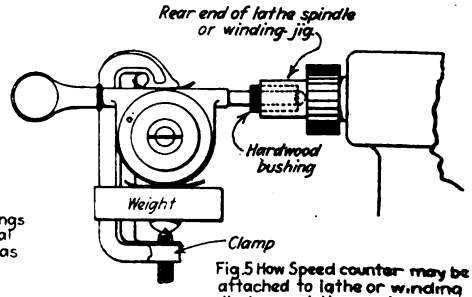


Fig. 5 How Speed counter may be attached to lathe or winding jig to count the number of turns in coil winding.

Digitized by Google

Construction of Core

Taking up the core, primary and secondary windings in order: for the core, get some black stove iron, as thin as possible, though it generally runs about 0.025 inch in thickness. If obtainable, regulate transformer iron or silicon steel will be better and a smaller core may be used as mentioned above. Have this iron cut up, if possible, into strips an inch and a quarter wide; the amount required depends upon the thickness of the iron. Then cut up the strips in two lengths for the core and yoke pieces, to the dimensions given in Fig. 1; pile them up, clamp in a vise and file the ends even and square, then separate and give one side of each a thin coat of shellac. When dry assemble the two cores and one yoke around the wooden form shown in Fig. 2, being careful to stagger the joints. The other yoke must be left off until the windings are in place, when the pieces are pushed into place separately. The pile should be 1⅝ inches high when tightly compressed; clamp the two legs to the board "B" and remove the board "A." This frees the yoke, which may be clamped or held in a vise while the legs are freed from board "B." Round the corners of the legs very slightly, then wrap tightly with black friction tape, always keeping a clamp just above the tape as it is wound on. Wind on a single layer of cambric "armature" tape on each leg, release the yoke and clamping only the corners, wrap this also with friction tape. Give the whole several coats of shellac, especially the taped legs where the windings will be located.

How to Make the Primary Coils

Now for the primary: we will use two coils, connected in parallel for 110 and in series for 220 volts; two No. 17 dcc wires in parallel will carry about three amperes and 1000 turns of this will be used, in two coils of 500 turns and each coil wound in two sections of 250 turns each. Winding in this manner subdivides the E. M. F. in the coils and as both ends are on the outside, the bothersome inside end is eliminated. Make a wooden winding mandrel as shown in Fig. 3, the core being 1½ by 1⅞ inches to allow room for the tape wrapping on the coils. One flange of the jig should be adjustable; for winding the first section it should be placed ¾ inch from the end flange; after the first section is wound it is moved along to allow for winding the second section of the same width.

Prepare some sheets like those in Fig. 4, of thin fibre shellacked cardboard or other insulating material. Thread one of these spacers on the No. 17 wire, then the loose jig flange and then pull through and measure off about 224 feet of the wire, enough for 250 turns approximately. Without cutting the wire slip the spacer and flange over the mandrel, with the wire just measured off OUTSIDE; then wind it temporarily around the OUTER end of the mandrel, screw the flange in place ¾ inch from the other end, lay some friction tape in the groove on each side to hold the sections temporarily when wound and wind on 250 turns; the wire is fed from the spool while the first portion measured off stays on the mandrel and revolves with it. This winding may be performed upon a lathe or a made-up winding jig or even simply by hand. As it is bothersome to keep track of the exact number of turns, if a revolution counter is at hand it may be attached to the rear end of the lathe spindle as shown in Fig. 5 or to the shaft of the winding jig. A weight clamped to the body keeps it from turning with its spindle.

One section being wound, stay the loose end and move the flange along for its second position; the first section will usually remain in place without taping. Wind off the outer portion of the wire on to another mandrel or spool; it will be necessary to pull it through the flange or if the latter is made in two parts and screwed together this trouble will be obviated. The wire being rewound, the second section of the coil is ready for winding, but be sure to wind this in the OPPOSITE DIRECTION from the first, otherwise the two sections will neutralize each other. Another method would be to wind the two sections, separately and opposite, then solder the inner ends together, but while this might be practicable with the No. 17 wire, the secondary wire is much heavier and might cause difficulty in making a smooth joint; the joint would also have to be specially insulated.

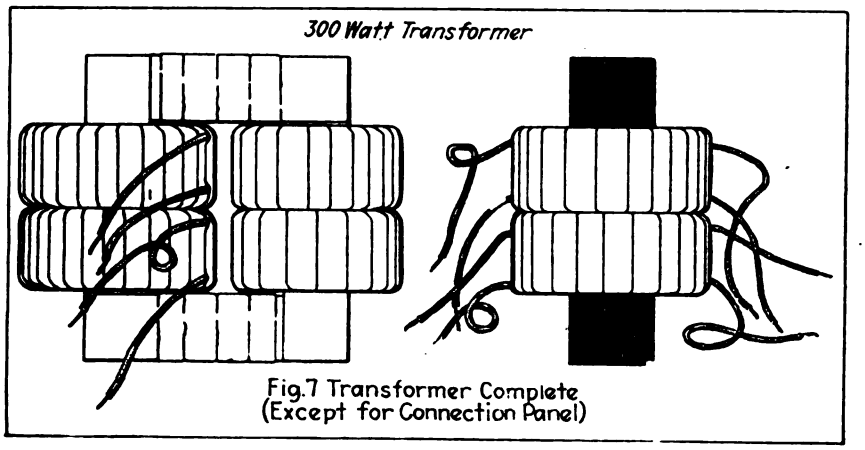


Fig. 7 Transformer Complete (Except for Connection Panel)

The two sections being wound, bind them temporarily with the friction tape and slip off the mandrel; the coil will then look like Fig. 6. Solder flexible leads to the coil and as it is convenient to have both leads leave the coil in the same direction, solder one reversed as shown. Insulate the joints and then soak the whole coil in shellac and bake in an oven. When dry and hard wrap the coil in cambric or insulating tape (Do not use black friction tape) beginning the wrapping under the leads and working away from them around the coil and back over them. Secure the tape with a few stitches and give the tape several coats of shellac. Mark the corresponding end of each coil so that they may be properly connected in series or parallel.

Winding Secondary Coils

The secondary coils are wound in the same way but they will be harder to wind as the wire, No. 12 dcc is rather stiff. Each coil will contain 136 turns in two sections, 68 turns, or about 60 feet, to the section. As the leads should always be carried to some kind of connection panel and as flexible secondary leads would have to be rather heavy, it would be best to carry out the No. 12 wire itself to the panel; the No. 17 wire, being smaller, would be in danger of being broken.

If the builder desired a different secondary voltage, the number of turns could be varied in accordance with the proportion

Primary EMF: Secondary EMF= No. turns in primary: No. turns in secondary.

After all the coils are thoroughly baked dry, they are slipped over the legs of the core; if a coil should stick, taper off the end of the wooden winding mandrel and drive it into the coil to open it slightly. The two primary coils are on one leg and the secondary on the other; this arrangement is best for the purpose the transformer is to be used for, as there will be a certain amount of magnetic leakage when the secondary terminals are shorted, which will assist in cutting down fluctuations in the house circuit. To complete the core assembly, the remaining yoke pieces are pushed into place across the top of the core, the corners clamped, the yoke taped and the clamps released for good. Fig. 7 shows the transformer complete, but no connection panel or mounting is shown.

Digitized by Google

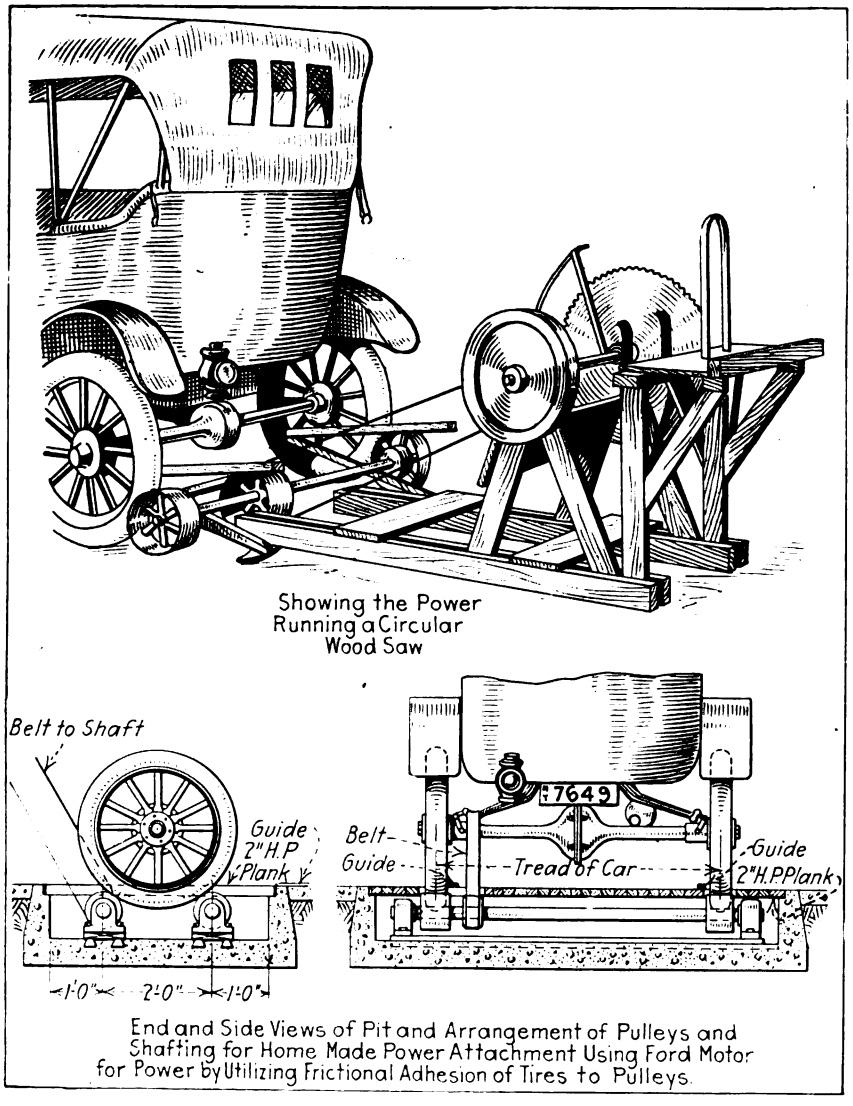
Utilizing Auto Motor Power for Driving Machinery

A NUMBER of appliances have been constructed to make use of the power of engines of Ford and other cars, for driving machinery. All may be practical, but some are better adapted to the work than others. The better types of these devices are installed at the front of the engines, having power take-off mechanism or transmitters that are firmly attached to the frame of the car. The type for transmitting power that is directly connected to the crank-shaft of the engine, by a coupling that remains permanently on the crank-shaft, has been previously described in EVERYDAY ENGINEERING MAGAZINE. In a recent issue an extemporized rigging was described by which an automobile furnished power for a factory. The accompanying illustration shows two methods that will interest our readers as they are easily carried out and while it is not an economical proposition to use an automobile as a power plant as a permanent installation yet for intermittent or emergency work, it is well to know that this can be done without injury to the car mechanism.

In one type of power take-off or transmitter, the power is taken from the rear wheels. To use this no changes in the car are necessary. The transmitter consists of a pair of jacks connected to a shaft having three pulleys, two being of one size and the third or center pulley a smaller size. The transmitter is placed under the rear axle and with the jacks the wheels are lifted and positioned so the tires bear against the faces of the two outer pulleys. The engine is started, the high speed clutch engaged and the rear wheels drive the pulleys and shaft. Power for driving machinery is taken from the center pulley. A governor is not used, the regular spark and throttle affording control. Because of friction, the power delivered at the rear wheels is not as large as with the type coupled to the engine. No statement is made by the manufacturers as to the power obtained for useful work, but apparently it is adequate for the purpose desired. The manufacturer claims that the power obtained will drive wood saws, concrete mixers, grinders and other machinery of a like type.

A home-made transmitter was described in a recent issue of the *Automobile Journal* and the owner claims that he operates a small shop with power from his car. When not in use on the road, the car is backed into a shed adjoining the shop, at the back end of which a concrete pit has been made. In this pit are two short lengths of shafting supported by suitable bearings, the shafting being spaced about 24 inches apart. The front shaft carries a pulley at each end to engage the faces of the wheel tires. The rear shaft carries the two pulleys for engaging the wheel tires and a pulley for running a belt to a line shaft in the shop. Slots are cut in the floor so that the car may be backed into them, the wheels engaging the pulleys of the power transmitter.

The wheels are held in place by the weight of the car and the width of the slots. The owner makes the suggestion that the car may be anchored at the sides to keep the tires from working against the slots, but if flat-faced pulleys perfectly leveled are used he claims little trouble will be experienced. Hard wood blocks placed under the pillow blocks of the bearings serve as cushions and the method of obtaining power is the same as with the device shown above it.



End and Side Views of Pit and Arrangement of Pulleys and Shafting for Home Made Power Attachment Using Ford Motor for Power by Utilizing Frictional Adhesion of Tires to Pulleys.

It is said that from the days of Hannibal to the days of Waterloo, the size of an army was restricted by pestilence. Preventive medicine has made enormous strides in the last few years and armies are now subjected to the most active and efficient methods for preventing all diseases. This, on its face, has a humanitarian aspect, but the result has been to make possible the use of the enormous armies of the late war that caused the enormously greater loss of life and production of misery than in the olden times. While chemistry is thus busy saving lives, it has been calculated that in the late war over 30% of casualites among the United States troops were due to chemical gas attacks. Chemistry bids fair to be an increasing factor in offensive warfare in the future.

Camphor moth balls and tobacco have been used for preserving woolen goods and furs from moths during the summer. Neither of these have been proved to be really effective. The French wrap the article in newspapers, and it is quite a possible theory that the odor of printers' ink plays a part in the precipitation of the goods from destruction.

Digitized by Google

A GIANT GERMAN AIRSHIP

AN interesting report on German progress in aviation has been made by Col. William Hensley of the balloon and airship division of the Air Service. Col. Hensley flew to Scotland on the return trip of the R-34 through the courtesy of the British Government, and shortly thereafter departed for Germany. He reports that the Germans gave him every opportunity to see the various creations in heavier and lighter-than-air craft and afforded him an opportunity to pilot the giant passenger airship Bodensee. He was shown through the Zeppelin works at Lowenthal, where he saw the giant L-72 which was designed and constructed for the sole purpose of bombing New York. He sought out the pilot of this machine, learning that this man was the coolest, most daring and efficient of German war pilots and had successfully bombed London ten times, raked Dunkirk and caused great havoc on the Russian front early in the war.

The enormous airship is unique in many ways. To camouflage it to the minimum of visibility, the belly is painted black, its sides are splotched with cloud-effect gray, while the top is painted a medium amber color. At between 5,000 and 10,000 feet these colors fit in almost perfectly with the sky. The L-72 is 779 ft. long, has an 89-ft. beam and is 95 ft high. It is propelled by six 260 h.p. Maybach engines at a speed of 91 m.p.h. and the capacity of its fuel tanks is 11,000 gal., which gives a cruising radius of 9,500 miles. The hydrogen capacity is 2,470,000 cu. ft. and the total lifting power is 86 tons, with 50 tons of this available as dispensable lifting power. The L-72 was designed to carry 5½ tons of bombs in addition to the crew, fuel supplies and stores.—*Air Service News Letter.*

A Steam Traveling Crane

A Suggestion for the Model Maker Who Wishes to Make an Interesting Working Model of Unusual Design

By T. S. M. Stirling

WITH the coming of winter again and inclement weather, when one feels the comfort of being indoors, we all begin to look for something interesting to take up our attention. And for some readers of EVERYDAY ENGINEERING who no doubt are interested in mechanical work there is pleasant entertainment in their workshops, be it merely a few tools and a collection of odds and ends or the splendidly equipped workshops of those more fortunate, who had more cash at their disposal.

The question of what to make is often a tiresome one for some inexperienced model makers, and how to go about it and what is required in the way of material is a source of worry to the inexperienced.

A very interesting model to build and operate is a steam crane. It is not too difficult to be beyond the average amateur mechanic and requires but a few feet of track to run on, is a compact model with a variety of motions and the material necessary is very modest and requires but a small outlay.

I shall endeavor to describe this little engine and begin with a summary of the material required, which in the case of the engine described is as follows:

A piece of seamless brass tube 9 in. long, 3 in. in diameter for the boiler. Two discs of brass cut to fit the inside of the tube should be of 3/32 in. in thickness for the top and bottom. A piece of seamless brass tube 6 in. long, 1½ in. in diameter, 3/32 in. thick for the control flue. Four pieces of brass tube about 2 in. long. Standard ⅛ in. brass pipe is very good for the cross water tubes. A piece of ½ in. hardwood 10 in. long, 5 in. wide for the crane deck. About 1 sq. ft. ⅛ in. sheet brass for the main bearings of the engine. Two cylinders ½ in. bore, ¾ stroke. These can be obtained in castings and built up, or bought already finished. The question of cylinders can be best dealt with to suit the requirements of the individual. Double acting oscillating cylinders can be used with excellent results, or two slide valve cylinders. I would recommend ready made slide valve cylinders and the link motion reversing gear of the large machines can easily be left out, if so desired, and the load controlled in lowering by the hand brake. If one has a lathe in the workshop the castings of cylinders can be made up and finished with ease, the necessary data for the operation being usually furnished by the makers. An internal gear 3 in. in diameter and a pinion of the same pitch ½ in. in diameter. Two bevel gears ½ in. in diameter, 3/16 in. hole, completes the swinging motion. One gear 3 in. in diameter and pinion ½ in. in diameter for the hoisting motion. These were obtained from an old telephone magneto, the pinion being bushed to fit the crankshaft. Six other bevel gears are required for the traveling motion; these should be ½ in. in diameter, 3/16 in. hole and the same pitch. Also, there are four locomotive trailing wheels 1¼ in. in diameter on tread, but any size near that which would be suitable. Some ¼ in. steam pipe and various odds and ends to be found in the scrap box.

The base or deck was first prepared; it was cut from the piece of hardwood 10 in. x 5 in., as shown in Fig. 1. The circular portion is the position the boiler is to occupy; it was planed and sandpapered smooth and given a coat of oil.

The truck was now built, the wheels were mounted on axles 3/16 in. in diameter silver steel and 4½ in. long. The wheels were already tapped for 3/16 in. axles when bought. Four axle boxes were made from scrap brass, and drilled 3/16 in. for axles and two ⅛ in. holes to take ⅛ in. bolts for fastening to under side of truck. The bolts were made from ⅛ in. brass wire and nuts were made by drilling down the center of a piece of small hexagon brass rod and cutting off ⅛ in. pieces with a hack saw, afterward filing them up on faces. The dimensions and shape of axle boxes are shown in Fig. 2.

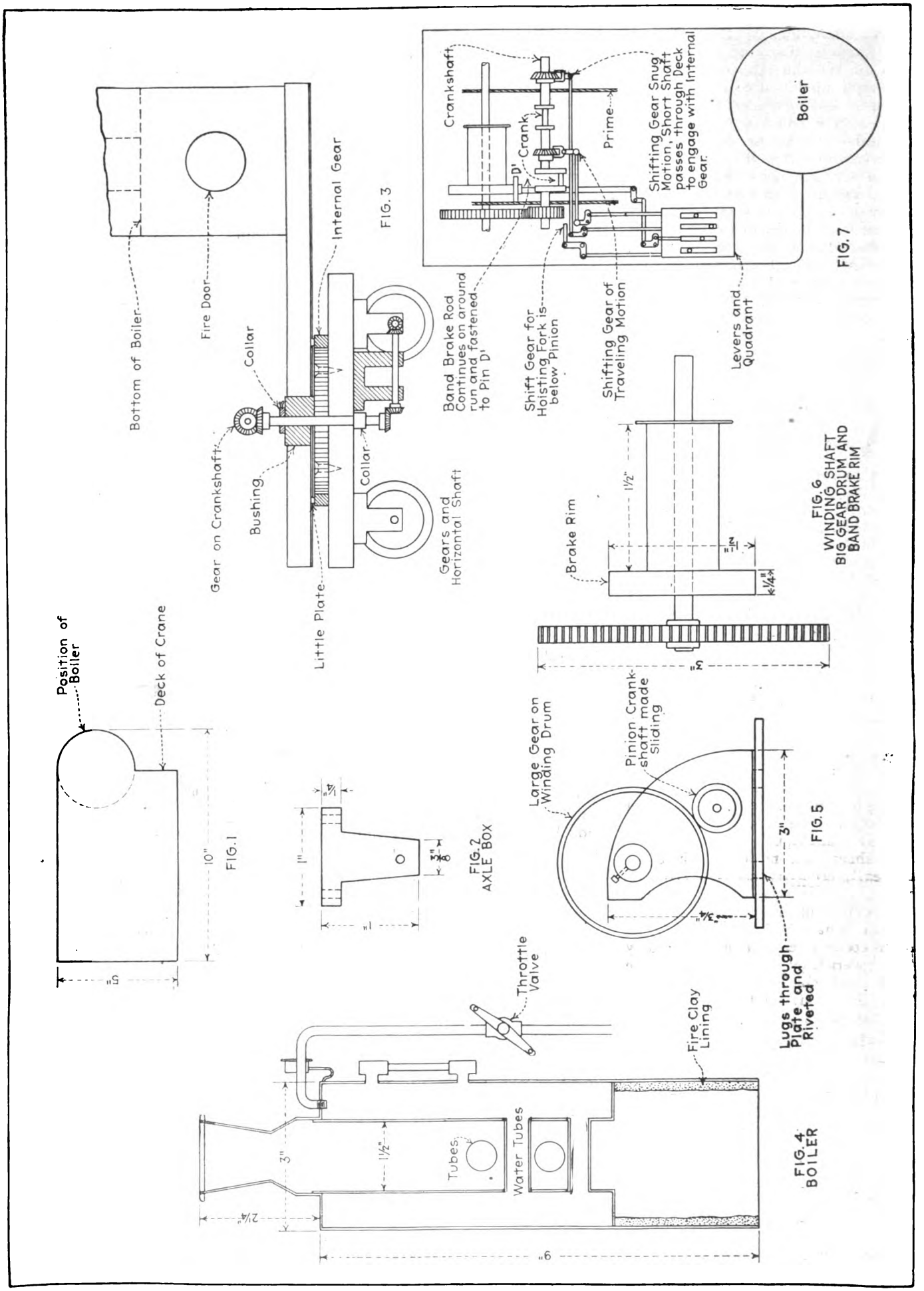
The wooden deck can be smoothed and finished up to suit the builder; if it happens to be mahogany a coat of oil looks very well, or it can be left and given a coat of paint to match the remainder of the engine.

The truck deck was made 6 in. long and 5 in. wide. The axles were slipped in the boxes and the boxes set on the upturned truck deck. Boxes were bolted on a distance of 1½ in. from the ends of the deck and wide enough apart to allow axles to run freely. One of the ½ in. bevel gears was slipped on the rear axle and for the present left loose, having been fitted with set-screw previously.

The internal gear was now screwed to the truck with its center on the center of the deck. A center hole was drilled to take the 3/16 in. shaft which is to drive the truck in the traveling motion and form a pivot for the swinging of the crane deck. A brass bushing was fitted in the hole for the 3/16 in. shaft to pass through—just a small bushing long enough to pass through the hardwood and driven in the hole with a good tight fit. Two collars fitted with set-screws are necessary to hold the shaft in the required position.

The small horizontal drive shaft below the truck was now fitted up; a short piece of silver steel 3/16 in. in diameter made the shaft and the bevel wheels on each end were fastened with set-screws. Two small bearings were made from some scrap brass to carry the shaft. The arrangement of the gearing, truck and deck is shown in Fig. 3.

Digitized by Google



Digitized by Google

The main engine frames are made from the ⅛ in. sheet brass cut to the shape and dimensions shown in Fig. 5. The base of the frames were riveted through flat plates, as shown in Fig. 5, and they were drilled to take bolts to fasten them to the crane deck.

The shaft holes must be drilled in positions suitable to the diameter of gears used. If desired, small collars can be sweated onto the brass frames where the shafts pass through to make a larger bearing surface, and oil holes drilled. It makes a nice substantial job when done in this way. The winding drum was cast from babbitt metal, with a rim for the band brake, as shown in Fig. 6.

A built-up crankshaft is used very nicely, and it is easily made from 3/16 cut from ½ in. key steel made ½ in. in. steel for the shaft. The webs are wide and ¼ in. thick, drilled and slipped on the shaft, and crank pins inserted. The whole thing is then well silver soldered, the pieces being afterward cut out between the webs and the little crankshaft filed up and finished with emery cloth. The dimensions are left to be made to suit the occasion and cylinders used.

The sliding gears which drive the swinging, traveling and hoisting motions are shown in Fig. 7. The keys for the gears to slide on were made by taking a piece of 3/32 in. square steel and riveting it to the shaft with three 3/64 in. pins, afterward cutting out the corresponding keyway in the gears with a small warding file.

The frames were set up on the deck, which proved a little tedious on account of getting the various gears meshing and running nicely together. Fig. 7 shows relative position of the parts. The cylinders used were set upon feet and bolted to the deck with four ⅛ in. bolts and small guide bars, and crosshead shoes were made, but these are not really necessary with so small cylinders. The throttle was an ordinary plug cock fitted with a small steel handle, which had a very good appearance. Drain cocks were fitted and operated by small levers between the cylinders. The levers and quadrant were made of brass; the arrangement of the levers and bars and gearshifts are shown in Fig. 7.

All the joints in the boiler were silver soldered, and this proved very satisfactory. The central flue was drilled in four places below the water line, and the four cross water tubes silver soldered in, as shown in Fig. 4. The holes in the top and bottom plate of the boiler were drilled around and cut out with the chisel and filed up to fit control flue. The control flue was now silver soldered to the two plates, the lower end being kept flush with the outside of the plate, and the upper end allowed to project through a little. These joints were all soldered on the water side and a liberal allowance of solder used.

The top and bottom were now silver soldered to the brass boiler barrel, previously drilling a ⅜ in. hole for safety valve in the top plate. The fire door was drilled around and cut out and the little door made from sheet brass and the firebox lined around the inside with fire clay. Three angle plates were made for fastening the boiler to the deck. The little safety valve was made from scrap with little trouble and works satisfactorily.

Two smokestacks were made from 1/32 in. plate and fits snugly over central flue, where it projects at the top. Pressure gauge, water gauge, blowdown cock, check valve and try cocks were bought articles, and they do not repay one for the trouble of making them.

In spite of the fact that the boiler design is somewhat unconventional, it steams very well, and when fired with a small kerosene vapor burner maintains 15 pounds pressure quite easily and "pops" in most practical fashion at 20 pounds pressure. It was tested to 50 pounds in a thorough hydrostatic test, and 15 pounds is ample to make the little engine run at a furious rate.

The boom was built up of oak and makes a smart looking and practical job. The arrangement of the cylinders, various shafts and gearing, gear shafts and levers can best be decided by the circumstances and the material at one's disposal. Small brass chain makes a nice looking hoisting line and fits nicely on the drum.

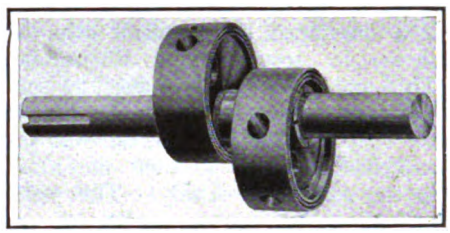
The whole machine was painted a dull gray with a few black trimmings and bright parts. There was a little hand boiler feed pump used to keep up the water, but the writer observed some good drawings of feed pumps in a recent issue of EVERYDAY ENGINEERING and in consequence did not deem it necessary to give a description of the pump used in this case.

The little crane makes an interesting model to construct, and is a most entertaining engine to watch in operation.

A NEW ROTARY STEAM ENGINE

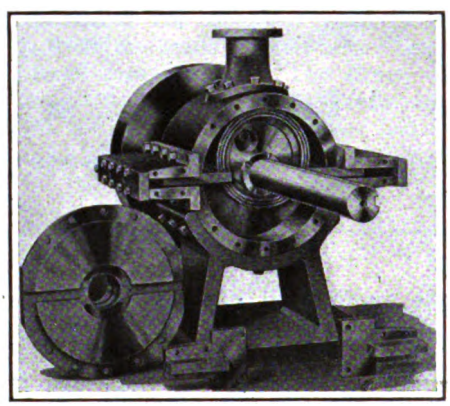
FOR many generations mechanical engineers of considerable renown have spent several days, months, and years in continued efforts to perfect a Rotary Steam Engine, the seed and germ of which was planted by James Watt before his death a century ago. Watt declared that his slide-valve engine was only an approximate machine and that the ultimate engine would, if necessary, be a Rotary engine, but such an engine, even the great Watt was unable to build.

Briefly described, the Bannon Rotary illustrated Steam Motor is a very compact steam engine and in its construction there is used only about one-fifth the materials of a slide-valve engine of the same horsepower. It is claimed that its compactness effects a saving not only in the material and labor used in its construction, but also a saving in foundations required in space in the engine room. The most startling thing about this engine is that it has only three moving parts; an eccentric piston keyed to the drive shaft and two sliding gates which operate with their ends forming



The engine rotor

contact with the periphery of the piston. These three simple moving parts are the heart and soul of the engine and any man, whether a mechanic or not, can quickly tear down and rebuild a Bannon engine, because it is so simple and easily understood. On the shaft of the two-cylinder engine there are two of these eccentric pistons, 180 degrees apart, which balances the shaft per-



Engine with end plate removed

fectly and eliminates all possibility of rust or any bearing surface. The engine has positively *no reciprocating action* to overcome and consequently no loss of steam and fuel which is always experienced in overcoming the reciprocal action of slide-valve engines.

Possibly for the first time the acceleration and momentum of the piston is a decided advantage in the rotary engine as this piston moves always and continually in the same direction; whereas in the slide-valve engine these mechanical principles are a decided disadvantage inasmuch as the piston must be stopped and started twice in each revolution.

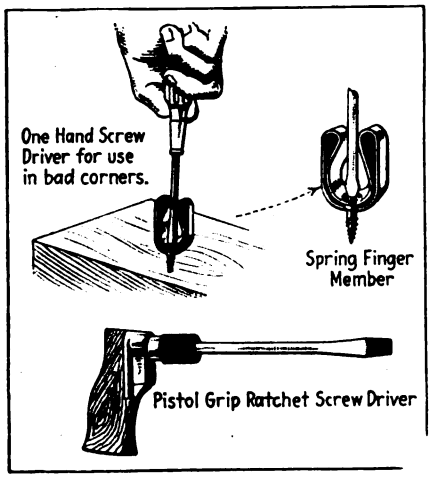
This Rotary engine is not at all like a Turbine inasmuch as the Turbine derives its power from the Kinetic energy of the steam, while the Rotary engine operates on the steam expansion, and it will start off with any load that it will carry subsequently; this a Turbine was never known to do.

Digitized by Google

SHOP PRACTICE

SCREW-DRIVER STUNTS

A NEW ratchet screw-driver recently developed has a pistol grip, as shown in accompanying illustration. This tool gives the user absolute control over the screw. It enables him to see exactly what he is doing, and get sufficient pressure to hold the blade in the screw slot firmly. The pistol grip gives the user a positive grip at all times. It does not matter whether the hands are oily, wet, tired or cold,



Screwdriver stunts

the comfortable shape of this handle gives the user certain control over the stubborn screw. The operation of the driver is simple. Only one hand is required, and it will work in any position. On the upper part of the blade, a convenient distance from the handle, is a knurled ferrule. With this an easily run screw may be quickly run in or out, without taking the hand off the handle. The blade is chrome nickel steel, heat-treated to give the most durable tip. The tip is cross-ground to prevent slipping from the screw slot.

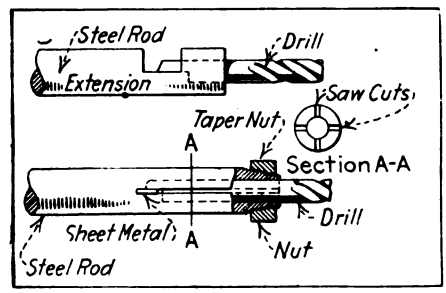
The one-handed man will find no difficulty now in driving screws, and his two-handed brother will be able to operate the screw-driver in corners and in restricted spaces where there is no room for a holding hand—there's many a place like that on motor boats, machinery and automobiles and also about the homes and shop. This device, made from spring steel, is so shaped that its fingers hold a screw in place on the end of a screw-driver. The upper part of the screw holder is secured to the screw-driver blade.

A small hand mirror will reflect light to any dark corner.

DRILL EXTENSION

TWO forms of drill extensions are shown in accompanying illustrations that can be easily applied when it is desired to drill a hole in a place that cannot be reached with a drill of the ordinary type and length. A rod of the proper size for the extension is selected and a hole drilled in the end to the size of the drill, a method shown at A. After the hole is drilled a portion is cut away and a flat end is filed on the drill shank to fit a flat in the extension socket. This makes it possible to drive the drill positively and also makes it possible to fit another one if the drill is broken as is often the case when the small diameter drills are used in extension shanks. Of course, it is possible to braze or solder a drill in the extension but when soldering is used the drill may turn in the socket and break the solder bond. If the drill is brazed, the parts are sometimes raised to a sufficiently high temperature to draw the temper and these must be re-hardened after the brazing operation is complete. It is more difficult to replace a broken drill when it is fast in place by either soldering or brazing.

Another modification which is not as well known as that previously described is shown at B. In this the extension rod

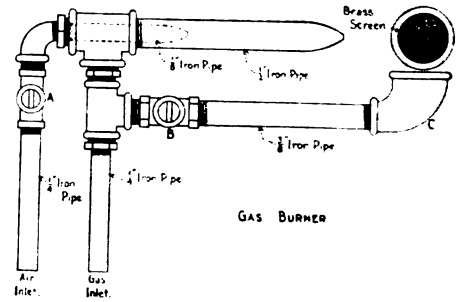


Drill extensions

is drilled just as in the previous instance but the drill is held in place by a different method. Two saw cuts are made in the end of the rod, these being at right angles to each other so that the end is really divided into four sections. A taper thread is cut on the end of the rod before the slotting operation takes place. A piece of sheet steel is forced in the lower end of one of the slots and acts as a driving member against which the flattened portion of the drill is placed. By tightening down on the nut the device acts just like a chuck and the four jaws are clamped tightly against the drill. As there is more elasticity to the jaws one extension shank will take drills that may vary slightly in diameter such as the body and tap size. An advantage of this form of extension is that by spreading the ends of the jaws apart and dressing them down for ¼th of an inch or so inside with a file as a square hole is obtained, the extension can be used for turning a tap and one extension shank not only holds the tap drill and body drill but also can be used for turning the tap and making the thread in the hole if necessary.

COMBINATION GAS BURNER

THE accompany illustration shows a very simple form of gas burner that is made up of ordinary standard pipe fittings. This is a combination burner that can be used to



Combination gas burner

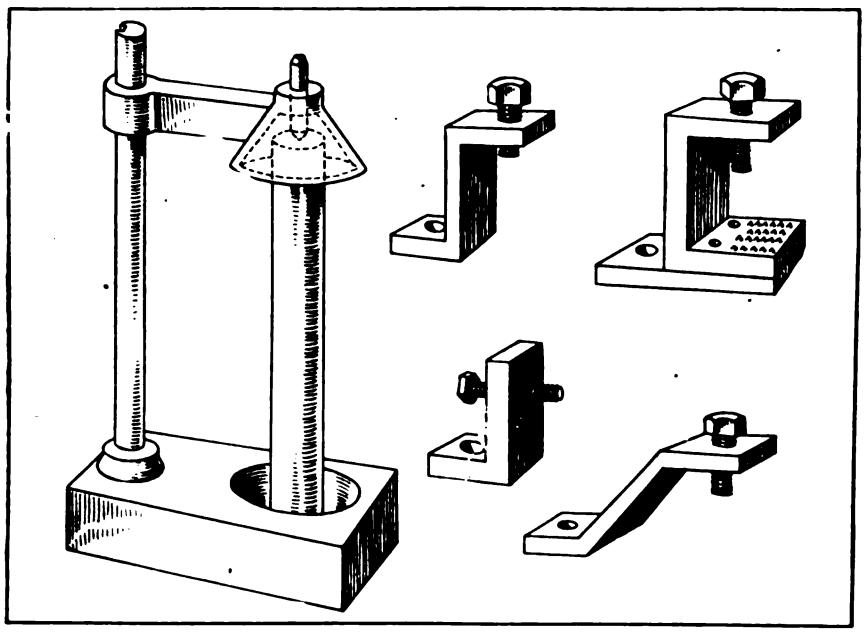
give a flame of large volume and low heating value, such as is often times needed in the shop, or it may be employed to give a blast flame for brazing, depending on which section of the burner is used.

DRILL PRESS KINKS

BAND iron and ordinary bolts or special screws form excellent clamps by which it is easy to secure work to the drill press table for drilling. They may be quickly attached to the table or to the angle plate and may be bent up from ¾ or 1-inch by 2-inch flat iron stock by any one who knows enough to heat the iron to the proper temperature, and then bending it by placing in a vise and hammering to the required form. Case-handened, cup point, special screws are excellent clamping members. Another useful device which is not difficult to make and which can be profitably added to the shop equipment is a centering jig which is especially valuable if one has a considerable number of short pieces of

Digitized by Google

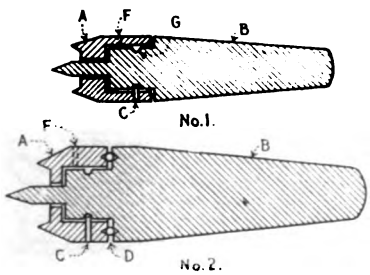
round stock to center for turning or threading in the lathe. A conical depression is placed in the base and a movable cone casting carries a special center punch in a suitable centrally placed bearing. This cone is attached to a sliding arm that is prevented from turning on the vertical shaft by a key attached to the arm boss that slides with that member in a guiding key-way machined in the upright. It will be evident that cones will automatically center stock various diameters and that a suitable blow on the center punch will indicate the central point at the end of the round bar.



Centering jig for short round bars shown at left. Simple drill press clamp outlined at right

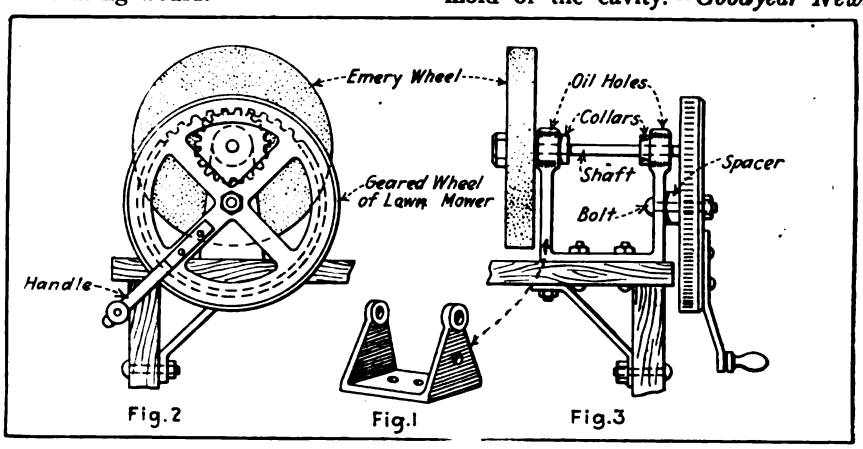
LIVE CENTERS

TWO useful and simple forms of live centers for use on wood turning and some forms of spinning lathes are shown in the simple diagrams herewith. The type illustrated as No. 1 consists of the usual form of taper shank (B) to fit the tail stock or head



stock, as the case may be. It is provided with a groove (G) machined around the surface on which the spur portion (A) revolves. A pin (C) fits into the groove and keeps the spur portion from coming off. The oil hole (F) is provided so that the bearing portion of the device may be adequately lubricated.

While this form is suitable for various kinds of light work, it is not well adapted for work where there is considerable thrust, such as metal spinning. For work of this nature the live center shown as No. 2 is best adapted, because, in addition to the other features of the simpler type shown above it, it includes a ball thrust bearing (D), which revolves with considerably less friction under heavy loads than a plain bearing would.



Drawings showing how old lawn mower may be used to make emery grinder

EXTEMPORIZED EMERY GRINDER

ANY one who is handy with tools and that has an old lawn mower that he does not know what to do with, can make an emery grinder that will be very useful for rough work. The drive wheel of the lawn mower, which is the large wheel on the side and its internal gear are used to turn the pinion that normally is fastened to the cutter axle. The bearing for the pinion shaft can be easily made from flat-bar stock having holes machined in it, in which bushings are placed for bearings or a simple cast metal supporter may be made from a home-made pattern. The driving wheel is held by a bolt which has shoulders on it and a separate collar is placed between the gear and the end of the supporting bracket. This collar should be made less in width than the distance from the inside of the gear web to the shoulder on the bolt in order that the wheel will be free running. A crank is made by bending up some flat bar stock and is riveted to the outside driving gear as depicted at Figure No. 3. A suitable handle is provided at the end of the crank by which it may be turned.

The part sectional view at Figure No. 2 shows the gears in mesh while the general construction of the device, which can be altered to suit individual requirements, can be readily ascertained by inspection of the assembled view.

POROUS CONDITIONS AFTER CURING

ONE repair man has complained several times about the porous conditions of repair jobs after curing. Upon investigation the fault was found to be damaged bead molds. The bead molds had been battered and bent until they would no longer fit the cavity snugly and would not slide forward. The sectional mold being tapered, the beads wedged before being placed into position. The clinch on the bead held the casing firmly and did not allow it to rest on the bottom mold of the cavity.—*Goodyear News.*

The United States Bureau of Standards has been investigating the mixing of concrete. Cement and water were mixed for a long period, 15 to 30 minutes, and to this mixture were added the sand and stone constituents of the concrete. The usual way is to mix all the constituents together for a few minutes and then to put the mixture in place. It was found that there was no advantage by this preliminary mixing of cement and water.

An interesting report from Portugal puts the total world production of corkwood at 396,832,000 pounds, of which 45% is produced in Portugal, 30% in Spain, 5% in France and Italy, and 20% in Algeria and Tunis.

Digitized by Google

Oil-Burning Locomotives

THE use of fuel oil as a standard combustible for locomotives is a more familiar practice in the Western than in the Eastern States. From the standpoint of the passenger it is most desirable, as the action of the burners can be and is so regulated by the fireman that there is a complete absence of smoke; cinders, of course, are also lacking. We give two cuts in this issue showing the distribution of parts in an installation on the Santa Fé system, and we give some of the results obtained in exhaustive tests recently carried out on that road.

The specific gravity of the oil was 0.958, a gallon weighing almost eight pounds (7.88 pounds at 110 degrees F.). It contained 18,550 British Thermal Units per pound.

The oil flame is known to be very severe on the metal of the fire chamber of the boiler, and even bricks succumb to its cutting action. Special oil bricks are supplied for general use in oil fires. Yet, all things being taken into account, it was found best to dispense with brick arches in the fire chamber, so as to leave it more open for inspection and to avoid the liability of bricks falling out of the arch and interfering with the operation of the blast pipe.

In some trials the burner was placed in the back of the fire chamber, in others in the front. Sometimes the seams of the boiler plates were protected by bricks.

The cuts accompanying this article are in such detail as to be self-explanatory.

Practically the same quantity of oil was burned per hour, whatever variety of apparatus was used, the brick arch construction being slightly less economical; 3,100 to 3,240 pounds per hour running time were the range of consumption. The water evaporated per pound of oil ranged from 14.06 to 14.60 pounds, which shows an efficiency of from 73.5 to 76.4 per cent, a very satisfactory result.

In the total figures recorded it is interesting to notice the great variation in oil consumed according to the conditions of the trip. In some cases less than half as much was recorded, but the efficiency figures in all cases came out very close to each other, as has just been shown.

While we may all be longing for the day when the locomotive engine will be relegated to the scrap-heap, and when electricity will do all the propulsion on our roads, the engine in question will not disappear for many years, so every effort to make it a better and more economical prime motor will be welcomed by the engineering world.

THE BUSY IGNITION SYSTEM

THE spark plug used for ignition purposes is one of the most important parts of the automotive power plant and when one considers the work it must do, it is remarkable that it will work for the extended periods it does without giving trouble. It is subject to alternate heating and cooling and must deliver a large number of sparks across its points as the accompanying table shows. The contact points of the primary timer also have some work to do because they must open and close for every spark that takes place at any of the plugs. Thus on a six cylinder engine, the contacts must make and break a circuit 3,000 times a minute, or 50 times per second at an engine speed of 1,000 r.p.m. Similarly, the induction coil must transform a low voltage battery current to a high voltage secondary current each time the contact points separate. Owing to mechanical and electrical limitations, it is usual to provide two sets of breaker points and two induction coils for high speed engines having more than six cylinders.

The heat generated in the cylinder at the instant of combustion is intense. The temperatures will vary from 3,000 to perhaps 4,000 degrees Fahrenheit, which intensity is illustrated by comparing the heat at which steel fuses, or about 2,550 Fahrenheit. The mean temperature of the cylinder is much lower

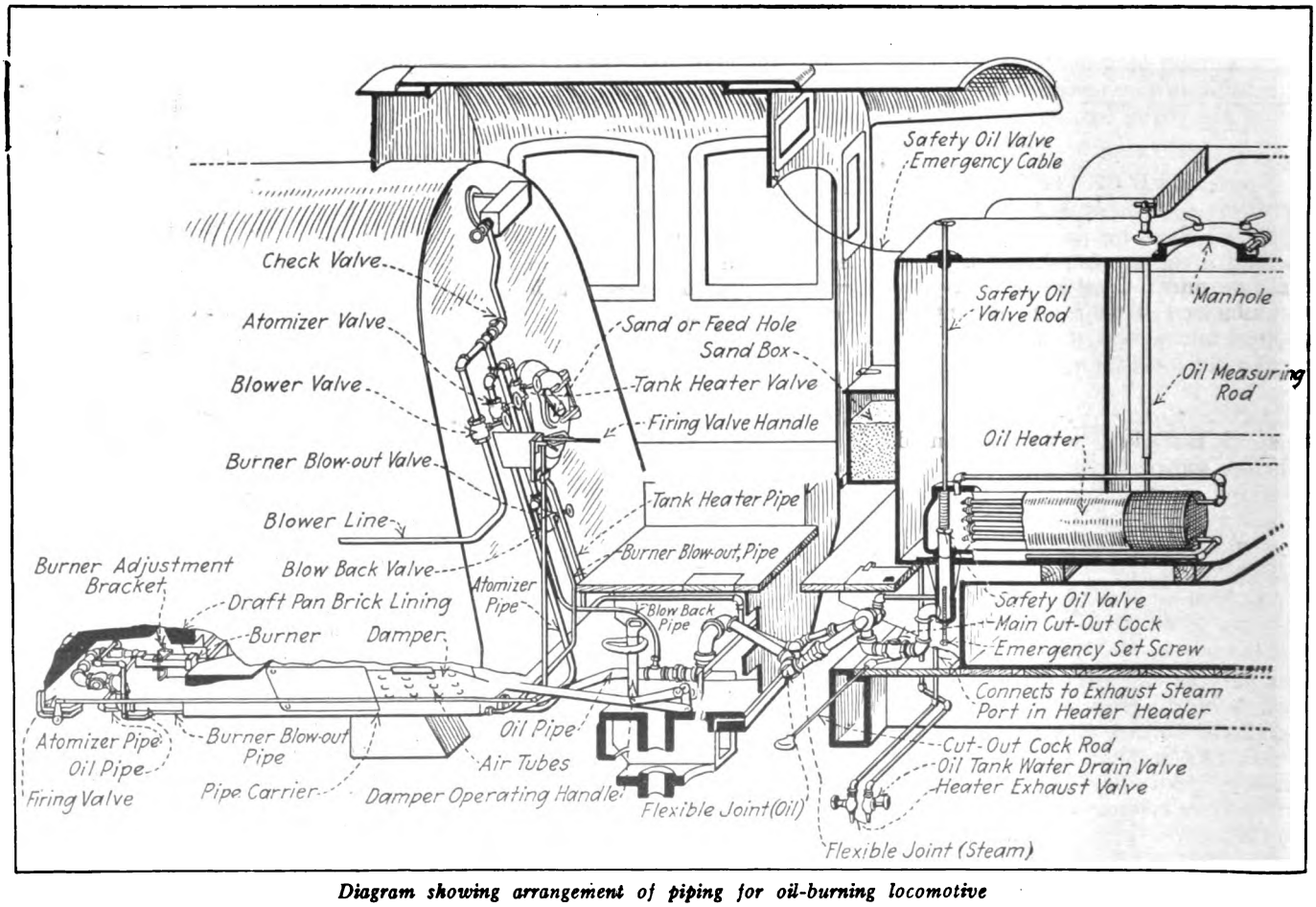


Diagram showing arrangement of piping for oil-burning locomotive

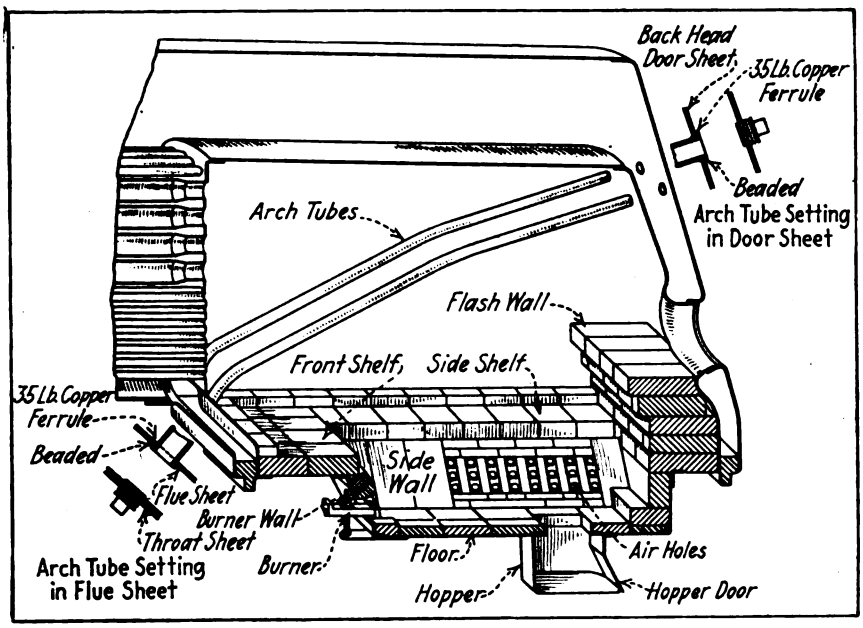
Digitized by Google

because it is reduced as the piston descends for the power stroke, is cooled somewhat by the exhaust stroke, and is cooled decidedly during the intake or suction stroke and to some degree while the cool fuel gas is being compressed.

While the engine is in motion these cycles are repeated. The tabulation shows that with engine speed of 1,000 revolutions there will be an average of 500 power impulses for each cylinder, and an average of 8.33 ignition sparks created a second. This may appear to be comparatively slow, but from 1,800 to 2,400 revolutions a minute is not uncommon with standard automobile engines, and from 3,000 to 3,600 is sometimes reached with racing car

No. Cyl.	Engine R. P. M.	Power Impulses a Minute	Ignition Sparks a Minute a Cylinder	Ignition Sparks a Minute an Engine	Ignition Sparks a Second a Cylinder	Ignition Sparks a Second an Engine
1	1000	500	500	500	8.33	8.33
2	1000	1000	500	1000	8.33	16.66
4	1000	2000	500	2000	8.33	33.33
6	1000	3000	500	3000	8.33	50.00
8	1000	4000	500	4000	8.33	66.66
12	1000	6000	500	6000	8.33	100.00

develop less power than engines with valves in the heads.



Firebox arrangement of oil-burning locomotive

engines. The maximum stated would be approximately 29 power impulses a second to a cylinder. But the term power impulses does not represent the rapidity of the consumption of the fuel in the cylinder. Considering the period of combustion, if the engine is running 1,000 revolutions a minute and each cylinder has 500 power impulses the time for each impulse revolution is slightly more than 1/6 second and if the spark is made 15 degrees advanced or before top center, and with 360 degrees for a revolution, the time for ignition would be 15/360, which allows 1/24 of the time for one revolution, or 1/144th of a second, for the gas to burn and create the expansive within the cylinder. This is so brief a period that it is not possible to make comparison. Yet in that time the electric spark must create a flame that will spread through every part of the combustion head. If the combustion chamber is irregular the flame will not be uniform in its progress in all directions from the electrodes of the spark plug, which is held to be the reason why L and T-head cylinder engines are either slower in action or

WHY WE TEMPER STEEL

IN the vast majority of cases the writers who deal with the heat treatment of steel, when outlining the process of tempering, state that the object is to soften the steel. They say that steel, when heated to the required hardening temperature, becomes too hard and that therefore it is necessary to draw the temper in order to soften the steel. This is a common error—a failure to distinguish between the hardness and brittleness in the steel, two entirely different qualities.

Hardened steel is tempered in order to make it less brittle, but unfortunately the tempering process also softens the steel to some extent.

REPAIR POINTERS

WHEN adjusting overhead valve clearances it is just as well to leave final adjustments until the cylinder head, as in the Chevrolet, etc., is firmly bolted down. The new gasket will give considerably as the engine warms up.

When setting ignition by the head center position of the fly-wheel it is sometimes advisable to look at the piston, as fly-wheels are not always in their original position.

Try hard oil on cylinder head gaskets instead of shellac.

IMPORTANCE OF BRUSHES

APPROXIMATELY 90 per cent of starting and generator trouble is caused by lack of proper attention to brushes. A number of holders are so constructed that when the brushes wear out they wear on the commutator, causing it to groove. Yet there are many persons using automobiles every day who do not know what a brush is or that they have brushes on their starting motor and lighting generators and magnetos. Few realize the importance of the brush to automobile efficiency. A brush is the heart of the lighting and starting system. Without proper brush contact, or with poor commutation, one would be unable to start the car, to have a lighting system, and, where a distributor is used, to run it.

Lighting and starting systems were first installed on pleasure cars in 1912. Now they are placed not only on all pleasure cars, but on some makes and sizes of motor trucks and tractors. There are about a thousand kinds of brushes manufactured, varying in size from one-eighth of an inch square to 2½ inches square. Their carrying capacity varies from 30 to 300 amperes a square inch.

Brushes are made of copper gauze, or compounds of graphite, carbon and copper, depending upon the contact resistance and current required. The metal types contain from 15 to 90 per cent copper. Brushes other than the copper gauze type—the graphite compound brushes—go through a complicated process before they are ready for the market. The materials are first transformed into a fine powder, which is placed into mixing machines. This mixture is put into hydraulic presses, where it is subjected to a pressure of from 150 to 500 tons, and pressed into blocks varying in thickness from one-quarter to 1¼ inches. The blocks are then placed in furnaces giving a terrific and constant heat. They are left in the ovens for from seven to fourteen days, after which they are permitted to cool gradually. When the blocks are cold the ovens are unpacked and the blocks are sent to the cutting department and cut into the numerous sizes and shapes. Next they are brought to the drilling department, where holes are drilled with minute care in order that they may be assembled with the copper wires or "pigtails," which are either spun, riveted, screwed or soldered on to the brushes.

Digitized by Google

WHAT IS NEW IN AVIATION

(*Continued from page* 492)

pected to make real progress until it demonstrates that it provides speed, combined with economy and safe transportation. During the war, the DeHaviland No. 4 biplane equipped with a 400 horsepower engine was capable of carrying a pilot, observer and a few machine guns and necessary ammunition. By sacrificing both speed and climb, it may be loaded with a few hundred pounds of bombs. When this biplane was converted to mail carrying purposes, it required a 400 horsepower engine, to carry a pilot and less than 500 pounds of mail. Recent performances of all-metal, internally trussed monoplanes, show that it is possible, with but 180 horsepower to carry 1,000 pounds of mail at practically the same speed.

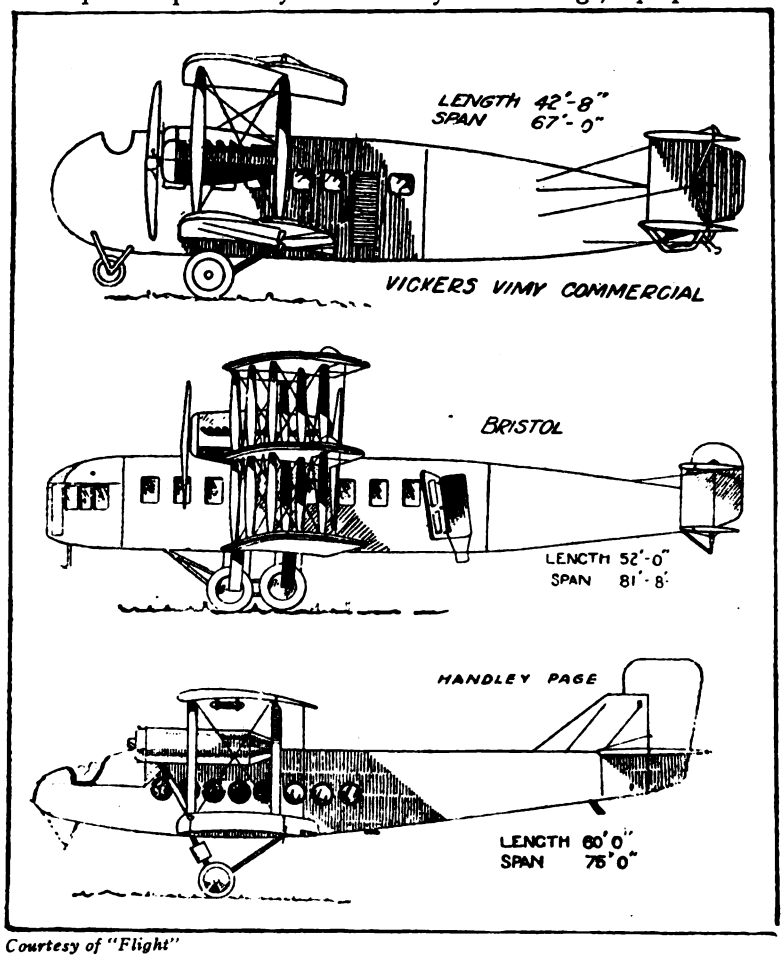
There is no question but that the capabilities of airplanes have been known for some time past, but it has also been appreciated that operating costs have been so as to retard civil aviation development. The expense of operating a plane equipped with two 400 horsepower engines that use about forty gallons of gasoline per hour and a correspondingly large amount of lubricating oil, would bring the fuel cost, with the present price of gasoline, to about $30.00 per hour. Lubricating oil for the same period would cost about $5.00 per hour and the depreciation of the airplane of the usual wood and fabric construction, might easily equal all the other operating expenses.

It is apparent that commercial aviation cannot be made practical if high operating costs are to prevail. The all-metal, internally trussed monoplane previously mentioned, has made a non-stop trip from Omaha to Philadelphia, a distance of about 1,400 miles in 11 hours and has carried three people that distance with an average gasoline consumption of about ten miles to the gallon. It has been stated that in the DeHaviland war-plane, that over 230 horsepower was expended in propelling parts that offer a parasitic resistance and that only 90 horsepower was expended to actually support the machine by the wings. On the newer types of commercial airplanes, every effort is being made to develop wings that will have high lift at comparatively low speeds and that will eliminate all possible waste of power by eliminating exterior parts that do not contribute to the sustentation of the airplane or its propulsion.

The monoplane construction made possible by the internally trussed wings, which is one of the most efficient of modern airplanes, provides a structure that is possessed of a greater aerodynamical efficiency than any form of multi-plane can have. It is reasonable to believe that as airplane development progresses, we will find that machines of the future will be able to carry considerably more than their own weight. This has not been true in the past, as in the case of the DeHaviland mail plane, we have a total weight of 3,200 pounds, of which only 1/8th or 400 pounds represented useful paying load. Considerable interest is being displayed in designing types of air craft that will carry express matter economically and the writer feels safe in saying that it will not be long before it will be possible to carry material of that nature on long distance trips cheaper by air craft than it is by road with motor trucks at the present time.

The advantages of all-metal construction and the elimination of bracing wires are many. One of the most important of these is that once an airplane of this kind is assembled that there is no possibility of losing its adjustment. In the present types of wood and fabric airplanes it is necessary to check up the alignment of the wings periodically and to go over all of the bracing wires every day to make sure that these are in proper condition and not too tight or too loose. The new method of metal airplane construction means that it beomes a structure that cannot be changed in form by any service for which it was designed. It may be compared to a bridge, which when once completed, preserves its form and needs but little attention to maintain it.

Another advantage of the all-metal construction is that a plane of this type may be left exposed to the weather, which will have no more effect on it than it has on modern motor vehicles, or other automotive equipment. It is not only in economy of operation that planes of this construction offer advantages, but also in that cost of maintenance is greatly reduced.



Courtesy of "Flight"

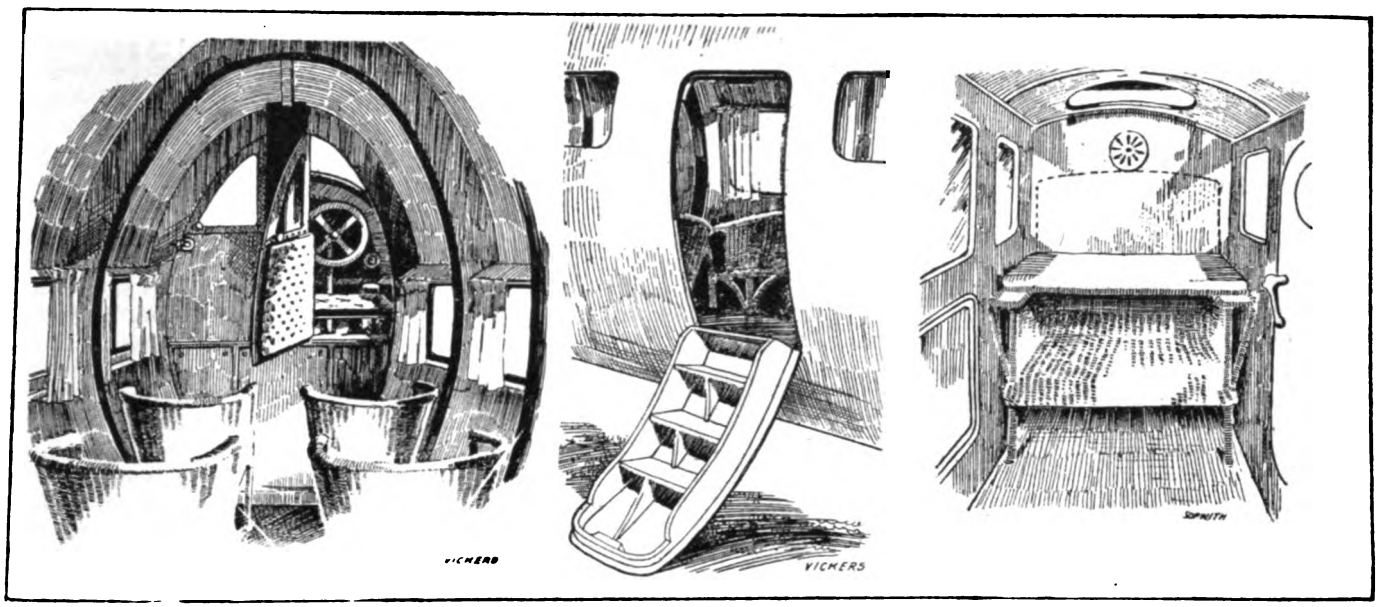
Side elevations of some of the best known English commercial airplane designs

Bristol Triplane Pullman Express

The *"Bristol"* Pullman Triplane, which can travel at over 130 m.p.h. combines with high speed luxurious comfort for its passengers, reliability and absolute safety. With two only of its four engines in operation, flying speed can be maintained. The roomy Pullman saloon, tastefully decorated and electrically lighted and heated, is seven feet in height and is fitted with comfortable fauteuils for the 14 passengers carried, in addition to the pilot and engineer. The gasoline tankage is sufficient to allow of a non-stop flight of 600 miles.

The ordinary uncorrected air speed readings show a maximum speed of some 134 m.p.h. With the engines at little more than half throttle the speed recorded was in excess of 100 m.p.h. No actual figures were taken at the time of these tests concerning the climb, but it was said that it climbed much more like a fighting machine than a passenger plane. Especially satisfactory was the fact that the machine on every occasion took off from the ground within, at the most, 180 yards after the engines had been let out, whilst a similar run after landing was

Digitized by Google



Courtesy of "Flight"

Interior view of the cabin of the Vickers Vimy commercial shows luxurious appointments for passengers and pilot's seat in nose

How the door of the Vickers Vimy commercial airplane folds down to permit passengers to step into the cabin in the fuselage

The seat back of one of the Sopwith models folds down on the arm rests to give the passenger a higher seat if desired

experienced. The whole of the first half of the fuselage is formed into a commodious and luxurious cabin, providing accommodations for 14 passengers in addition to the pilot and engineer, the latter occupying the extreme fore part of the cabin. The cabin is 7 ft. in height, and a central gangway affords access to the comfortable fauteuils which, though removable are normally placed on either side of the cabin. Large Triplex glass windows are provided for the convenience of each passenger, and an adequate system of heating and lighting by means of electricity is installed.

The question of ventilation has also been carefully studied. Any or all of the seats may be removed for the conveyance of mails or cargo and a total space of 570 cubic feet can thus be made available.

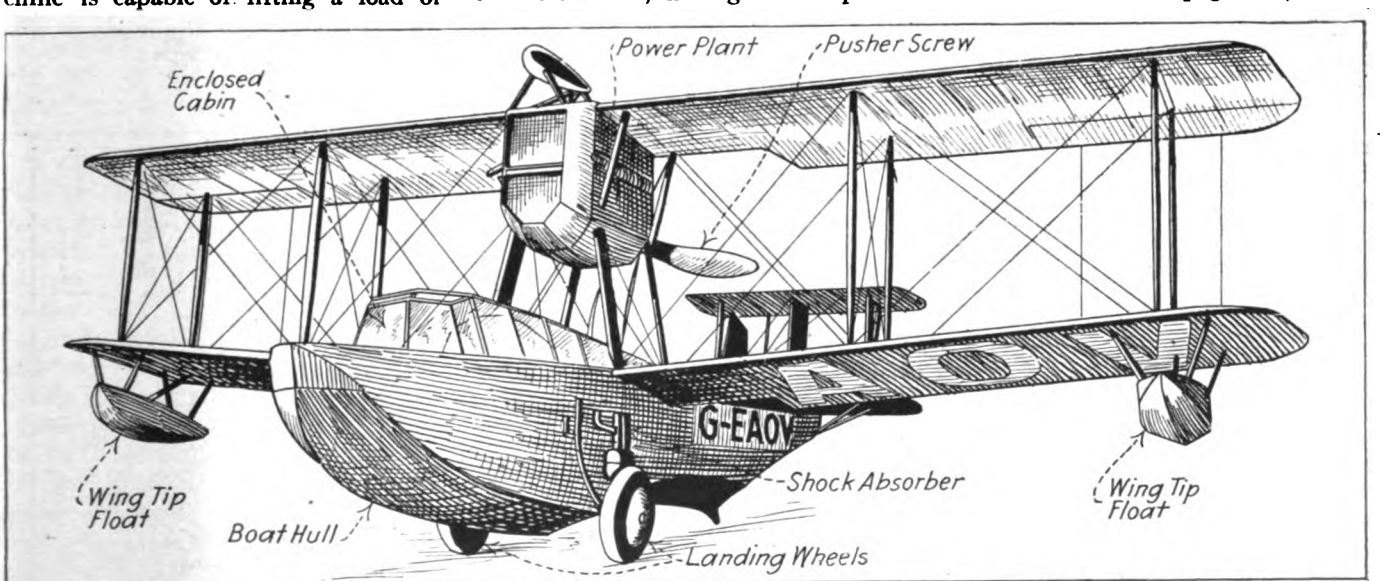
In addition to the two pilots the machine is capable of lifting a load of 2,700 lbs. with fuel for five hours' flight, or alternatively 4,000 lbs. with fuel for two and a half hours' flight. These figures are based on an economical speed of from 100 to 105 m.p.h., i. e., at three-quarter throttle giving a sufficient reserve of power to reach a maximum speed of 125 m.p.h or more if necessary. All three planes are given a sweep back and a dihedral angle, but are not staggered. Balanced ailerons are fitted to the top and middle wings. The tail is of the biplane type with three fins and rudders. The four engines, each of 410 h.p., are mounted two in tandem on each side of the fuselage on the middle plane, and each unit drives a tractor and pusher screw.

Handley-Page Model

The machine is a medium size twin-engined biplane, specially designed for commercial use, having an exceptionally large carrying capacity and reserve of power. The particular machine shown has two Napier-Lion engines, but these may be replaced by either the Liberty engine or Rolls-Royce "Eagle" VIII. The fuselage provides one large saloon or cargo space, which is entirely free from wires, tubes or internal structure of any description. The planes are arranged to fold, thus allowing the storage of the machine in a very small space, and owing to the special design of the wings, the overall height of the machine is kept smaller than usual. The weight of the machine fully loaded is 12,000 lbs.—which includes fuel for 6½ hours' flying and a useful load, in addition of the crew, of 3,200 lbs.

The planes follow the same general arrangement as previously employed on the large four-engine machines. The spans of the top and bottom planes are

(*Continued on page* 561)



The Vickers Viking Amphibian, an airplane type that can make landings on either land or water with perfect safety

Digitized by Google

Simple Model Steam Engine and Boiler Construction

By Wm. A. Helms

PART III

THE readers who have built the engines described in the past issues successfully have no doubt, after a time, experienced a lack of interest in the model in its present state. They would not be good model engineers if they did not try to improve upon it, especially as they become more efficient in the use of the tools. The first step taken is usually to add some arrangement to make the engine run in either direction. Therefore I shall deal in this article with the reversing arrangement of the single acting oscillating engines and with the multiple cylinder type.

It is extremely simple to reverse oscillating cylinders. It is this reason which makes them sometimes preferable in model work. Reversing can be accomplished by two different means. (1.) By employing a four-way cock, which is placed between the boiler and the engine. (Fig. 1 clearly shows the principle.)

(2.) By a false port face, which according to its construction is either placed between the cylinder and steam block (see Fig. 2) or at the back of the steam block (see Fig. 3). The ports are so arranged that the moment the reversing plate is moved it instantly changes the direction of the steam.

While theoretically the four-way cock seems to be the simplest method, the model engineer who undertakes to make one will find it to be a very troublesome task, especially for the beginner. For this reason I will pass this method and come to the reversing plates.

To make the reversing plate shown in Fig. 2, we take a 1/8 in. or 5/32 in. piece of sheet brass and cut out the false port face to the shape given in Fig. 2A. Having finished this we find the center for the pivot pin hole and take the distance from the center of the pivot pin to the center of the cylinder steam port, and describe a circle on the false port using the center of the pivot pin as center of the circle with that distance as radius. The three port holes of the reversing plate are found on that radius.

Having found the centers of the steam ports and drilled them, we recess the outlined grooves to half the thickness of the plate and drill the pivot pin hole. The only difference in the construction of the reversing engine besides the reversing plate is the arrangement of the steam ports in the steam block. They are placed vertical to the center of the line instead of on either side (see Fig. 2b). Fig. 2c shows a cut through the reversing plate, and Fig. 2d the reversing plate placed on the steam block to give a clear view of the different steam ports and of the passage of the steam.

The third and simplest method for reversing an oscillating cylinder also employs a reversing plate, but the latter is placed on the outside of the steam block instead of between the steam block and cylinder (see Figs. 3 and 4). This makes it necessary to face the steam block on both sides. The only difference in the port holes is an additional port for the entrance of the steam. The latter is drilled half way into the back of the steam block a little above the pivot pin. This hole meets the steam passage which is drilled through the side of the steam block (see Figs. 3A and 3B). Fig. 3C shows a front view of the reversing plate. The shaded portion is to be recessed to half the thickness of the plate. Fig. 3D is a section cut of the reversing plate. Figs. 3E and 3F show how the movement of the reversing plate changes the direction of the steam. Fig. 4 gives a sectional cut of a single acting single cylinder oscillating steam engine with reversing plate attached.

THE TWIN CYLINDER OSCILLATING ENGINE

We have now finished the single acting single cylinder oscillating engines and come to the twin cylinder

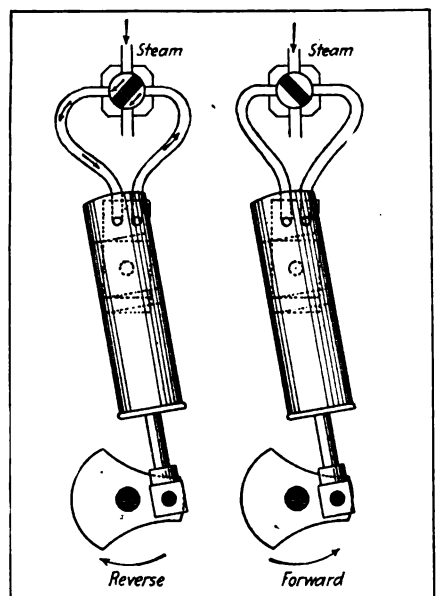


FIG.1. Reversing Oscillating Engine by Means of of a Four Way Cock

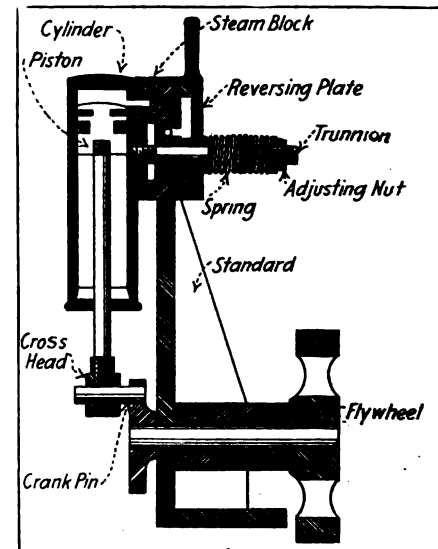


FIG.4. Section of Single Cylinder Reversible Oscillating Engine

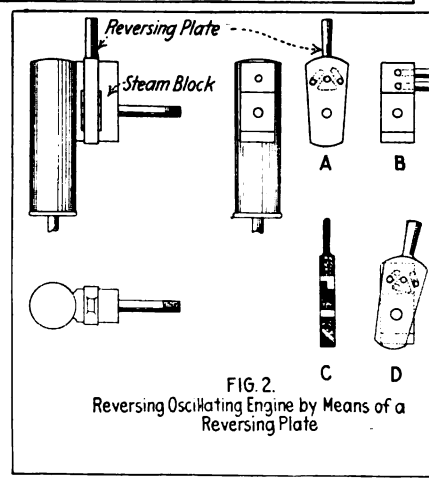


FIG. 2. Reversing Oscillating Engine by Means of a Reversing Plate

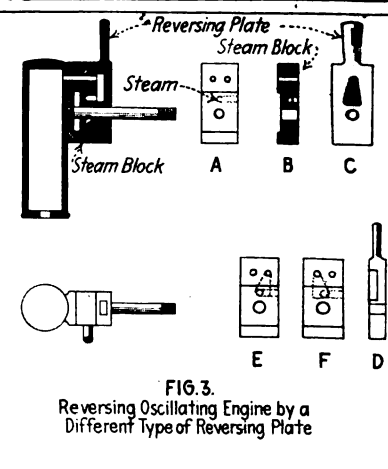


FIG.3. Reversing Oscillating Engine by a Different Type of Reversing Plate

Digitized by Google

type. Fig. 1A gives a front view of the engine with the left cylinder removed to show the steam block and the main frame which are cast in one piece. The dimensions of the latter are given in Figs. 2A and 2B. Fig. 1B shows a cut through the center of the engine with the left cylinder in place and Fig. 1C shows a top view of the engine with the left cylinder removed.

This engine is an ideal type to propel model boats as large as three feet, as the height of the engine is as low as possible. It is 2⅜ in. from the base to the cylinder top. Another important factor is that the weight of the engine is kept very low. The main frame is a light bronze or brass casting. The dimensions of the cylinders are ½ in. bore by ⅞ in. stroke. They can be either built up as described in the July issue or turned out of a bronze casting.

Fig. 3A shows a cut through the cylinder, piston connecting rod, and cross head. Fig. 3B shows the outside of the cylinder with the steam port and bearing surface. Fig. 4 shows the component parts of the cylinder and gives their dimensions. Note that the cross heads are halved to prevent angular thrust on the crank pin.

The flywheel is exceedingly heavy, with the weight placed in the rim to insure a steady and smooth running engine. Fig. 5 gives the dimensions of the flywheel, crankshaft and crank pin. The crankshaft is made out of a 3/16 in. steel rod. The crank pin is either turned out of a casting or out of a piece of brass.

In the next article I shall describe a suitable boiler for this engine and a 39-in. cabin cruiser which uses the boiler and engine as its steam plant.

NEW EGYPTIAN OIL FIELD

PROSPECTS of a good supply of oil fuel for Egypt are very promising. At the beginning of the war the Anglo-Egyptian Oilfields was the only one of the various companies formed to search for oil in Egypt that remained in operation, and down to 1914 the only finds of importance had been at Gensah, where none of the gushers that had been struck had given anything like a permanent yield. But the new field discovered in 1914 at Hurgada has been proved to be of singularly regular formation, and its yield has steadily increased, until, according to recent reports, it now stands at over 15,000 tons of crude oil a month. Meanwhile, the Suez refinery has been enlarged and there is every reason to hope that as much oil will shortly be available for internal consumption as can be dealt with by the company's existing facilities.

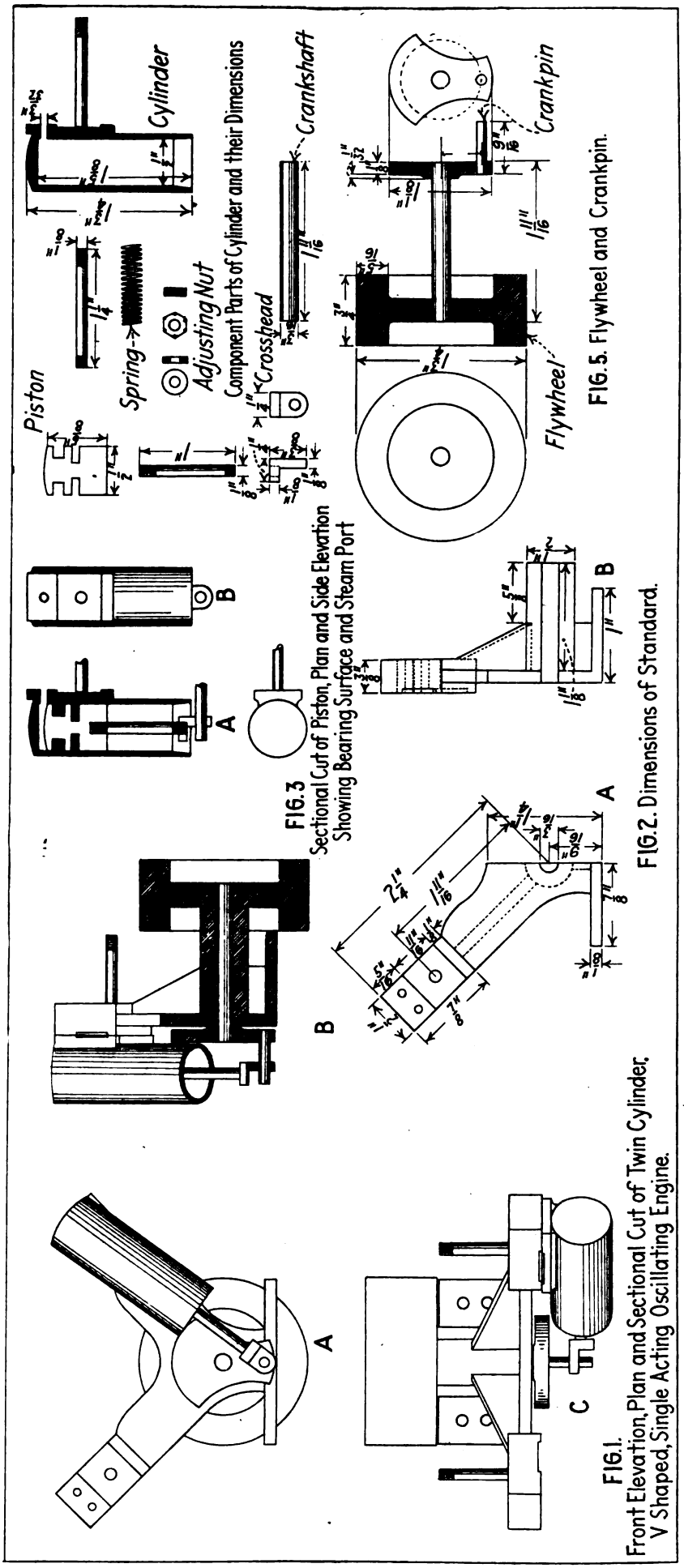


FIG. 5. Flywheel and Crankpin.

FIG. 3 Sectional Cut of Piston, Plan and Side Elevation Showing Bearing Surface and Steam Port

FIG. 2. Dimensions of Standard.

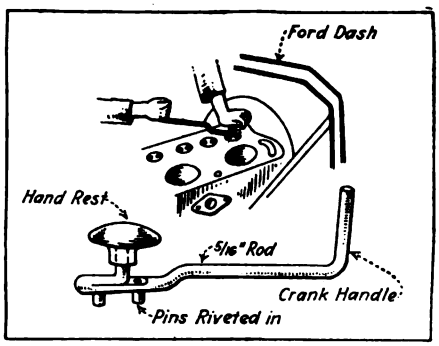
FIG. 1. Front Elevation, Plan and Sectional Cut of Twin Cylinder, V Shaped, Single Acting Oscillating Engine.

Digitized by Google

EVERYDAY MOTORIST

SIMPLE VALVE-GRINDING TOOL

MOTORISTS and repairmen who have tried to grind in the valves in the rear cylinder of the Ford engine realize that it is somewhat of a task to oscillate the valve head with the usual form of valve-grinding tool that will handle all of the other valves properly.

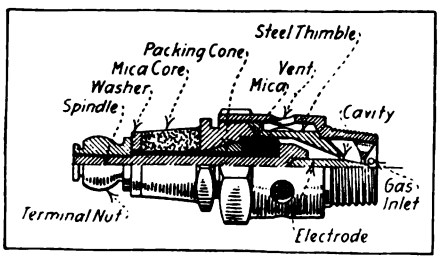


A simple valve grinding tool

A simple tool that may be easily made is illustrated herewith. This may be bent up of cold-rolled steel stock 5/16 or ⅜ inch in diameter. The shape of the tool can be readily ascertained by referring to the sketch. A slight off-set is provided to carry the hand rest, which may be made of a small door-knob or easily turned out of hard wood for the purpose. This hand rest should be of free fit on the upwardly extending off-set. A grinding handle is provided and the pins which fit in the holes in the valve head are easily inserted in a slightly flattened section and are riveted in place.

SELF-CLEANING SPARK-PLUG.

THE B-G spark plug, which is shown herewith, is a practical self-cleaning type that has been widely used in aircraft work and that is now being offered to automobilists. The points are cleaned by the gas movement produced by the peculiar construction. Some degree of cooling is provided by means of

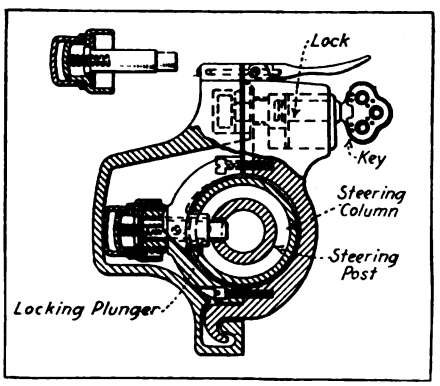


A self-cleaning spark plug

air vents to the chamber surrounding the steel thimble. As the exploding gases are in contact with this thimble, the internal heat is conducted to the outside and dissipated. A cavity may be noted near the bottom, extending up into the steel thimble to a point near the center, where the space is filled by the mica insulation. Into this cavity four gas inlets extend, in addition to the gap around the sparking point. During the compression stroke, fuel gas is forced through all of the entrances into the cavity and with sufficient speed through the spark gap to clean it thoroughly just prior to ignition, it is claimed. When the spark jumps, the gas within the plug explodes, along with the charge in the cylinder, and during the power and scavenging strokes the confined and expanding gases rush out of the plug cavity and blow out any carbon or oil that may have accumulated.

A STRONG AUTOMOBILE LOCK

THE ever-increasing activities of the car-thief naturally call attention to devices designed to curb the crook's ambitions in a number of ways. One of such locks shown in accompanying illustration operates by making it impossible to turn the steering wheel of the car after the lock had been closed.



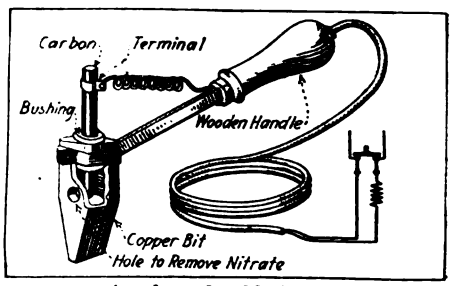
A strong automobile lock

The lock is secured to the steering column by a hole drilled through it as well as through the steering tube or post and locking action is by means of a steel pin which enters hole in steering tube. The location of the device, immediately under the steering wheel, makes it easy of access. The locking plunger is engaged by closing down the removable cap piece which is held by a hinge joint at one end and a lock at the other. When the device is in the unlocked position the cap is swung back and the spring pressed plunger comes out of the hole made to receive it in the steering post.

From the standpoint of traffic authorities this mode of automobile theft prevention has a number of advantages, one of which is that its application does not make it altogether impossible to move the car for a short distance, as in case of fire or other emergency. The thief, however, even though he might succeed in starting the car, could proceed only in a straight line, something which would make it very difficult to get away with the car.

ELECTRIC ARC SOLDERING BIT

THE following description of a novel soldering bit that can be easily made by the experimenter is by B. A. Briggs and is reproduced from a current issue of *Power*. Most electric soldering irons are constructed so that they are heated by the current passing



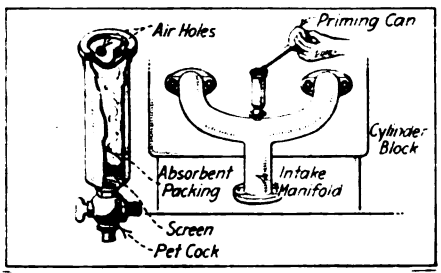
Arc heated soldering bit

through a resistance coil inclosed in a tube attached to the top of the iron. The illustration shows an electric soldering iron that is heated by an electric arc in the iron itself. A hole is bored in the center of the iron having a diameter equal to the outside diameter of the tube of a battery bushing down to where the iron begins to taper. A standard battery porcelain bushing B is placed in the hole and a ⅜-inch arc-lamp carbon C is placed in the bushing and allowed to come down in contact with the bottom of the hole, then the carbon is withdrawn about ¼ in. to establish the arc. The iron should be connected to a 110-volt circuit and resistance enough connected in series to keep the current down to between two and three amperes. About 30 ohms will be sufficient. This resistance may be made of about 600 feet of No. 18 B. & S. iron wire and connected in the circuit, as in the figure. The soldering iron is connected to the circuit with the positive terminal on the carbon, as shown in the illustration. The carbon is held in place in the bushing by small metal wedges, and adjustment of the carbon is made by tapping it down to give the desired length of arc. A second hole is bored at right angles to the first so as to allow the arc to be cleaned of the nitrate that forms around it.

Digitized by Google

SUPPLEMENTARY CARBURETOR

THE electric motor starter has not made the progress abroad that it has in this country and many cars are used in England and France that have no means of starting the engine other than the usual hand crank. As many trucks in this country are not fitted with electric starting means, a description of a device which is used in England to facilitate starting the engine should be of interest. This is known



Supplementary carburetor

as the Blake supplementary carburetor and is an extremely simple fitting, the construction of which can be readily ascertained by studying the sectional view in the accompanying illustration.

The fitting is made of tubing having a detachable pepper-box top at one end and a cock at the lower end. The tube is fitted with packing material which is used to vary the suction for different engines by being packed in more or less tightly as conditions demand. The top is formed in the shape of a cup and it will be apparent that any gasoline or ether used as priming fuel dropped into the depression will sink down into the absorbent packing material, which may be asbestos fiber or of similar substance. The cock is opened when it is desired to start the engine, and air entering in through the holes in the top of the device will become instantly saturated with fuel particles in passing through the packing material, which naturally has become soaked with fuel.

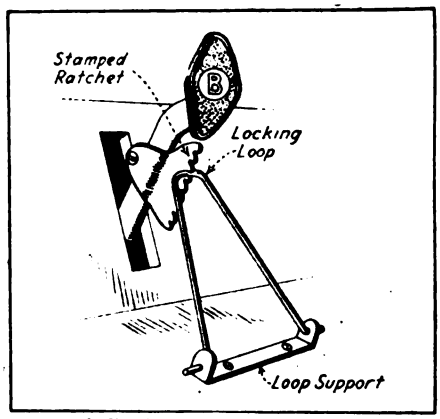
The device screws into the center of the intake manifold and is readily installed on practically all engines. On those forms where the manifold is cast integral with the cylinder block and the carburetor bolts against the block, the supplementary carburetor may be fastened into the carburetor by being placed between the throttle valve of that member and the passage in the cylinder block. A device of this kind can be fitted on engines that are equipped with electric starters, as it will make starting much easier in cold weather or damp weather and reduce the strain on the automobile battery.

A FOOT BRAKE ACCESSORY

THE attachment shown in the illustration is interesting, as it provides a simple means of holding a Ford car on steep gradients. It consists of a ratchet clamped by a screw to the arm of the brake pedal and a wire loop hinged to a small bracket screwed to the footboard. When the brake pedal is depressed the loop falls into one of the notches in the ratchet and locks the pedal in that position. To unlock the device the pedal is depressed slightly, when the loop may be lifted out of engagement and swivelled back out of the way against the floor. In cases where a thick floor mat is used, the position of the loop can be raised slightly by fitting it into another pair of holes in its bracket. The device is of English origin.

IMPROVEMENTS IN VALVE MECHANISM

MUCH ingenuity has been displayed in making the valve actuating mechanism of the modern car as silent as possible, and there is no doubt that a quiet running engine appeals enormously to the average owner-driver. One of the difficulties of obtaining silent valve mechanism is the necessity



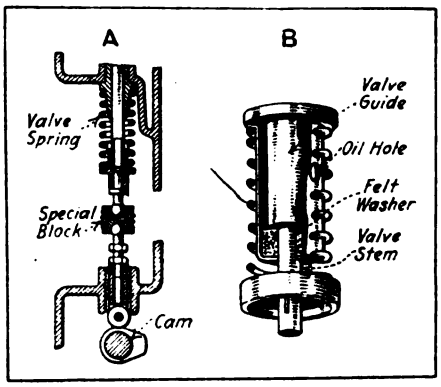
A Ford foot brake accessory

for clearance between the valve stem and the valve tappet. The coupling here described has been designed expressly to give quiet running by an English inventor.

The illustration, which is taken from the *Autocar*, is self-explanatory and, as will be seen, the ordinary tappet is replaced by a pair of blocks with special curved faces. These curves are struck from centers eccentric to a line drawn through the pivot centers of the blocks. The blocks are mounted on spherical ends attached to the valve stem and valve tappet and are held apart by a light spring. The action is as follows:

When the valve is at rest, the blocks are in contact eccentric to their pivot centers, but when pressure is applied—that is, when the valve is being raised—the curved faces are caused to roll together until the point of contact is concentric with a direct line of pressure. In the arrangement shown, the blocks are of circular formation, and a tongue and groove are used to maintain the blocks in correct relation.

The device shown at B is intended to prevent air leaks, rattle and wear in the exposed valve mechanism of engines made several years ago, before the importance of enclosing the valve operating mechanism was recognized. The construction is very simple, an oil-soaked felt washer being carried in a special stamped cup member held in place against the cylinder by the valve spring as indicated. It is specially good for engines having worn inlet valve guides.



Improvements in valve mechanism

POINTS TO WATCH

ASBESTOS packing is used on the flanged joints of the exhaust pipe. These gaskets can be had in various sizes to fit standard manifold connections. If they are not available asbestos board will answer the same purpose. It should be soaked in water and rubbed with graphite before it is put in place. Inlet manifold joints can be made tight with shellac.

The joints in the cooling system, such as unions, flange elbows, etc., may be smeared with read lead and oil. At this season of the year, the owner should go carefully over the water connections to make sure they are tight. It is a good plan to get under the car occasionally and inspect the radiator for small leaks. There is but one real remedy for such leaks, solder.

CASING MUST BE DRY BEFORE REPAIRING

CERTAIN porous conditions resulting from moisture in the casing to be repaired can often be traced to numerous tread cuts through which water has penetrated and soaked the fabric of the carcass. Before repairing, casings should be carefully inspected for tread cuts and consequent moisture in the carcass and allowed sufficient time to dry thoroughly. If there is moisture in the casing when it is built up the heat applied in curing will cause steam to form between the piles and the result will be bubbles and an imperfect cure. — *Goodyear News.*

At Lakehurst, N. J., a hangar for rigid dirigibles is being built whose inside dimensions are 803 ft. by 262 ft. floor area and 172 ft. in height. It will be the largest roof in America with an absolutely clear space below it, for, of course there can be no intermediate supports.

Digitized by Google

The Romance of Tungsten

By E. W. Davidson

A CASUAL look at the filament of the incandescent lamp in your library or at the tiny spark coil or breaker box contacts on your automobile brings no suggestion of the romance of science which lies back of those devices. It is the romance of tungsten, one of the heaviest of metals, a metal nearly 140 years old but which resisted the efforts of mankind to make use of it in its pure state for about 130 years.

But the service pure tungsten has rendered the world in the last decade since it was "conquered" is almost too great for calculation. Tungsten in its various forms reduced America's electric light bill a billion dollars a year and more than double the usefulness of the incandescent lamp. Ductile tungsten kept the automobile industry alive during the war. It helped make possible the Coolidge x-ray tube with tungsten targets which tremendously increased the value of the x-ray machine to mankind. With it the pliotron was built so that wireless telephony could be developed to a useful and dependable point. With it the tungar rectifier was created so that owners of automobiles could charge their cars in their own garages by simply plugging into a light socket. With it phonograph needles are being made more than 50 times as good as the steel and the fibre needles, heretofore the best that could be produced.

Tungsten bullets might have served in the recent war as projectiles hard enough to pierce the heaviest armor the Germans could put on their air-craft, for a few were made to prove their usefulness in that capacity, but the plan to use them was given up after a less expensive way to accomplish the result was discovered.

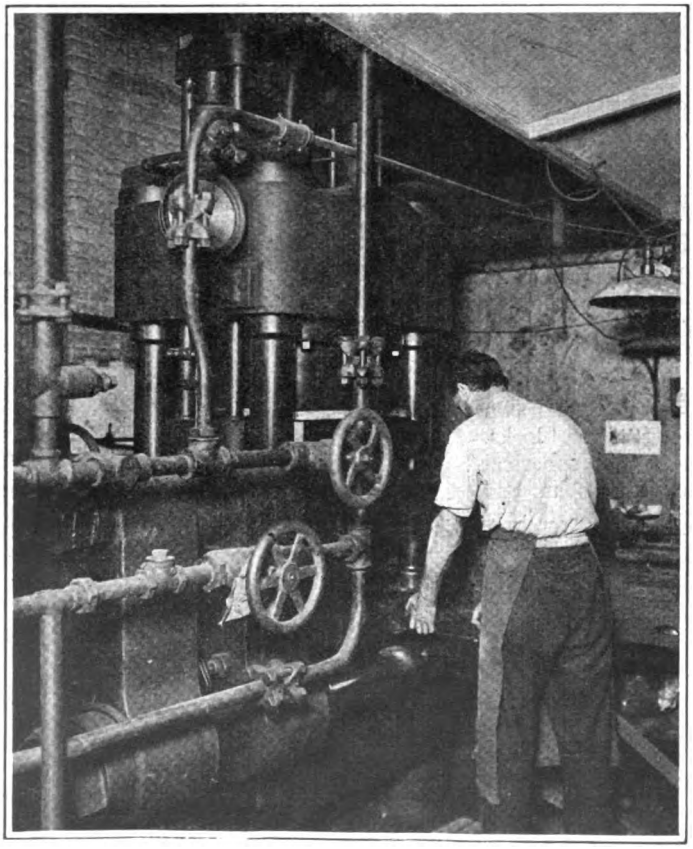
This Hardest and Heaviest of Metals Was Brittle and Therefore Unworkable in Its Pure State for More Than a Century After Its Discovery Until Dr. W. D. Coolidge Made It Ductile. Tungsten Saves This Nation Alone a Billion Dollars on Its Annual Electric Light Bill and Otherwise Benefits Mankind — EDITOR.

Before the war only a few thousand tons of tungsten ore were mined in all the world and the price of raw tungsten ranged around 90 cents a pound; but with the war came a tremendous demand for tool steel hard enough to work at high speed though red hot. Tungsten was required as an alloy to make such steel.

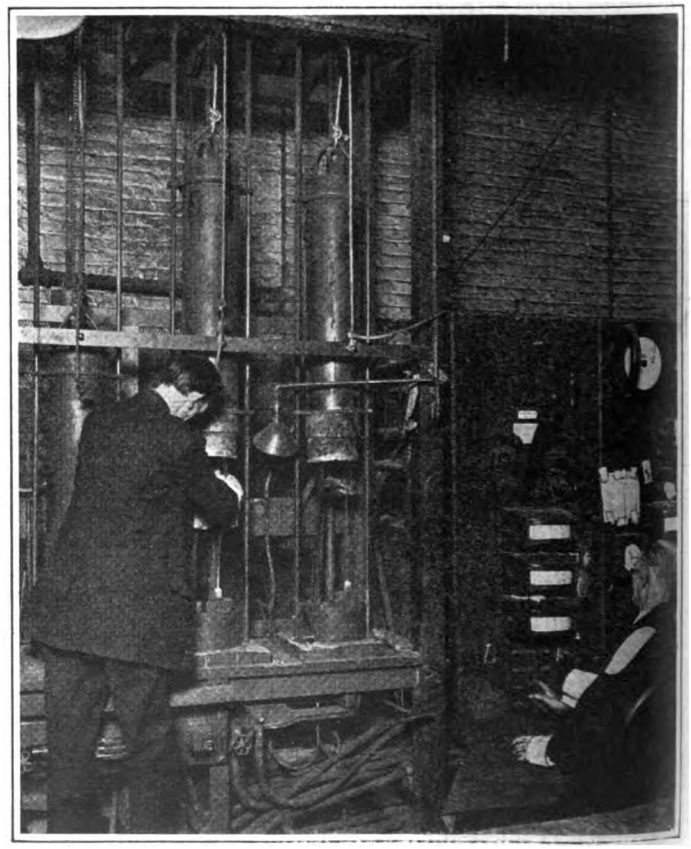
The price rose steeply when the supply diminished before the sudden demand until it reached $7 or $8 a pound. The world's production in 1918 mounted to 35,800 tons. The control over the sources of it was 59 per cent American and 35 per cent British. The price and production slumped with the end of the war until today raw tungsten can be bought for a little over a dollar a pound.

Most of the adaptions for tungsten are due to a discovery made by Dr. W. D. Coolidge, a physicist in the research laboratory of the General Electric Company of Schenectady. He was the first man to find a way to work this most brittle of metals. He made it ductile and thereby hangs this tale.

For about 100 years tungsten had been known before it was put to any use whatever, even as a mere alloy. Its presence was first noticed by Scheele and Bergman in 1781. They found traces of it in a metal called scheelite and coined the name "tungsten" for it from the Swedish "tung" meaning weighty and "sten" for stone. In 1783 three Spaniards discovered tungsten in the mineral Wolfram. To this day



Pressing tungsten powder under 16 tons pressure into 16 by ¼ by ¼ inch slugs. This is the first stage in working tungsten. The slugs are too crumbly to be handled



Putting a tungsten slug into treating "bottle" where an electric current is passed through it in a hydrogen atmosphere. This makes the tungsten a degree stronger

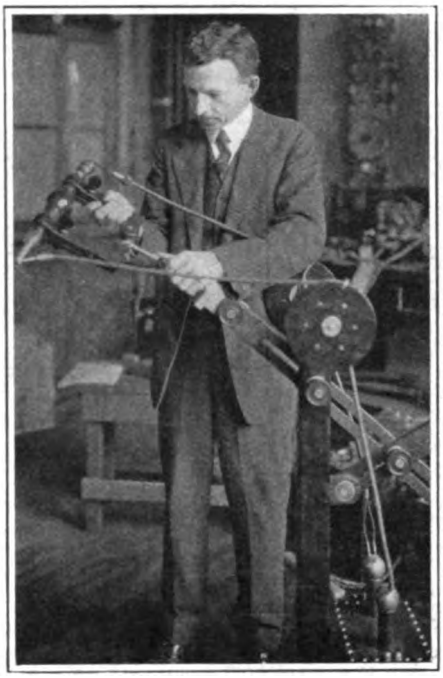
Digitized by Google

there is little tungsten taken from any other minerals. It is found in small quantities in Cumberland, England; Limoges, France; and in parts of Connecticut and North Carolina, but most of it comes from Colorado, and China.

Extracted from these minerals and pulverized, tungsten was found useful in certain steel alloys. Mixed with an adhesive it was made into lamp filaments that were efficient but exceedingly fragile. However no metallurgist was able to discover a way to work tungsten separately. This was because in pure metallic form it is absolutely brittle. It confounded all experts with its utter intractibility. The established processes in working other metals proved useless with tungsten.

Perhaps it was this very thing which finally brought about the harnessing of this valuable metal. Because it had so steadfastly refused for more than 100 years to respond to the arts of the metallurgist, Dr. Coolidge, with the instinct of the true scientist pioneering in untrodden fields, tried ways that any metallurgist would have thought an idle waste of time. The result was that after long effort and many failures he finally made tungsten ductile and workable so that it could even be drawn like wire down almost to the gossamer fineness of spider's web and still be strong enough to permit its winding and curling into almost any shape. When he had done that he had conquered tungsten and made possible many devices which could never have been built without ductile tungsten.

The radical difference in workability between tungsten and normally ductile metals, the difference which nonplussed the scientific world for more than a century may be explained thus: Pure tungsten pressed into bars is brittle after the very treatment which makes



Dr. W. D. Coolidge who made tungsten ductile. In this photograph he holds part of the Portable X-ray which is another of his triumphs

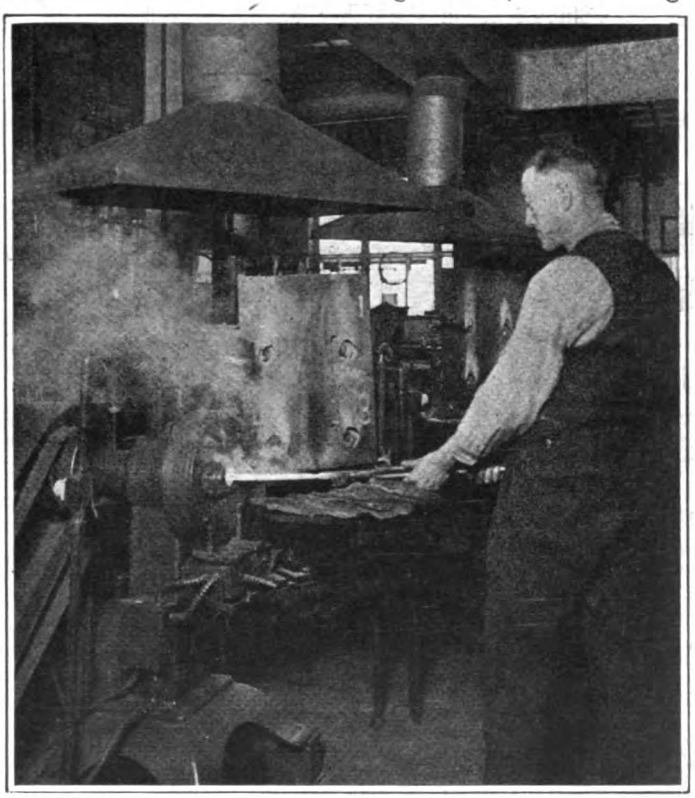
other metals most ductile. It differs from all other ductile metals in that when composed of grains it is extremely brittle at "room temperature," but is ductile at this temperature when fibrous.

Many an experimenter had sought to work tungsten mechanically. But none had ever succeeded in getting this intractable metal into a form suitable for mechanical working. Moissan, by an electric furnace method, obtained tungsten in a porous condition which could be slightly compressed and the pores closed up by hammering when hot. However nobody in the world suspected at that time that if tungsten could be obtained and put into suitable condition and then mechanically worked at suitable temperature, its inherently brittle nature would gradually disappear. But nobody knew how even to make a start upon the problem of working tungsten.

To make any ordinary metal soft it is heated above its annealing point and then cooled down to room temperature. Doing this to tungsten however left it as brittle as ever. Violating all metallurgical rules and working for years with utmost patience, Coolidge discovered the astonishing fact that the only way to make tungsten ductile was to mash tungsten's grains out into fibrosity and thus make the metal ductile cold and this he did by first heating it to a degree below its annealing point and then mechanically working it with infinite pains at a variety of heats each cooler than the one before until the metal got down to room temperature. A similar treatment, if applied to ordinary metals would destroy their ductility. He worked out a process which, if followed without the slightest deviation, stretched the grains out, thus attaining

Squirting pulverized tungsten ore into furnace which removes oxygen and produces pure tungsten in powder form ready for compression into bars which are hammered and then drawn into finest wire





The operation of putting red hot tungsten bar through one of the many swagers whose revolving hammers chatter on all sides of the bar reducing it to smaller and smaller diameter is shown at the right

Digitized by Google

ductility. But if the working varied from his process, failure resulted. The tungsten would smash to flinders at a stroke when it got cold. This elaborate and delicately measured system of working tungsten is a scientific triumph. Thus was tungsten finally made ductile.

The greatest immediate use for it was in the making of electric lamp filaments. Previously the best filament was made of fine tungsten powder, mixed with a binder into a plastic mass which was squirted through fine dies to produce fragile "wire."

This was an enormous improvement over the old-style carbon filament, thanks to the facts that tungsten, with a melting point of 3350 degrees Centigrade will stand more heat than other metals and its vapor tension is so low that even under tremendous heats its volatile decomposition is slow. Tungsten even in this form made so good a lamp that it saved the American public a billion dollars a year on its electric light bill. But filaments of those days could not withstand the slightest jar during the process of manufacture. They necessarily could not be strongly mounted in lamps.

Pure tungsten, on the other hand, drawn into filaments can stand almost anything. For one thing it is heavier than any other metal. Whereas wrought iron weighs 490 pounds per cubic foot, and lead 708 pounds, tungsten tips the beam at 1193 pounds. Its tensile strength is startingly high. After it has been worked down to drawn wire of about a thousandth of an inch diameter its tensile strength is no less than 600,000 pounds per square inch of cross section. This is greater than the best piano wire.

To produce tungsten from the sheelite or wolframite the ore is fused with alkali carbonates and the fusion dissolved in water. This may be changed to tungstic oxide by adding acid. The oxide, a yellow precipitate, is then filtered off. The tungsten oxide is purified to any desired degree by dissolving it in ammonia and then precipitating by adding acid, followed by filtering and washing.

To use tungsten in lamp manufacture, it is dried, mixed with thorium nitrate solution and then thinned with water into a batter. This is dried and heated at 2000 degrees Fahrenheit for an hour in a silica or fire clay crucible to agglomerate the fine particles into coarser ones. This mixture is reduced by hydrogen at 1800 degrees Fahrenheit into tungsten metal powder.

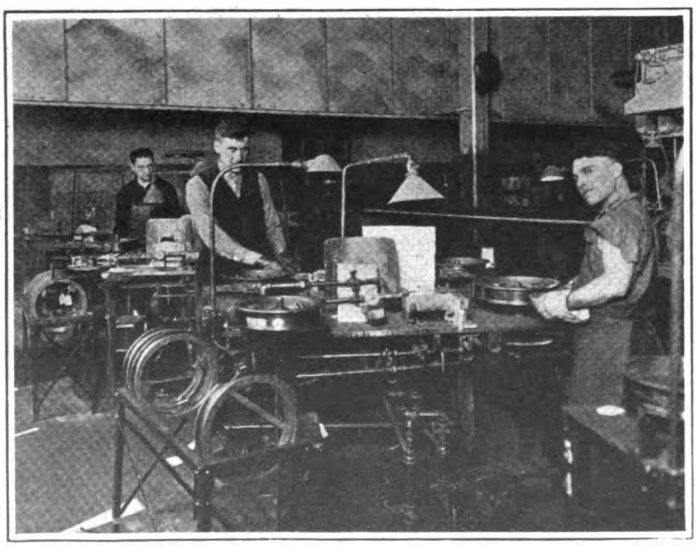
The reduced tungsten powder is poured into a steel mould which is a slab whose face bears a groove a quarter of an inch wide and deep. Under hydraulic pressure of 16 tons per square inch this groove full of powder is pressed into an ingot 16 by ¼ by ¼ inches. The pressure has been exerted on the sides of this ingot, not the ends. The ingot at this stage is too fragile to handle.

The slug next goes into an electric furnace where it is baked at about 2400 degrees Fahrenheit. Now it is strong enough to handle. It is then sintered in a hydrogen atmosphere, the bar being heated for 10 to 15 minutes to about 5000° Fahrenheit by the passage of an electric current through it.

The bar, though brittle when cold, is ready to be worked. It is heated to about 2800 degrees Fahrenheit, and passed through the revolving dies of a swaging hammer which reduces its size and produce it in rods growing smaller and smaller and necessarily longer and



Winding the tungsten wire into incandescent lamp filament coils



After tungsten has been swaged down to heavy wire, the drawing process begins. Here it is being drawn through a gas flame and then through a die reducing it from 0.030 to 0.014 inches. It is tough and thoroughly ductile by this time but is far too large for lamp filaments and must be drawn down again



Drawing tungsten down to finest proportions, about four ten-thousandths of an inch is one-sixteenth of the size of fine human hair. It is used as filament in smallest "bug" lamps. The thread of tungsten passes through lubricant, then through gas furnace which has a diamond die at its end nearest the operator

Digitized by Google

longer as the metal goes through one swaging after another until it gets down to a diameter of three hundredths of an inch. It is now a metal that is ductile and its strength has increased with leaps and bounds so that at a diameter of three hundredths of an inch it can stand a pull in the proportion of 215,000 pounds per square inch of its diameter.

But it is still too large for lamp filaments though wound on drums it appears hardly coarser than linen thread. So it starts into the process of being drawn down by successive stages through diamond dies of smaller and smaller sizes, to any degree of fineness needed. On the drawing machines it unwinds from the feeding spool, passes through a lubricant, runs through a small gas furnace to attain red heat, negotiates the infinitesimal "eye" in the fragment of diamond clamped in its course, and is wound on a receiving spool ready for use.

Various of these fine sizes of tungsten wire are used for lamps of wide range of powers, the finest of them all being used for the tiniest of lamps such as "bug-lights" on automobiles and in flash lights. The diameter of this is 0.004 of an inch. It is six times finer than human hair. The original pressed ingot 16 inches long would produce more than 250 miles of such wire.

Tungsten wire thus produced is what has made the incandescent lamp the thing of power and service it is today in the form of the well known Mazda.

The metal is worked in various other ways for its various other uses, but it never could have been had not Dr. Coolidge spent years in experimenting with it beyond the point where the scientists and metallurgists of the world had written the word "impossible."

ELECTRICALLY PROPELLED BATH CHAIR

VISITORS at various shore resorts in this country that do not wish to exert themselves on the boardwalks are usually seated in light chairs pushed about by an attendant, who walks behind the chair or who is astride a bicycle attached to it, depending upon the construction of the conveyance in question. The accompanying illustration shows a simple electrically propelled chair which renders the occupant independent of any external source of power.

A light storage battery is carried in a special compartment at the feet of the occupant. The rear wheels are operated by a light-power electric motor, which is controlled by a simple switch conveniently placed at the side of the occupant. Two forms of brakes are provided, one of which is electrical, the other being controlled by the foot. The device is steered by a simple form of tiller and the control is so easy that anyone can learn to operate it after a few minutes' instruction.

As the speed of this self-propelled bath chair is very low, not being more than a walking pace, even if the chair should collide with some obstruction, due to the inexperience of the operator, no appreciable damage to either the vehicle or the driver will result.



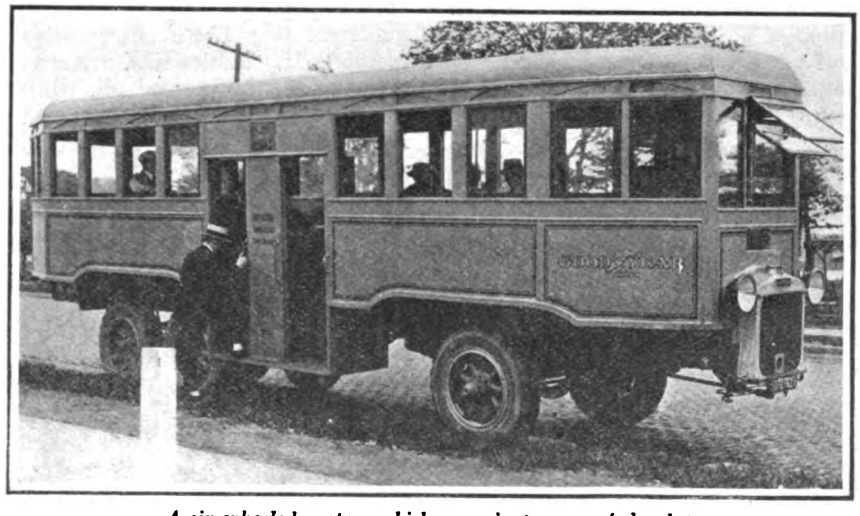
An electrically-propelled bath chair of English design

A SIX-WHEELED VEHICLE

EXPERIMENTS have been carried on by one of the large tire manufacturing companies that have resulted in the development of a special form of six-wheel vehicle in which the usual rear axle is replaced by a truck composed of two axles, each of which is provided with its own driving gearing and which are driven from the power plant at the front end in the usual manner. The use of four rear wheels makes it possible to carry very heavy loads on the pneumatic tires without using tires of excessively large size.

The use of pneumatic tires makes it possible to attain higher speeds with such a heavy vehicle than could be secured with the usual form of solid rubber or cushion tire. Such a design also makes it possible to use the same size tire on the front and rear wheels. The chassis developed by this tire company has been equipped with a special type of car body and is being used in an experimental way to determine its capabilities for passenger transport.

The body will accommodate forty-four passengers comfortably if only its seating capacity is utilized, but if standing room is called on also, it is claimed that ninety people can be carried. The body has a side-door entrance and exit and is operated on a "pay-as-you-enter" basis. It has the usual features with which any tram-car or omnibus is provided, such as adjustable windows, upholstered seats, electric lighting and signal arrangement, etc. The power plant is a six-cylinder, 75-h.p. gasoline engine which is mounted at the front end of the body.



A six-wheeled motor vehicle now in process of development

Digitized by Google

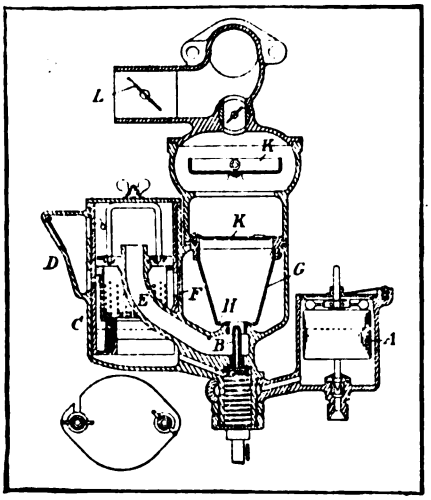
USEFUL AND INTERESTING INVENTIONS
AUTOMOTIVE - MECHANICAL - ELECTRICAL

SAND-MIXING MACHINE

A NEW sand-mixing machine to replace manual labor in mixing sand which has been employed in foundry molding has been invented by Russell C. Stokes of Portland, Ore. The mixing is done by a rotatable drum having sharply pitched spiral blades; these blades are arranged in a manner to allow them to engage and cast material toward the center of the path of travel of the body of the machine. A series of fingers around the central circumferential portion of the drum cast the sand rearwardly in the path of travel in granular condition. The mixing fingers are hinged and are spring-controlled, so that the springs will not be broken should they meet with any unusual resistance. In such cases an automatic mechanism operatively connected with the fingers releases the drum from operative movement. The drum is operated by an electric motor. Less power is required than would be necessary for blades arranged only to stir the sand.—Lester L. Sargent.

PARTIAL COMBUSTION TYPE CARBURETOR

A RECENTLY patented form of kerosene vaporized of the partial combustion type is shown in accompanying illustration which is the invention of an English experimenter, E. W. Thomas of Luton. The construction may be easily understood by referring to the accompanying reproduction of the patent office drawing. This is a vaporizer of the form in which a portion of the fuel is burnt for the purpose of vaporizing the main part. The oil is supplied through a float chamber A of the usual form, and passes to the jet B and the wick chamber C. A supply of air is drawn, through the flap valve D, into the wick



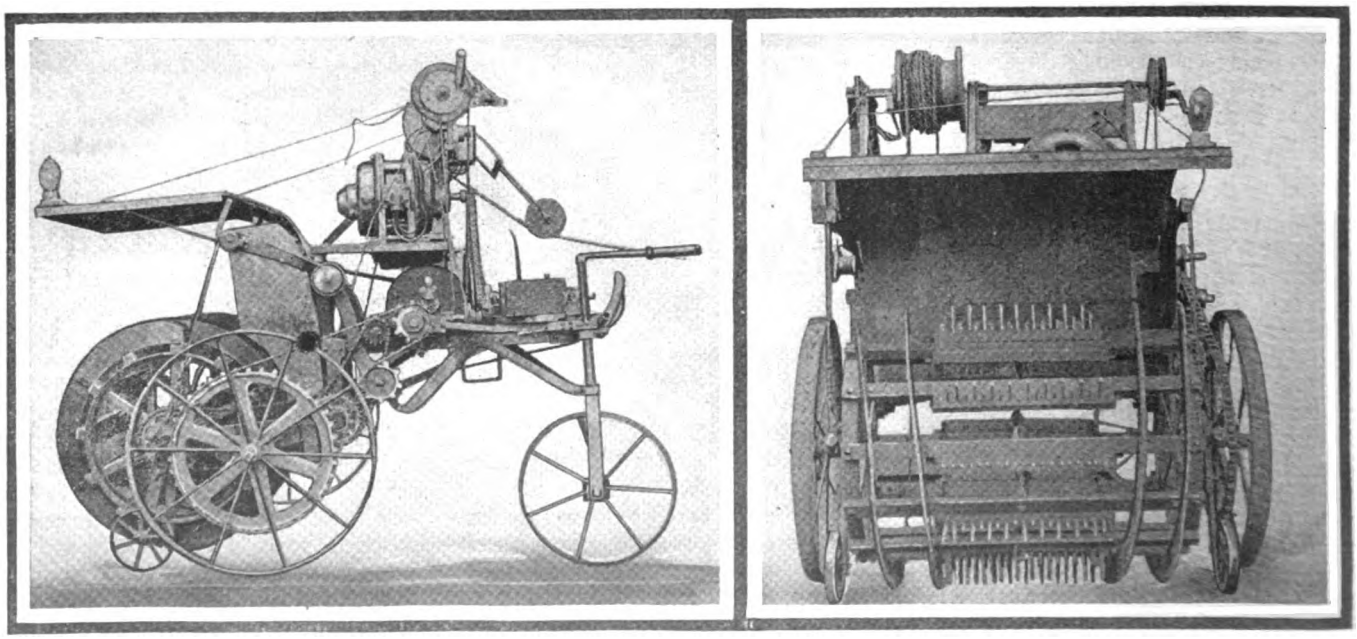
Partial combustion type carburetor

chamber, and there supports the combustion of part of the oil. The products of combustion pass, by the passage E, to the neighborhood of the jet and by the opening F to the exterior of the vaporizer G. These latter escape by the ports H. Baffles K K are arranged to intercept unvaporized oil, while air for the combustion of the resultant gas admitted at L, because the vapor coming from the producer portion is much too rich for energetic combustion in the explosion chamber of the engine and it must be thinned down by admitting auxiliary air.

THE "WEB" NUT

THE ordinary hexagon nut is such a common object that few people give a thought as to whether it is the last word on the subject. As a matter of fact, an English firm has brought out an improved nut for which several advantages are claimed, especially for use in connection with aircraft. The general arrangement of the "Web" nut, as it is called, can be gathered from the sketch. It consists of a barrel with a flange at the lower end, and four webs arranged at right angles. The webs permit of the nut being screwed up or loosened by means of the special spanner, which is simply a short tube (with slots to fit the webs) attached to a handle, and the positive grip which is obtained makes the nut easier to tighten or slacken than is the ordinary nut.

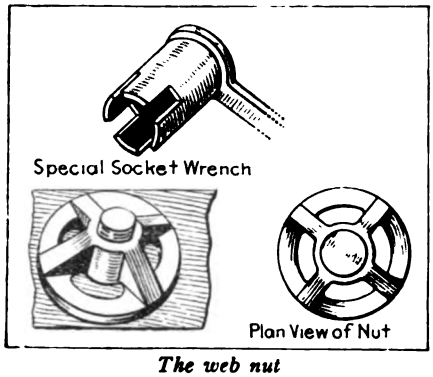
It will be noticed that four slots are cut between the webs. Apart from the fact that this lightens the nut to a certain extent, it also permits of the nut performing the double function of nut and lock-out. When used on metal it is claimed that slight oxidization is permitted opposite the slots, and this is sufficient to prevent the nut working loose. Again, when used on wood, the



Sand-mixing machine for use in foundries invented by Russell C. Stokes of Portland, Oregon

Digitized by Google

nut when screwed up allows the wood to swell into the slots just sufficiently to hold the nut and prevent it turning. As the nuts weigh less than those of

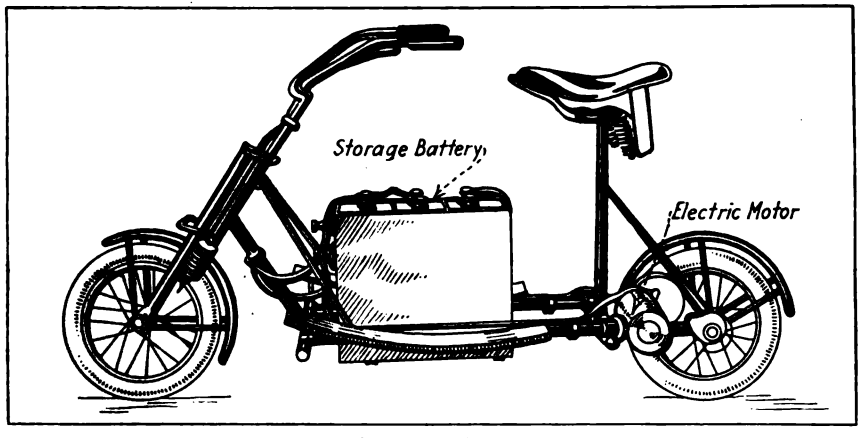


The web nut

ordinary design, and in ordinary cases render the use of a lock-nut unnecessary, it is possible to save a considerable weight by their use. The nuts are made in a wide range of sizes.

ELECTRIC MOTOR SCOOTER

THE experimental model of electric scooter illustrated here has been brought out in England and will attain a speed of 14 m.p.h. and cover about 40 miles on a single charging of the storage battery. The frame of the scooter is of duplex tubular construction so that a cradle is formed in the center of the frame. A ½ hp. electric motor, which with a reducing gear forms a single unit is bolted to the rear part of the frame and drives the rear wheel which is 12 in. in diameter, through a small chain. It is expected that the diameter of the wheels will be increased to 18 ins. when the scooter is regularly placed on the market and the motor may be incorporated in the rear wheel. The battery which delivers current at 8 volts, weighs about 112 lbs. The cradle formed by the spreading of the two frame members supports the battery, which is readily detachable from the frame and can be moved on rollers to the charging point. It is expected that a charging plug will be provided on the frame of the commercial machines, thus making it possible for the battery to be charged without removing it. The control of the current from the battery to the motor is obtained by turning the right grip on the handle bar. A motorcycle saddle and footboards of ample size are included in the equipment.



An electrically-propelled motor scooter

A MOLDING MACHINE WHICH WHICH THROWS THE SAND

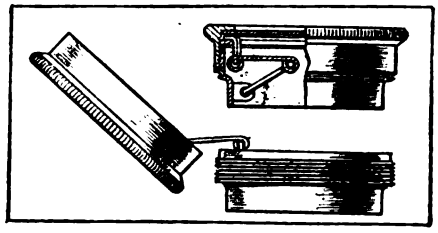
It will be possible before long to pour a casting without the use of a mold, so rapid are present advances. We have molding machines which do the work of several molders and now we have a sand throwing machine for filling molds. The experienced molder knows the effect and the practical value of throwing the sand in place, a handful at a time. So thrown the sand needs no further ramming. A machine to do this more expeditiously and with equal precision has been designed, and, after passing the test of several months experience in some of the Chicago foundries, has been put on the market.

The sand is thrown on the mold with considerable force by mechanical means. Hence a large quantity can be handled in a unit of time, so that finished molds should be turned out quickly. Obviously the density of the ramming can be regulated by controlling the speed of the impeller. The essential element of the machine is the throwing head, which is mounted on a double-jointed arm, allowing it to be swung into any required position over the mold. This head is connected by a shaft to an electric motor which runs at high speed. It is cast with three arms, on one side of which is a pair of brackets, to which the impeller is bolted.

When in use, the whole of the head is enclosed in a combination cast-iron and sheet-iron hood. The sand entering from a chute at the top, is violently ejected by the rapidly revolving impeller through a hole in the underside of the hood. For ordinary gray iron, a suitable speed is from 1,200 to 1,400 revolutions a minute; for steel castings a higher speed is required. The sand may be rammed at densities over the different parts of the pattern by passing the head slowly or quickly over the parts. Two standard types, one a tractor, the other stationary, are constructed.—*Scientific American.*

SCREW FILLER CAPS

TO prevent loss of the cap when disconnected, it is provided with a jointed link, one end of which is hinged to a lug within the filler-neck, the other end being hinged to lugs on a member rotatable within the screwed cap as outlined in accompanying illustration. When the end of the cap is of metal, this member may rotate around a pin in the end face of the cap. When the end of the cap is a glass disc, the member can be, as shown, a ring retained between the cap. The jointed link permits the cap, when unscrewed, to be swung clear of the filler aperture and also to accommodate itself to the location of the cap on the filler neck for engagement of the threaded parts. This forms the subject of a recent British patent.



Screw filler cap

It has been seriously suggested that to economize in heating a house the chimney area, where open fires are used, should be restricted. It is claimed that with a large open chimney five to ten changes of air per hour may occur. Smoking chimneys are recognized as a source of great discomfort and damage from contamination of the air. Frequently it is said that there is a great loss of fuel due to the carbonaceous smoky particles, but one writer says that smokeless chimneys may indicate waste also if they are kept smokeless by the introduction of a great excess of air. Smoke, it is claimed by the same writer, only indicates one or two per cent waste of fuel, a smokeless chimney may indicate much more. The open-hearth fire, however, is coming to its own, as some recent experiments by the English Fuel Research Board show that 60 to 70 per cent of the heat in an open fire is usefully employed in warming the room itself and the general fabric of the building. Of the total heat of the coal no less than 20 to 25 per cent goes out into the room as radiant energy and with coke as much as 35 per cent may be so radiant.

Digitized by Google

Simple Keys and Keyways

Common Forms of Keys Used in Mechanical Work and Suggestions for Making Keyways Without Special Machine Tools

By Kenneth Alton

IN all machinery, and especially in automobiles and other automotive apparatus, numerous parts which must be removed from the pieces to which they are fastened and by which they are actuated when the mechanism is dismantled are held by a method of fastening called "keying." Various forms of keys are shown at Fig. 1, that at A being a form made from ordinary key stock which may have either rounded ends or square ends depending upon whether the key is to set into a keyway machined into the center of the shaft or at one end. If the keyway comes

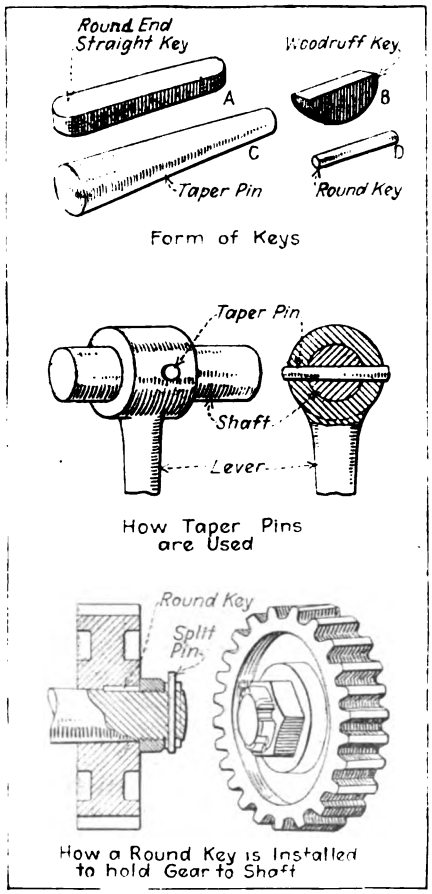


Fig. 1—Common forms of keys used in mechanical work

in the middle of the shaft, a round end key such as shown at A is generally used. If the keyway is at the end of the shaft, the key is apt to be a form having square ends or it may be slightly tapering on its upper face and have a projection at its outer end by which it may be removed. Such a key is called a gib key. Key stock is procured in various standard sizes and is usually made smooth enough when manufactured so that no great amount of fitting is needed to insert it in the keyway.

The key shown at B is known as the Woodruff key and is a very popular form in automobile and even in machinery construction. It is commonly used for securing such parts as gears, cams, and rocker arms to shafts. The taper pin shown at C is a favorite method of retaining brake actuating and control levers to the shaft operating them. The straight, round pin shown at D may be used in two ways; it may be driven entirely through a hole in the shaft and the hub of the lever and then headed over or it may be driven into a drilled hole which is made after the gear or piece it is to hold is in place on the shaft, the hole being drilled in such a way that half of it is in the gear and the other half in the shaft. The use of a taper pin is clearly shown while that of the round pin or key shown at D is also outlined. The half round keyway for the Woodruff key is shown in the taper end of the shaft outlined in Fig. 3 as is the method of making a template to obtain the radius of the Woodruff keyway when it is desired to fit a new Woodruff key or to determine the size of the keyway if the old key is lost.

The method of making the taper pin lock is a simple one. A straight hole is drilled through the boss of the lever and the shaft, the drill size being the same as that of the small end of the taper pin. Taper reamers may be obtained to conform to the taper of standard taper pins and these are employed to produce the correct taper in the straight hole in order that the corresponding taper pins may be a tight drive fit in both shaft and lever boss.

Laying Out a Keyway

The method of laying out a keyway when the rounded end key shown at Fig. 1 A, is to be placed in a shaft is shown at Fig. 2 A. The outline of the key is scribed on the shaft, care being taken to have the curved end a half circle whose radius is equal to half the width of the key. For example, if the key is supposed to be one-quarter inch wide and two inches long the first operation will be to describe a straight line along the shaft and to indicate thereon the useful length of the key, which is that of the straight portion, by center punch marks on the line. The dividers are then set to one-eighth inch radius and circles are drawn using the punch marks as centers. The sides of the circles are then joined by lines parallel to the center line. The next operation is to drill a series of holes into the shaft with a 7/32" drill as shown at Fig. 2 B. These are cut out by means of chisels such as shown at Fig. 2 C. The operation is started with a narrow chisel, followed through with the medium width chisels and finished off with the wide one which is accurately ground to the correct width of the keyways. A piece of quarter inch keystock is then obtained cut to the proper length and the ends rounded off with a file or on an emery wheel, to conform to the shape of the key-

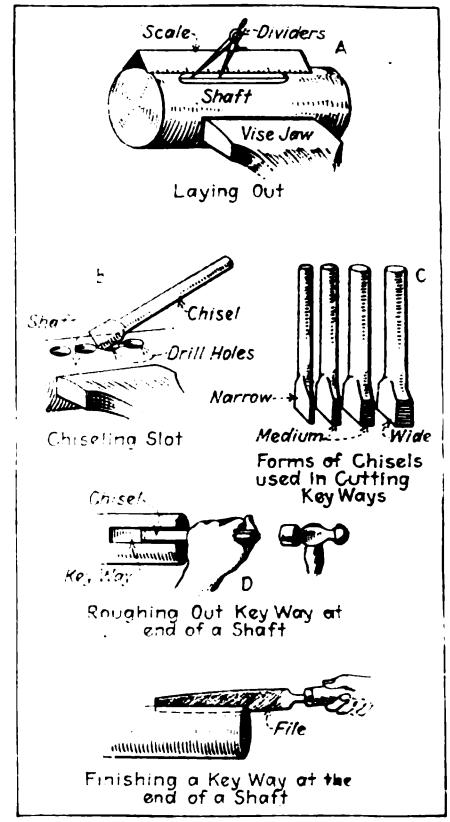


Fig. 2—How to lay out and cut a keyway without machinery

way. The method outlined is, of course, used only in a small shop where regular keyway cutting machinery is not available, as would be the case in an experimental or auto repair shop where milling machines or shapers are not included in the tool equipment. The method of making a keyway in the end of the shaft is similar to that for making one in the middle of the shaft except that it is much easier to chisel out the keyway with a cape chisel and finish it with a file as shown at Fig. 2 D.

Digitized by Google

Woodruff Keying System

The Woodruff key may be obtained in a wide variety of sizes and in different materials. It is a very simple form to make if a key of the right size is not available. A very satisfactory Woodruff form key may be made from a bar of round stock of the desired material and radius as indicated at Fig. 4, in views A to F, inclusive. The first step is to saw into the end of the rod as shown at A, then to cut into the side of the rod with the saw as shown at B, this permits the piece of stock to break away as shown at C. Of course, the key is cut wider than the keyway it is to fit as well as longer than the regular size key. The operation of filing the sides and face to produce the finished key shown at F is easily accomplished.

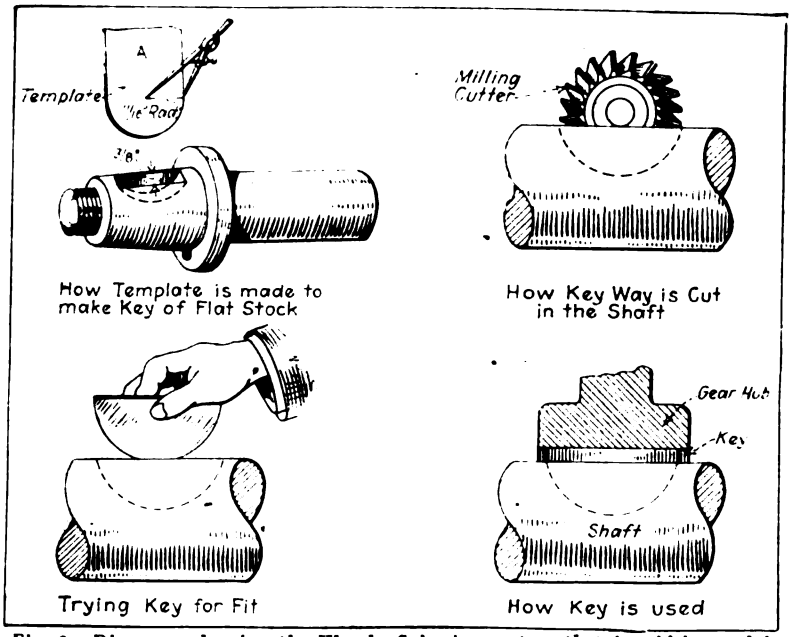


Fig. 3—Diagrams showing the Woodruff keying system that is widely used in automotive appliances

The keyway for a Woodruff key can be cut accurately only by a special milling cutter of the proper size made for the purpose. It is not necessary to have a milling machine to use this milling cutter as very satisfactory results can be obtained by putting it in a lathe or drill press chuck. The depth to which the cutter is fed into the shaft is outlined in an accompanying illustration. The key is then placed in the keyway and the hub of the part it is to retain is forced over the key and shaft as shown in the lower part of Fig. 3.

Care must be taken when fitting any form of retaining pin or key to have it a tight fit in its keyway because if keys are fitted so loosely that some degree of movement is permitted between them and the keyway there will be motion between the shaft and the part it drives and sufficient movement may develop so the key will be sheared off. This applies especially to keys subjected to variable or shock loads as in those employed for holding flywheels, driving wheel hubs, transmission system parts, gears, cams and similar components of machinery.

Each year sees the use of more and more Woodruff keys for fastening gears and similar parts to round shafts, for which reason the various sizes are of considerable interest. A table gives the various sizes which are referred to in the sketch above it, the letters in the table corresponding with those in the figure. There are 30 standard and many special sizes. These sizes vary from .5-inch diameter and .0625-inch thickness up to 1.5-inch diameter and .375-inch thickness. The general shape of the keys is that of a coin cut into halves, although to be exact the half is not complete, as the sketch shows. The key is set down into the shaft less than its full depth by almost the amount of its thickness, so that the portion projecting above the shaft and into the gear or other part is nearly square in section. One great advantage of this form over a square ended key is the ease of placing or removals, as a slight tapping on one end causes the semi-circular form to rock in its seat and one end to rise out of the key seat, until it projects enough to be picked out with a pair of pliers or the fingers.

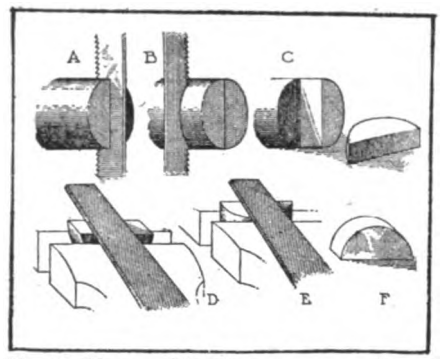


Fig. 4—How a Woodruff key may be cut from round bar stock

GERMAN METAL AIRPLANES

WE have illustrated various types of metal airplanes in these columns, these being of German Junker design but there has been but very little information available about the salient points of construction. The technical department of the British Air Ministry has recently described two models which cannot fail to be of interest to those following aviation progress, an armored two-seater biplane, type J-1, and a single-seater pursuit monoplane, type D-1. Both are constructed entirely of metal and have cantilever wings. This firm has also produced a commercial six-seater cabin monoplane, which has been illustrated in a previous issue. Its construction is undoubtedly similar.

The wings have a deep section with a thick, round leading edge. This is also probably a "high lift" section. They do not have spars, as the term is generally understood, but have a rather large number of tubes running through the wing. In both types these tubes support the top and bottom surfaces. The biplane has ten such tubes in the upper wing and six in the lower. With the exception of two in each wing, they are arranged in pairs, that is to say, one under the top surface of the wing is directly over one on the lower surface. They are braced to each other within the wing by smaller tubes in such a way as to form a Warren truss between any two spar tubes. In the monoplane there are seven spar tubes, not in pairs, but evenly spaced when viewed from above but the bracing is the same. This construction is of sufficient strength to carry the bending moments due to the cantilever design. The fuselage of the biplane is made in two parts: an armor box containing the crew and engine, and a tail section built up of duralumin tubes in the form of a box girder and cloth covered. The pilot is under the center section and a square opening is cut in the upper wing for him to see through. The landing gear and center sections with their struts form a unit. The struts at the center section are the only ones on the machine. There is one pair on each side sloping outward and running from the lower wing roots to the upper center section. They are braced by another pair on each side, which cross to make an X and have the same fitting at the upper plane as the first pair. At their base they join the fuselage.

The metal used both for bracing and covering is duralumin. The covering of the wings is corrugated with the grooves running parallel to the line of flight. The sheet used for wing covering on the biplane is 0.015 in. thick and weighs 3.65 oz. per sq. ft. On the monoplane it is 0.014 in. thick. The

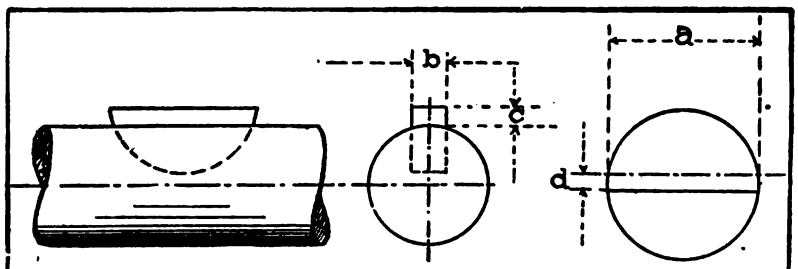
Digitized by Google

bracing is of the same material, but steel is used generally for fittings.

The brief specifications of these two machines are:

D-1: Type, single-seater, pursuit monoplane; engine, 160 hp., Mercedes; span, 29 ft. 2 in.; length, overall, 22 ft.; total wing area, 158.8 sq. ft.; speed, 140 m.p.h.

J-1: Type, two-seater, armored biplane; engine, 230-hp., Benz; span, top 55 ft., bottom 35 ft. 7 in.; length, overall, 29 ft. 8 in.; height, overall, 11 ft. 9 in.; weight, empty 3724 lbs.; useful load, 845 lbs.; wing loading 8.5 lbs. per sq. ft.; power loading 19.9 lbs. per hp.



No. of Key	Diameter	Thickness	Depth in Gear	Less than ½ Diameter
	a	b	c	d
1	.500	.0625	.0312	.0468
2	.500	.0937	.0468	.0468
3	.500	.1250	.0625	.0937
4	.625	.0937	.0468	.0625
5	.625	.1250	.0625	.0625
6	.625	.1562	.0781	.0625
7	.750	.1259	.0625	.0625
8	.750	.1562	.0781	.0625
9	.750	.1875	.0937	.0625
10	.875	.1562	.0781	.0625
11	.875	.1875	.0937	.0625
12	.875	.2187	.1094	.0625
A	.875	.2500	.1250	.0625
13	1.000	.1875	.0937	.0625
14	1.000	.2187	.1094	.0625
15	1.000	.2500	.1250	.0625
B	1.000	.3125	.1562	.0625
16	1.125	.1875	.0937	.0781
17	1.125	.2187	.1094	.0781
18	1.125	.2500	.1250	.0781
C	1.125	.3125	.1562	.0781
19	1.250	.1875	.0937	.0781
20	1.250	.2187	.1094	.0781
21	1.250	.2500	.1250	.0781
D	1.250	.3125	.1562	.0781
E	1.250	.3750	.1875	.0781
22	1.375	.2500	.1250	.0937
23	1.375	.3125	.1562	.0937
F	1.375	.3750	.1875	.0937
24	1.500	.2500	.1250	.1094
25	1.500	.3125	.1562	.1094
G	1.500	.3750	.1875	.1094

Table of Woodruff key sizes and standard dimensions

CAUSE OF RACING CAR FAILURES

IN *La Vie Automobile,* Robert Faroux presents some interesting figures on the defects resulting in the failure or withdrawal of racing automobiles in the past decade. The article gives the results of a careful study of failures of cars in 84 tests and 1,000 cases of withdrawal from races and trials. The engine was the offender in a majority of the cases, while tires, which are often considered the weak spot of a car in severe road tests, had a remarkably low record of failures.

A study of these figures reveals some rather unexpected causes of trouble. While the treatment to which the valves are subjected is severe and it is not surprising that they should be responsible for nearly 12 per cent of the failures, the breakdowns resulting from the cylinders themselves is unexpected. This is accounted for in the author's opinion by defects in the casting or the modification of working conditions by the high temperature which occurs in the interior of the cylinder. Steel cylinders are not responsible for a single retirement. Another interesting point is the low percentage of retirements caused by tire trouble. Even at speeds in excess of 70 miles per hr. they were responsible for less than 3 per cent of the retirements or less than the clutch or the rear axle.

The causes of trouble as tabulated by Mr. Faroux are given as follows:

Engine

Valves	119
Cylinders	105
Connecting-rods	83
Cooling system	65
Crankshaft	57
Ignition	47
Lubrication	19
Camshaft	17
Carburetor	13
Distribution gear	7
Crankcase	7
Flywheel	5
Total	544

Transmission

Clutch	34
Gearbox	32
Transmission	24
Torque Tube	17
Universal Joints	14
Differential	9
Rear axle	57
Total	187

Chassis

Steering	45
Springs	25
Chassis	17
Wheels	63
Brakes	9
Tires and rims	27
Fuel Tank	27
Oil tank	5
Total	218

From the foregoing it will be evident that much of value can be learned from racing cars and that the experience gained by their builders can be applied to good advantage in constructing cars for commercial purposes because a single race may show up defective design or material that severe testing on the road under ordinary conditions would not make evident in a reasonable length of time.

IODINE AND BROMINE

Iodine and bromine are important elements and have extensive uses in pharmacy and technology. The great proportion of iodine has come from the nitrate deposits of Chile and its extraction from sea-weed was an important French industry, which is menaced by the obtaining of iodine from mineral sources, and also by the use of kelp and sea-weed as a fertilizer, which deprives the manufacturer of that source. Much interest is developing in the direct chemical treatment of sea-weed for the extraction of these elements because preliminary burning or incineration of sea-weed involves loss. The object is to extract the mineral elements, potassium salts, iodine, and bromine without destroying the organic matter. In California, by application of fermentation, acetic, propionic and butyric acids, acetone and ethylic ether have been produced. It has been proposed also, to make horse feed out of it. Dry distillation can be used to get tar, formic and acetic acids.

Digitized by Google

The Bienvenu Heater

MANY are the combustibles which have been proposed to take care of the coal crisis, and still more numerous the systems of heating apparatus which have seen the light of day since the war. Peat, lignite and various artificial fuels have supplied our stoves and furnaces, and their more extended and rational use has helped in the crisis which confronted all of us, but more especially nations like France and Italy. This coal shortage crisis has by no means been disposed of, and there is every reason to still search for palliatives for the evil which is sure to last some time.

To supplement illuminating gas, on which many people have depended, and which is unobtainable in many places, a very simple little apparatus has been invented in France, "The Bienvenu Heater," adapted to all kinds of stoves, cooking ranges, boilers, etc. Supplied with heavy petroleum or kerosene this heater produces the gas which it burns, giving a blue flame free from carbon and producing neither smoke nor dust. It burns a mixture of 80 per cent of air and 20 per cent of oil. It is easy enough to get fuel oil, wherever one may be, whereas other combustibles are not always easy to obtain. The heater has no delicate or incumbering parts and is easy to transport. It has the advantage over some petroleum furnaces now in use of giving an intense heat, due to the special spreading plates which are fixed in the path of the flames, as shown in accompanying illustration at Fig. 2.

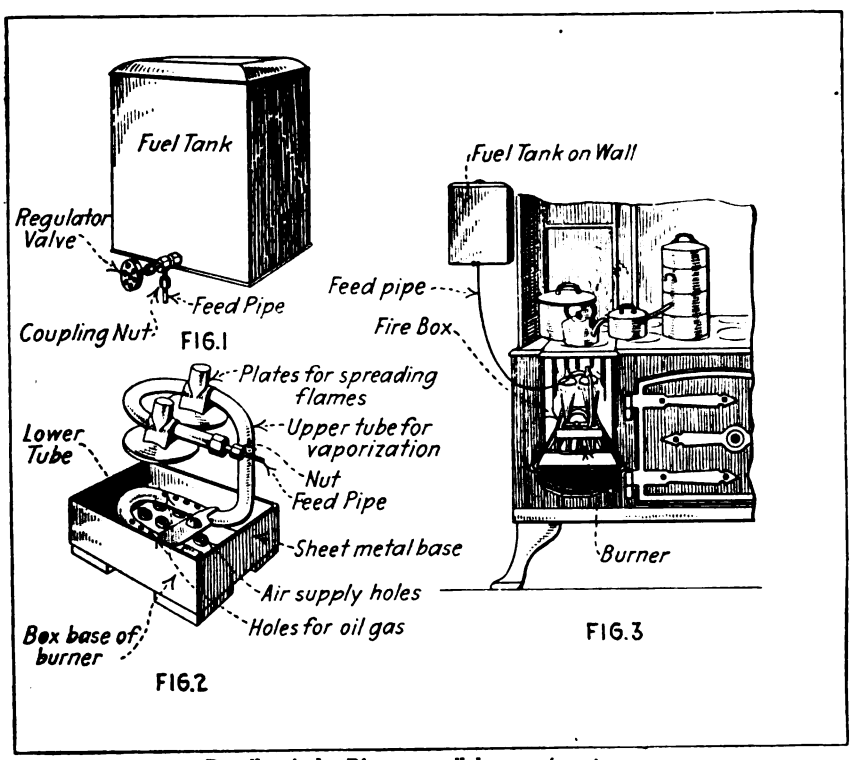
The expenditure of the fuel is slight, if we realize that it only burns 4½ quarts of oil in ten or twelve hours, according to the intensity of the heat, and that it is capable of boiling 135 quarts of water in 20 minutes.

It is composed of two parts: the oil tank and the burner proper. The reservoir, Fig. 1, has a capacity of about five quarts, it is provided with a regulator cock placed at its lowest part. A supply pipe effects the communication with the heater by means of screw couplings.

The burner, Fig. 2, is a hollow casting, a sort of rectangular box, covered with asbestos, and whose bottom is perforated with ventilating openings. This recipient measures 6 inches to 8 inches long and 4 inches wide and 2 inches deep. It contains a U-tube communicating with another tube of the same shape placed above it. The upper or vaporization tube carries two movable plates, designed to spread the flame and heat the vaporizing tubes, the lower tube is provided with two small orifices for the gas to escape through.

The very simple installation takes hardly three minutes. The heater having been placed in the fire box of the stove, Fig. 3, or under the boiler to be heated, the oil font is attached to the wall at a certain height. If it is placed at about five feet above the level of the heater, the pressure giving the maximum of heat will be obtained. The font and burner are connected by the supply pipe, the couplings are carefully screwed up with a wrench to avoid any leakage of oil. Next the font is filled with filtered oil, the base cock being closed. To light it a little wood alcohol or gasoline is poured into the burner casing and is lighted. This heats the upper tube to a high temperature. When this is effected a turn is given the regulating cock on the font which is at once shut off. A small quantity of oil escapes, which is vaporized in its passage through the heated tube and begins to escape by the orifices in the lower tube in the form of gas. Next the cock is opened to let the oil run down, and the gas is lighted, taking care to place the plates directly above the flames which they have to spread. These plates being adjustable, make it possible to direct the flame on the hearth, on the furnace or for the heating of water.

Before using the apparatus one must test the openings with a pin to see if they are obstructed, which would give an irregular and flickering flame. The burner must also be placed exactly level in the stove. When through with the heater and before it cools to any extent, a little cold water may be poured over it, which is all the cleaning it needs. The Bienvenu Heater is made in different sizes, according to the use to be made of it, whether for home use or for industrial purposes. The smaller sizes, such as we describe here, suffices for daily requirements in private houses, cooking meals, heating an apartment, a garage, heating the radiators of automobiles, etc. They will be of great use in country houses, on the farm, on motor boats and numerous other uses.



Details of the Bienvenu oil burner for stoves

LARGEST STEAM TURBINE

THE largest steam turbine ever built, developing 100,000 horsepower, has been installed in a street railway power house at New York City. It is said to be the first three-cylinder cross-compound unit in America. Superheated steam at 250-lb. pressure enters the high-pressure element and exhausts into the two low-pressure elements in parallel, condensing at 29-inch vacuum. At full load, the unit takes 826,000 pounds of steam an hour. All the elements which in an emergency can be used independently, run at 1,500 r.p.m. driving 25-cycle three-phase generators of 20,000 kw. each at 11,000 volts. The three generators combined have a two-hour overload capacity of 70,000 kw. The installation occupies a floor space 52 by 50 feet.

The production of nitric acid by synthesis from air has hitherto been very low in economy, as low as 2½% efficiency. Mr. Ferdinand Gros has endeavored to increase the economy of the process by drying the air perfectly, enriching it with oxygen and by these methods apparently is succeeding materially in perfecting the process.

Digitized by Google

ELECTRICAL PROGRESS DIGEST

ELECTRIC DRY-TYPE GLUE POT

THE Westinghouse Electric & Manufacturing Company has placed upon the market as an addition to its line an electrically heated dry-type glue pot, in a two-quart size. This glue pot is solidly constructed, consisting of a glue vessel of copper contained inside of a steel case. The glue pot may be easily removed for cleaning. This vessel fits snugly, making a perfect thermal contact with the heating element. There are many points of advantage and improvement of this line of dry-type glue pot over all other forms of heating glue. Among the most important are:



Westinghouse electric dry-type glue pot

The water bath is eliminated. With the old wet-type there was always danger of the water evaporating and burning the glue and the heater burning out. With the dry-type glue pot the current can be applied continuously without any danger of the heater burning out or the glue becoming overheated. The single-heat constant in-put heater gives the correct working temperature to the glue for continuous operation of the dry-type glue pot. The necessity of continuous additions of water and the inconvenience and sloppiness of the water bath are entirely eliminated. The new dry-type glue pot is more efficient because the glue is heated directly and none of the energy is required to heat a water bath.

There is a great saving in time because the glue is heated directly and held at the proper temperature without attention.

AN ELECTRIC ATOMIZER

THERE has recently been placed on the market an electric atomizer which is suitable for use in hospitals, schools, sickrooms, and in a variety of other places. It is suitable for sweetening cellars or ice boxes when formaldehyde is added to the water in the atomizer. The atomizer consists of a small brass bowl which contains a heating element imbedded in insulating material. The apparatus is mounted on a wooden base and is supplied with a cord and suitable attachment plug. In use, the bowl is filled with water and a few drops of perfume or disinfectant are added as desired. The boiling of the water drives off the liquid in the form of vapor, thus humidifying, perfuming or disinfecting the room.

LONG DISTANCE TRANSMISSION LINES

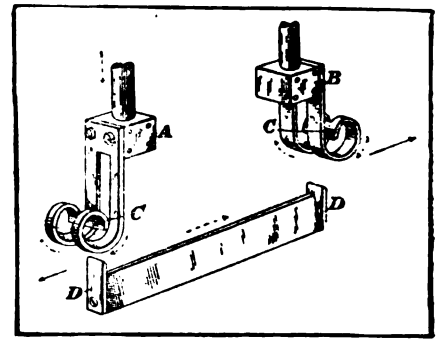
ACCORDING to a French engineer, writing in *Revue Generale de l'Electricité,* distances of 400 to 500 miles can be spanned with a transmission line by making use of the so-called "quarter-wave" construction. Such a line has the usual two conductors for single phase and three for three-phase, but frequency, capacity and inductance have such values that at no load the line is in resonance. The current must be maintained nearly constant at the generating end, and constant voltage will be received at the other, with reasonable regulation, efficiency and conductor cost.

ELECTROLYTIC IRON

WE have had occasion to speak several times of electrolytic iron. Another application of it for automobile repair work was carried out successfully during the war. It was found possible to deposit a layer of iron, up to about one-twelfth of an inch in thickness, on any cylindrical surface of wrought iron or steel. The metal adheres so that it cannot be chipped off. It can be subjected to red heat without apparent deterioration and can be carbonized and hardened in the regular methods of heat treatment. It enables many minor parts to be reclaimed. The greatest limitation to its use lies in the fact that it cannot be deposited satisfactorily on cast iron or aluminum. The best solution was found to be ferrous ammonium sulphate, seventy-five grams to the liter, with a one-tenth ampere current per 30 square c.m.'s of surface. The anode was made up of Swedish iron wire, woven into a sort of basket, so as to surround the work as nearly concentrically as possible. It was carried on a rocker arm and kept in motion, and to it were attached two celluloid cones so as to produce constant circulation of the solution. Constant renewal of the electrolyte in the vicinity of the surface of the work was thus ensured.

NON-ARCING OIL SWITCH

AN ingenious oil switch for blowing up the arc is illustrated here. The current from the terminals A and B divides into two parts, being conducted by the double conductors to the plate C,



Non-arcing oil switch

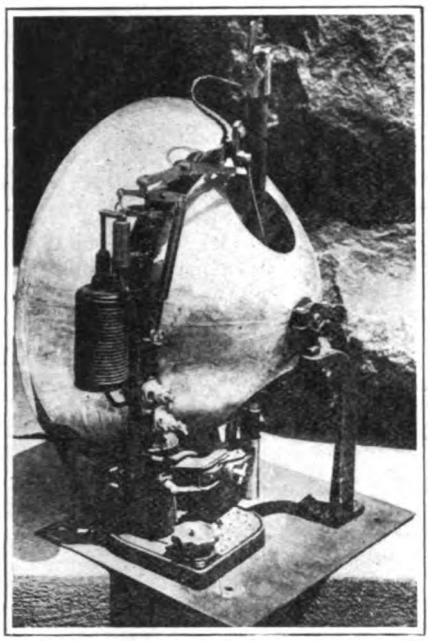
uniting the lower ends of the two conductors between which the current divides itself. The plates C C coming in contact with D in the oil bath close the circuit. The conductors are curved onto a sort of solenoid and this creates a field designed to blow out any arc which may form on breaking the contact.

Aqueous emulsions containing 25 per cent of mineral oil have been found to be excellent lubricators. It is quite an interesting thing because of the high expense of lubricating oils, which constantly continues to, or threatens, to, increase.

The well known singing or musical flame is being applied for the detection of fire-damp in mines. A flame contained in a tube is adjusted so as to be almost a singing flame, to be, as it may be expressed, on the edge of giving a note. A very small amount of marsh gas or fire-damp in the air will so alter the flame as to start it to sing, giving a very audible warning of danger.

Digitized by Google

At the Republican National Convention in Chicago locomotive headlights of the electric arc type with a parabolic reflector were used and made possible the taking of motion pictures there. To diffuse the light the plate glass in front



Modified locomotive headlight used to illuminate convention hall

of the reflectors was oiled and ground and the light in the great hall is described as approximating to white daylight. As a test of the reflector the sun's rays reflected therefrom burned a hole through a three-inch plank in four minutes.

Considerable attention has been given to experiments with wired-wireless transmission. It is partly a practical question in the line of supply. Thus in the year 1918 the United States were only good for eight thousand miles of twisted insulated wire per month. Under the conditions of the war this was far too little. The bare wire used in wired-wireless not only disposes of the necessity for braiding and insulation, but also occupies a very much less space in trains and ships holds. It works across rivers and underground and the general lines of wireless transmission are followed with it and frequency as high as one million cycles per second has been employed. It has been successfully used across the Potomac River. The best Atlantic cable of today is only good for a frequency of ten cycles per second, and for fifty to eighty volts potential.

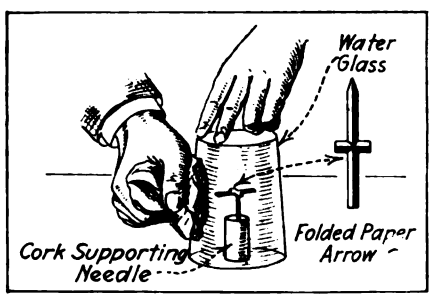
Albert Hall in London, which occupies somewhat the same place in London life that the Madison Square Garden does in New York City, has changed its lighting system from arc lights to one thousand watt Mazda lamps.

In the United States one hundred and eighty-three millions of incandescent lamps were produced in 1919, three million less than in the preceding year. In 1918, 11 per cent of the lamps made had carbon filaments and in 1919 only 7 per cent have them. Twenty-seven million gas filled lamps were produced in 1919 and twenty-three million in 1918. The average candle power is on the increase.

A company with over $20,000,000.00 capital is being organized in England for the fixation of nitrogen. They will probably use a modified Haber process and propose to start off with a daily production of one hundred tons of ammonia salts and ultimately to produce as high as four hundred and fifty thousand tons of ammonium sulphate per annum. Ammonia products are oxidized, if desired, to give nitrates and they have very important use as such for explosives.

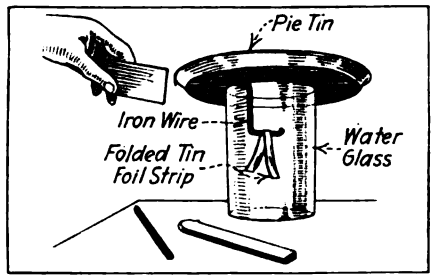
From the far East there are numerous reports of the development of electric power. In Japan some thousand miles of high voltage transmission lines are to be built within the next two years, presumably of the steel tower construction and possibly using aluminum conductors. From Korea and from Cochin, China reports of extensive electric installations in prospect are also given.

Some experiments with simple apparatus are shown in our cuts. In the first one a needle is thrust into a cork and on the cork is poised a paper arrow of the shape and folding shown on the right of the cut. When in position the least thing will cause the arrow to turn and its delicacy may be tested by a stick of sealing wax, which,



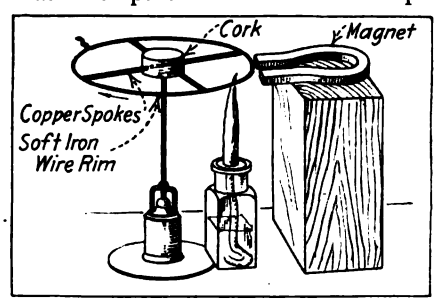
rubbed against the coat sleeve, will become electrified and will attract the point of the arrow when held near to it. Next a tumbler is inverted over the poised arrow and the glass of the tumbler is electrified by rubbing it with a silk handkerchief or a piece of fur. This electrification is local, and the arrow will turn so that its longest end points to the electrified portion of the glass, and by turning the glass around the arrow will also rotate.

The next cut shows a simple electroscope. A strip of tinfoil is suspended on a bent iron wire within a glass, as shown, and a pie tin is placed over the mouth of the glass, holding the wire in place. If an electrified object, such as a stick of sealing wax which has been rubbed with silk, wool or any animal substance, is touched to the plate, the latter will become electrified, as will also the strip of tinfoil and the ends of the latter will diverge. This



illustrates the principle of the electroscope, and the reader can refine the construction by using Dutch foil, or even gold leaf, for the strip and a neater suspending arrangement than that shown. The wire may go through the center of a block of wood, preferably parafined, which should fit the mouth of the glass.

The fact that hot iron is not magnetic is used in the next experiment to produce rotation of a wheel. The hub of the wheel is of cork, spokes are of copper wire and the rim is of soft iron. It is carried by a needle whose lower end rests on a plate of glass and is kept in position by a glass bead stuck to the glass plate with a little shellac or sealing wax. Care must be taken that none of this cement penetrates within the hole of the bead. A little metal brace keeps the needle vertical, and the greatest care must be taken to so adjust the wheel that it shall be in as nearly perfect balance as possible. A permanent magnet is placed on a block of wood in the position indicated as shown and a spirit lamp heats the wire as near the magnet as possible. Some experimenting will have to be done to determine the exact relation of parts and care must be spe-



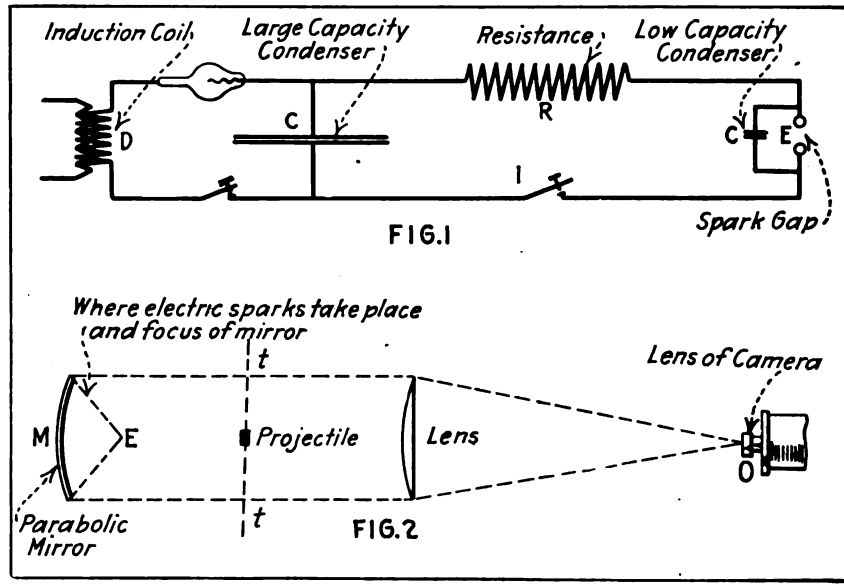
cially taken not to heat the permanent magnet. The heat of the lamp depolarizes the rim of the wheel in front of the magnet so that it is no longer attracted, but the more distant part of the rim, which has not yet been heated, is attracted, so that the wheel turns in the direction indicated by the arrows.

Digitized by Google

Photographing Projectiles in Motion

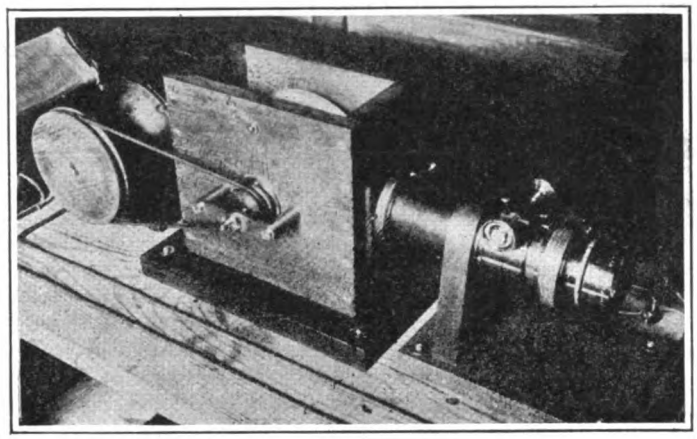
THE death in 1904 of Etienne Jules Marey, the eminent French photographer, removed from the stage an investigator who had done more to advance the development of instantaneous photography in the scientific field than any of his predecessors. After Maybiedge's very elaborate work Marey's great advance came as a direct simplification and not only that but he gave far superior results. In Paris today the Marey Institute is largely devoted to the class of work which it is fair to say originated with Marey.

Our illustrations show the apparatus and equipment for photographing projectiles in flight. We have already had occasion in our columns to speak of induction coil and Leyden jar spark photography which gives an incredible number of exposures in a unit of time. The standard speed of motion picture work may be taken at 16 exposures per second. In the work on the flight of projectiles as many as 15,000 photographs per second are taken, nearly 1,000 times as many. Thus it will be seen that if the projectile had a velocity of even 3,000 feet per second, which is very high, there would be 5 exposures given for each foot of its progress.



Figs. 1 and 2—Diagrams showing how it is possible to make 15,000 exposures per second

The diagram Fig. 1 shows the electric apparatus for producing the cascade of sparks. B is an induction coil, C is a large capacity condenser, E is the spark gap in parallel with a small capacity condenser C'. At I is indicated a switch. Referring now to Fig. 2, in which the optical system is shown, the spark gap is located at E in the focus of a parabolic mirror. This mirror reflects a parallel sheaf of rays to the condensing lens which converges them upon the objective O of the camera. The path of the projectile is indicated by the dotted line *t t* and P represents the projectile. It will be seen that the camera can photograph the projectile at any point within the diameter of the cylindrical beam of light reflected from the mirror M. A blast of air impinges upon the spark gap so as to prevent the formation of an arc. The diameter of the mirror M is 16 ins. By a simple inertia apparatus operated by the recoil of the



Electric motor-driven camera

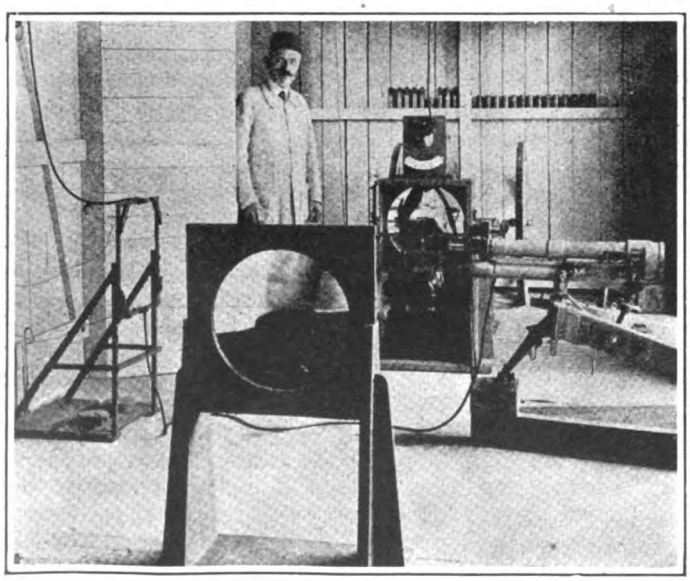


Fig. 4—Apparatus set up for photographing bullets in flight

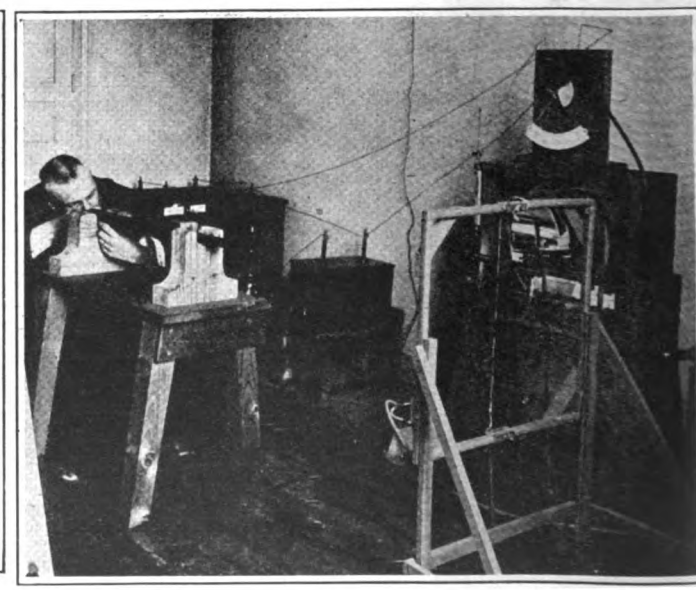


Fig. 5—Observer preparing to fire bullet across field of camera

Digitized by Google

piece discharged, pistol, rifle, or cannon, a film of paper is pierced and a contact made which closes the electric circuit and starts the stream of sparks. After the bullet has passed across the sheaf of rays it will have been photographed many times. Finally it cuts a wire, thus opening the circuit for stopping the sparks.

Within the camera K there is a light cylinder of duraluminum which rotates 12,000 turns a minute and a cinematograph film is wound upon this cylinder, whose speed of travel exceeds 300 feet per second. This film, it will be observed, can give from 5,000 to 25,000 images a second. Thus in studying the projectile fired from a 37 mm. gun, a frequency of 5,000 exposures per second was employed. The motor-driven camera and cylinder carrying the film are shown in Fig. 3, and the general apparatus with which the sub-director, Dr. L. Bull, photographed bullets in flight is shown in Fig. 4. The photograph at Fig. 6 shows the projectile of a 37 millimeter gun as it leaves the muzzle of the gun for the first few inches of the flight. Fig. 5 shows the observer preparing to fire a rifle bullet across the field that it may be photographed.

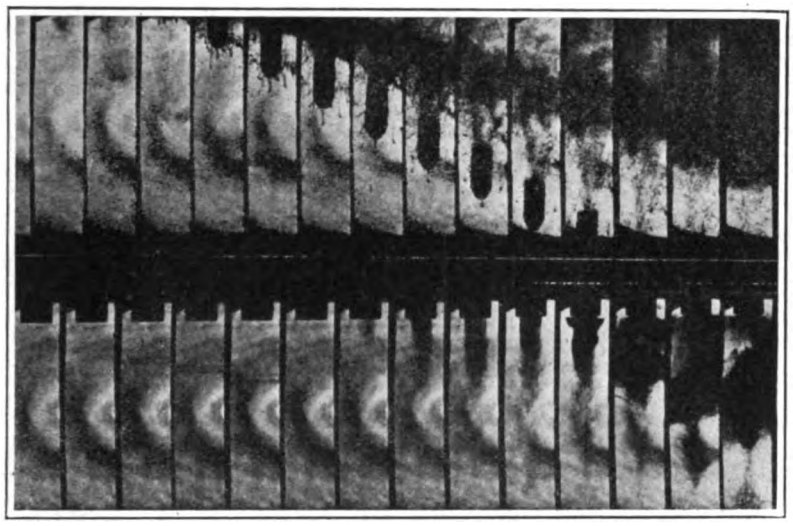


Fig. 6—Series of photographs showing bullet as it leaves muzzle of gun and escaping gases from powder explosion

THE WIMPERIS ACCELEROMETER

A DIAGRAMMATIC representation of the mechanism of the instrument is shown in the illustration. To make a measurement of the tractive effort necessary to overcome the resistance to motion, the instrument is leveled on the floor of the car by means of the adjustable leg, and then when the car is coasting the indication of the needle gives the reading in pounds per ton. The general nature of the internal mechanism may be described as a lopsided copper disc, mounted on a vertical axis and controlled in its rotation by a coiled spring. Any acceleration causes the heavier side of the disc to lag behind and so partially wind up the spring. The degree to which the spring is wound up measures the acceleration. Any tendency of the disc to oscillate is checked by a magnetic field at right angles to the plane of the disc. Besides these parts there is what is called "the compensating balance" which causes the instrument to record absolutely correctly, even when traveling around railway curves, or when on a road heavily cambered to one side or the other. The copper disc is shown at D; it has a hole cut in it near the circumference which has the effect of throwing the center of gravity slightly out of the center of the figure. On the pivot of the disc is fastened a spur wheel which gears in with another equal spur wheel, mounted on a parallel axis and carrying the pointer N. This pointer moves over a scale, not shown in the diagram. It will be seen that there is a small permanent magnet placed so as to damp the motions of the copper disc without having any of the sticking qualities which accompany frictional damping. The spring, which is called up by the rotation of the disc, is not shown, but lies in the horizontal plane just above the disc. In later forms of the instrument the arrangement described above has been varied slightly, but not so as to effect in any way the general principle of working. It had not been possible to include in the paper a description of more than a few of the tests which have been carried out, but the general conclusions which have been so far reached may be set out as follows:

(1) By the use of the accelerometer the road resistance of different kinds of roads or tracks, under various weather conditions, can be measured and compared;

(2) The amount of air resistance due to various forms of vehicle can be at once determined;

(3) The mechanical and thermal efficiency of the engine at various speeds can be obtained under real working conditions;

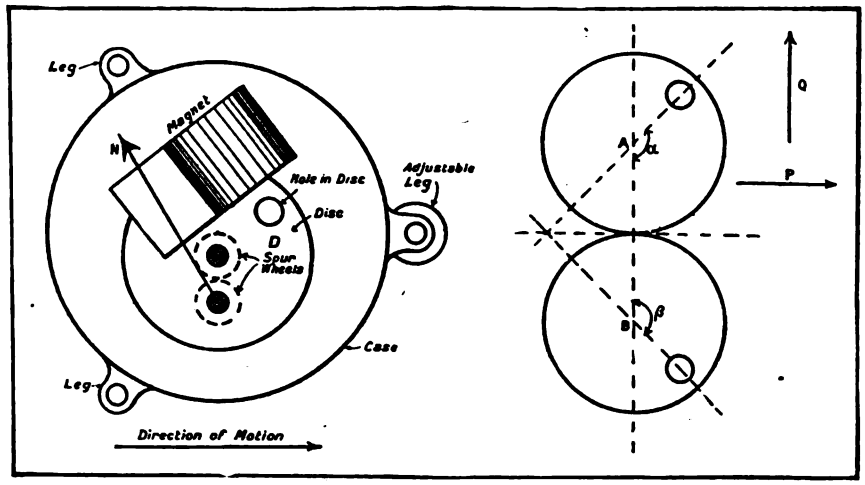
(4) The brake horsepower exerted by the engine when running at various speeds on the road can be easily obtained;

(5) It is possible to trace step by step the losses of power in transmission;

(6) It is possible to make a definite allowance for motor vehicles which are specified to show a given fuel economy (such as gross-ton-miles per gallon of fuel), and which may have to run their tests on exceptionally heavy roads;

(7) Lastly, the use of the accelerometer enables a useful interpretation to be given to speed and efficiency tests which are carried out on specially prepared motor tracts, having characteristics different from those of the ordinary highway at unrestricted speeds.

An English contemporary speaks of a ship's cooking range, fired by heavy fuel oil. It very appropriately is on an oil tanker, the *Narragansett*. Its small size six feet long and two feet wide with a single burner supplied by means of compressed air at a pressure of 45 lbs. to the square inch, indicates its efficiency, at it proved capable of preparing meals for 100 people. There is a special air pressure pump or compressor for the range.

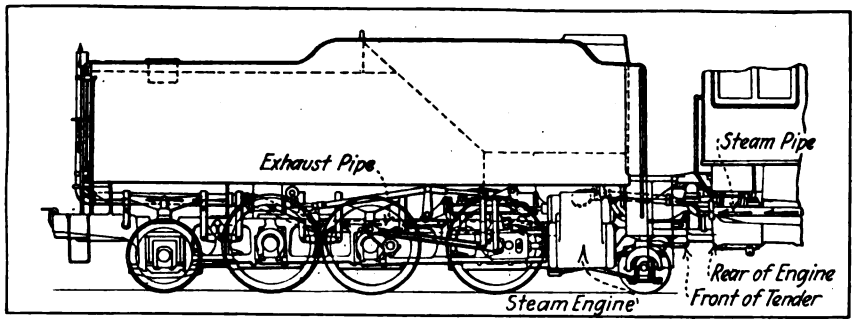


Details of the Wimperis Accelerometer

Digitized by Google

DUPLEX LOCOMOTIVES

WE have already had occasion to mention a recent modification in locomotive practice in which an old engine and underbody was placed under the tender to be supplied with steam from the regular engine boiler, and we illustrate in the present issue such a locomotive. The underbody (or what in the automobile is called the chassis) of a locomotive engine is coupled back of the main engine and the steam chests are connected with the main steam supply. On this underbody is mounted the body of a regular tender, carrying the supply of water and coal. While it makes a big draught on the boiler, it is found that the duplex engine can be run for nearly an hour without pulling down the steam pressure unduly. In practice the tender-engine is cut off or throttled down when not needed, but in ascending heavy grades the pulling power of the engine can be greatly increased until the grade is surmounted. The writer has gone up a grade on the Canadian Pacific Railroad where as many as five locomotives were required to get the train up the incline. On one road a three-inch pipe supplies steam for the tender, taking it directly from a superheater. American engines are so often seen blowing off steam from their safety valves that they at least suggest a steaming capacity in excess of the requirements of the engine. In these cases it is evident that the extra engine under the tender can be taken care of as regards its steam supply. For the present most of this work has been done with old engines which may be in reasonably good condition but are too light for modern practice. If the system wins sufficient approval, there is little doubt that new engines will be built on this system.



Drawing showing arrangement of steam cylinders for driving tender

NEW AIRPLANE WING RIB

EXTREME altitudes—the objective of Major R. W. Schroeder and aviators of like ambitions—are not to overshadow another problem of aeronautics, that of multiplying the speed range of airplanes. A new type of airplane rib developed by the U. S. Bureau of Standards, by varying the angle of attack, is capable of making greater speed than hitherto possible with the prevailing wings and was reported recently by S. R. Winters in the *Scientific American.*

Described as the Parker variable-camber wing, the newly designed equipment recognizes the principle of construction that if the angle of attack can be efficiently varied from a very small to a very large angle, a wide range of speeds is possible. The properties of the type of wing usually seen are held responsible for the restricted speed of airplanes.

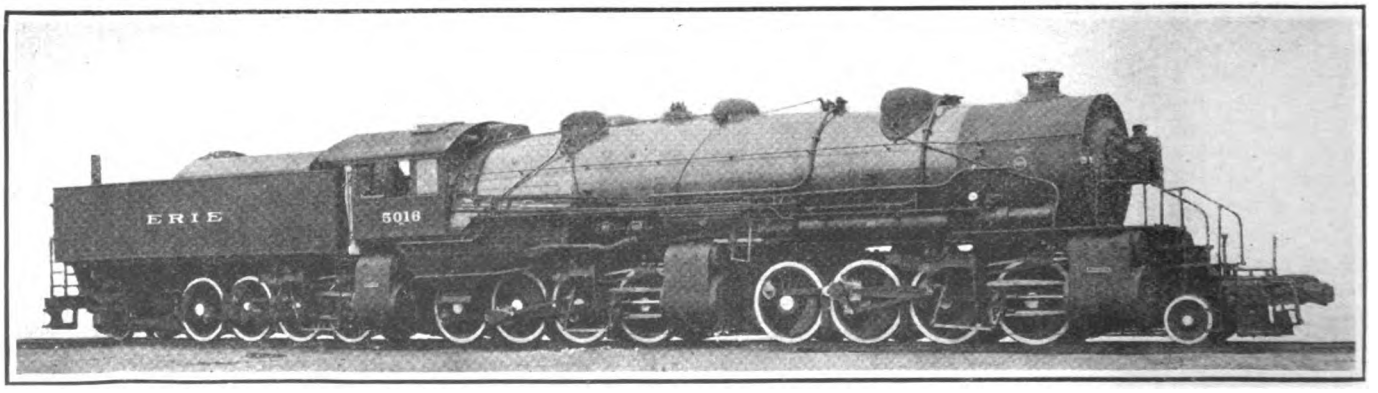
Among the features of the rib structure of the Parker variable-camber wing are: Deformation regularly with the load up to the unit flying load, then remains rigid under further applications of weight, being strong enough to stand up under several times its normal load without failure. Simple, fool-proof and easily manufactured are the virtues claimed for the wing. Metal construction is necessary in the new type of rib; other portions of the machine, such as spars, bracing wires and struts, are not altered. The essential parts of the new wing are: Channel shaped strips forming upper and lower surfaces of the rib between the spars; compression links are of channel section, also, and fixed to outer channels by pins, allowing necessary angular motion between links and strips; the tension links are flat strips of steel attached to the same pins which carry the compression links.

A radical departure from the prevailing type of wings, these links in streamline position carry no load, but in a lifting attitude they straighten out and make a truss of the rib, thus preventing further deformation under loads. The links in the first two and last two panels are slotted to permit of the insertion of reserve links. A tail piece is fixed in shape, riveted to the upper strip and constructed to slide over the rear spar. A spring is placed between the rear spar and the tail piece, this spring being used as a tension attachment to the rear spar and the front compression member of the tail piece.

A NEW ITALIAN AIRSHIP

ACCORDING to the Italian *Gazzetta de l'Aviazione* of recent date, the new Italian semi-rigid T34, known as "Roma", has given excellent results on test flights at Campiano. The ship, due to Comm. Useulli, has a capacity of 34,000 cu. m. (nearly 1,200,000 cu. ft.), is 128 m. (422 ft.) long, and has a maximum overall height of 27.5 m. (90 ft.). She is powered by six Ansaldo-San Giorgio twelve-cylinder V engines of 500 h.p. each, or may be fitted with an alternative power plant of 12 S. P. A. engines of 250 h.p.

Cruising with two engines (1,000 h.p.) the speed is said to be 85 km. h., and with the full 3,000 h.p. a speed in the neighborhood of 130 km. h. is expected. The disposable load is stated to be approximately 19 tons. Depending upon the length of the journey to be undertaken, the "Roma" can carry from 50 to 100 passengers.



Massive steam locomotive used on the Erie Railroad has three sets of drivers and engines, a pair of engines being used to drive the tender

Digitized by Google

Heat Treating Alloy Steels

A Series of Simplified Articles Detailing the Various Methods of Heat Treating Modern Alloy Steels. This Installment Explains the Critical Range and Why It Varies in Steels of Different Carbon Content

By Victor W. Pagé, M. S. A. E.

PART 5

Meaning of Critical Points

IF we heat up simple steel pieces of any composition containing less than .40 carbon, three points are observed, even though the piece is allowed to remain in the furnace where the temperature of the steel does not change for a few minutes.

These are the critical points of heating and are indicated on temperature chart as Ac_1, Ac_2, and Ac_3. On cooling the piece it will be found that there are three similar points, where the temperature of the steel does not become less, or it may even appear to rise. These are the recalescent points and are indicated as Ar_3, Ar_2, and Ar_1. These points are about 70 degrees Fahrenheit lower than the ascending points indicated by Ac, which are known as the decalescent points. This variation in temperature results from a certain amount of lag, which is due to the time consumed in the molecular change which takes place in the internal structure of the steel and which critical point represents alterations in the internal molecular arrangement of the steel, which are now well known to heat-treating experts.

These critical points may be understood by considering the case of water, which when heated to 212 degrees Fahrenheit, does not become any higher in temperature even though the heating process is continued until it is all steam, still at 212 degrees Fahrenheit. After this point, the rise continues, but in the process 760 B. t. u. of heat have been consumed on account of the structural change in the water, during which it changes from liquid to a vapor. In steel that has more than .40 carbon, for example, steel containing .90 carbon, which may be considered as the saturation point, we find that three critical points have combined into one and in particularly high carbon steels we note that there are two critical points.

To explain the reason for the various critical points occuring in steel of different carbon contents, the reader would be led into a discussion of the allotropic theory of iron-carbon alloys, which is not within the scope of a series of simplified discussions of this nature as it cannot be explained without the use of technical terminology. In simple language, the phenomena producing the critical points may be explained as follows:

When low carbon steel is heated to about 735 degrees Centigrade, or 1,355 degrees Fahrenheit, the pearlite in steel changes and absorbs heat and becomes a micro-constituent called austenite. The ferrite or iron is slower to transform, but by continuing the heating process it eventually changes into austenite also. For example, in a .67 carbon steel with about 25% ferrite, this micro-constituent is not transformed to austenite until a temperature of 1,415 degrees Fahrenheit is reached. The lower the proportion of carbon in the steel, the higher we find this latter temperature.

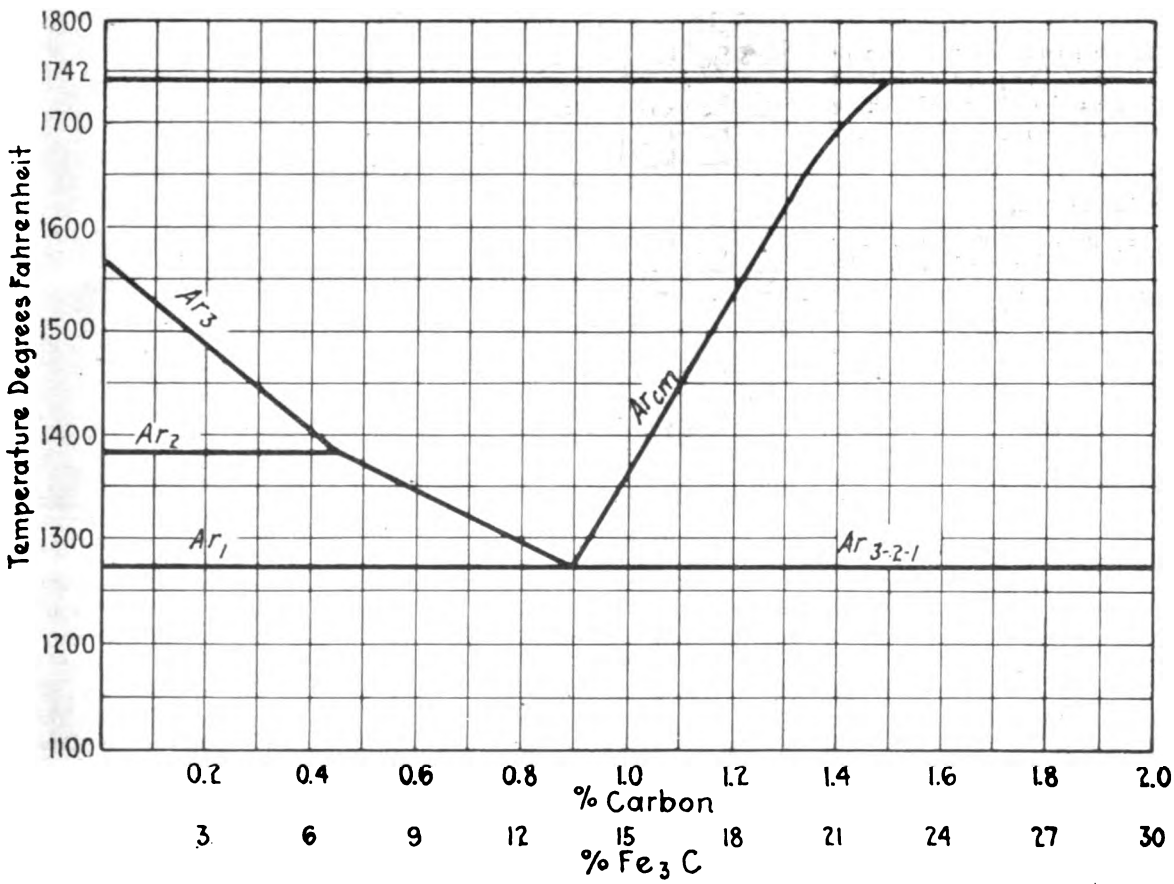


Diagram showing the approximate position of critical points of cooling for steels of varying carbon content. These are known as recalescent points, while change points on the rising heat are known as decalescent points

Digitized by Google

When pearlite only is present, as in .90 carbon steel, the change is completed with the transformation of pearlite at a temperature in the neighborhood of 1,350 degrees Fahrenheit. When the carbon content is higher than this, the pearlite first changes at about 1,350 degrees and the free cementite present, much later. In 1.50% carbon steel, the transformation does not take place until a temperature of 1,690 degrees Fahrenheit is reached.

It may seem to the non-technical reader, that the matter of critical points has been stressed unduly in this series of discussions, but it is believed that when the facts are fully appreciated, that the importance of treating steels of various compositions, at most suitable temperatures will be fully recognized. To use a homely simile, if a housewife removes a loaf of cake or bread from the oven before it is cooked through, the interior of this loaf will be found to be a paste or dough, which does not have any of the qualities of the outer, cooked skin. The same thing applies to steel, as really heat treating is merely a process of cooking the material in order to effect certain internal and surface structural changes. These structural changes in the molecular arrangement of the micro-constituents are produced by heat and as we have seen, different changes in the molecular arrangement take place at different degrees of heat.

The purpose of cooling the steel more or less rapidly is to fix the desired internal structure so that it will remain a characteristic of the piece after heat treating; just as the object of baking dough into bread is to turn a soft, pasty substance that is not eatable, into one that is harder and that has been changed chemically so that it can be assimilated by the digestic organs. The object of heat treating steel is to take material that may be soft and easily worked on machines in its annealed condition and by proper heat treatment, change it into a strong and hard material on which further machining processes or changes of form would be difficult. It is easier to mold dough into the form of loaves before it is baked than after it has undergone the heating process. For the same reason, it is easier to machine steel while it is soft than after it has been hardened by any of the heat treating processes described in a preceding installment.

A study of the foregoing will show that improvement in the quality or physical proportions of any alloy steel, can only be brought about by heating the steel to, or beyond the critical point, at which the molecular change takes place and then quenching it in brine water or oil, depending on the degree of hardness desired and the chemical composition of the alloy.

If steel is heated to a temperature below the critical point and then quenched in any cooling medium, it will be found that the structure of the steel will not be what is desired, nor will the grain be properly refined. If steel is heated to temperatures higher than those determined to be the change point, and then quenched, we find that this will result in hardening the steel, but it will have a much coarser grain than if the quenching had been done at the top of the critical range.

Even the old-time rule-of-thumb steel hardener recognized that the finer the grain of the steel, the stronger it was and it is understood that to obtain the maximum refinement of grain, the heating and cooling qualities of any special grade of steel must be determined by scientific means and the treatment or heating operation confined as closely as possible with respect to the critical range of temperatures. The reader will see that careless heat treatment will impair the quality of the treated parts. There is no use of paying the high prices asked for alloy steels unless one will follow the heat treatments that will bring out the superior qualities of these alloys.

It is not only necessary to heat the steel to the proper temperature, but it is also important that the heating be performed uniformly. A loaf of bread cannot be baked by throwing it into a hot fire, it must be placed in an oven and the temperature of the oven maintained at a certain heat for a certain period to complete the baking process. It is exactly the same with steel. If a cold piece of steel is thrown into a raging hot furnace, the temperature of which is above the critical range, the transformation of the pearlite and ferrite, or later, the cementite into austenite is rushed beyond the capacity of steel to withstand it, and this condition is more critical, the higher the carbon content of the alloy.

The molecular expansion which occurs may be so rapid as to cause cracking or fracture of the steel pieces. Then again, if the flame or source of heat acts directly upon the work, the transformation will take place on the surface long before it takes place at the

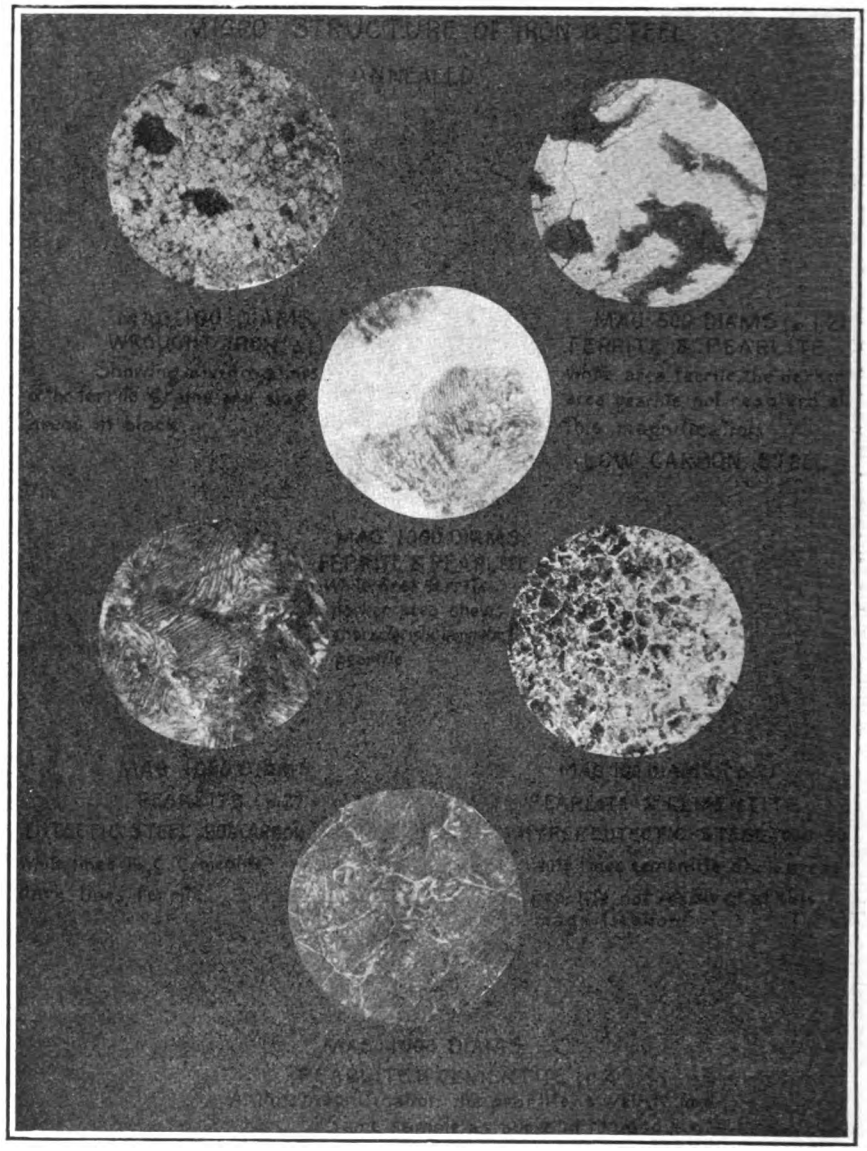


Photo-micrographs showing the microstructure of annealed iron and steel

Digitized by Google

core, inasmuch as this will produce a core having certain characteristics and the skin having widely different ones. It is apparent that cracking or warping of the piece must ensue as a result.

This explains why muffle furnaces and lead or salt baths give better hardening results than heating the steel in a forge fire or an unprotected blast flame would. Then again, in a lead or salt bath, upon the introduction of a piece of cold work, the salt or metal solidifies to a degree about the surface of the work and melts away from it slowly as the piece becomes heated throughout, and in this way serves to help in slowing down the transformation period.

It is found advisable to pre-heat certain grades of steel to a medium temperature before they are inserted in the hardening furnace, as this assists in having the steel pass through this critical range without damage. While cracking or fracture due to improper heat treatment may not be a serious matter in the case of a simple tool or an inexpensive automobile part, it will be apparent that it is a matter of considerable moment and a source of great expense if it takes place on a die, for example, used in drop-forging, or metal stamping, on which a month or more of a skilled mechanic's time has been expended.

The changes of structure in steel brought about by heat treatment have been summarized by Brinnell as follows:

Changes of Structure Brought About by Heat Treatment

1. When a piece of steel, hardened or unhardened, is heated to the upper critical point, Ac_3, all previous crystallization, however coarse or however distorted by cold work, is obliterated and replaced by the finest structure which the metal is capable of assuming, the structure of burnt steel being the only exception, save that in steels of .2 carbon or lower a multiple treatment of some kind is often necessary (the ferrite, pearlite and cementite is changed to austenite).

2. When a piece of steel, hardened or unhardened, after being heated to Ac_3 is allowed to cool slowly it retains the fine structure which it had acquired at that temperature. It then possesses the finest structure which *unhardened* steel is capable of assuming. (The austenite reverts to the original pearlite and ferrite but the grains, however coarse originally, become now the finest and best distributed possible.)

3. When a piece of steel, hardened or unhardened, after being heated to Ac_3 is suddenly cooled by quenching in cold water; for instance, it is fully hardened and retains the fine grain acquired at that temperature. The metal then possesses the finest structure which *hardened* steel is capable of assuming. The austenite which tends to rapidly revert through several stages to pearlite, etc., is trapped before reaching the soft pearlite stage and the resulting structure, depending on the carbon content and the alloying chromium, nickel, manganese or other elements, is either composed of martensite, the hardest stage in steel, except cementite; and the condition of greatest volume, troostite, which is softer than martensite or sorbite, which is softer still. But in each of these conditions the structure is the finest possible.

4. When a piece of steel, hardened or unhardened, is heated to a temperature *above* Ac_3 and cooled slowly, the metal whose crystallization has been obliterated by its passage through Ac_3 crystallizes again, the crystals or grains increasing in size until Ar_1 is reached below which there is no further growth. If the steel is heated above Ac_3 and allowed to cool to Ac_3 again and there quenched, it will be fully hardened but its structure will be coarser than if it had been quenched from Ac_3 without having been heated higher.

5. The higher the temperature above Ac_3 from which the steel is cooled or quenched the coarser the grain.

6. The slower the cooling from above Ac_3, the coarser the grain.

7. When a piece of hardened steel is heated to a temperature below Ac_3 some of its cementite is changed spontaneously into pearlite and the metal is thereby softened. This tendency increases with the temperature and is greatest at Ac_1. This transformation, however, is not accompanied by a change in the dimensions of the grain.

Researches in which the writer took part and the recent work of Professors Howe and Zimmerschied have developed that:—

1. When a piece of steel, hardened and slowly cooled or unhardened is heated to the temperature Ac_1, the cementite existing in the pearlite structure is radically altered from the previous laminated form to the globular state and the resultant is thereby softened and rendered ductile, though the size of the grain is unchanged.

2. When a piece of steel previously heated to Ac_3 and then either hardened or allowed to cool slowly is thereupon heated to Ac_1 and allowed to cool slowly the resultant structure shows globular cementite and is the softest and most ductile that steel may assume, the size of the grain being the smallest possible.

Brief Review of Steel Composition

Steel is an alloy of iron and carbon in its simplest form and is not found in nature. Steel has been defined as iron which is malleable or that is capable of hardening by sudden cooling. This metal is a modified form of iron that has more carbon than malleable or wrought iron and considerably less than cast iron. This is not an exact statement of fact, because some of the modern so-called steels have as low a carbon content as wrought iron. The properties of the various forms of steel that have been adapted to industrial uses naturally vary according to amount and nature of the alloying elements. We have learned that low carbon or mild steel contains from five-hundredths of one per cent to three-tenths of one per cent carbon. This carbon content is too low to have the steel hardened by quenching after the steel has been brought to a cherry-red heat unless the steel is subjected to a carburizing process to increase the carbon content at the surface, and then, of course, only the surface hardens. Steel containing from three-tenths of one per cent to eight-tenths of one per cent carbon is known as "medium carbon" steel and may be hardened to some extent by the quenching process. If the carbon content is from eight-tenths of one per cent to two per cent, we have what is known as "high carbon" steel, which is capable of being rendered very hard and at the same time brittle by heating to the required temperature and cooling suddenly by quenching in oil, water or brine, depending upon the degree of hardness desired and the use for which the steel is intended. The harsher the action of the quenching medium, brine being the one used to obtain maximum hardness, the more brittle the steel becomes.

Alloy Steels

Alloy steels have now come into extensive use due to the great advances that have been made in the automotive industry. In the development of the automobile and aircraft it has been necessary for engineers to design parts that would be light in weight and yet possess much more strength than could be obtained by using ordinary commercial grades of steel and iron. Among some of the elements which have been used in combination with carbon and iron are found manganese, nickel, chromium, vanadium, tungsten and molybdenum. The use of these elements either alone or in combination is to produce qualities of strength and hardness combined with ductility. The various natural properties imparted by the alloying elements may be greatly increased by intelligent heat treatment or may be entirely nullified by improper heat treatment.

The ordinary grade of nickel steel contains about one-quarter of one per cent carbon and 3 to 3½ per cent of

(*Continued on page* 551)

Digitized by Google

European Sport Planes

Some Recently Developed Small Airplanes for the Individual Flier

By E. H. Lémonon

EUROPEAN builders of airplanes have built sport machines of several models, each one being very different from any of the others. All these planes are designed to meet the requirements of a quick get-away, a fast climb, and a high speed combined with a low landing speed, to ensure the greatest possible degree of safety. The design and construction embrace light weight and economical upkeep to the highest degree consistent with the above qualities. Our Paris correspondent has sent details and photographs that will be interesting to the readers of EVERYDAY ENGINEERING MAGAZINE who are following aeronautical developments.

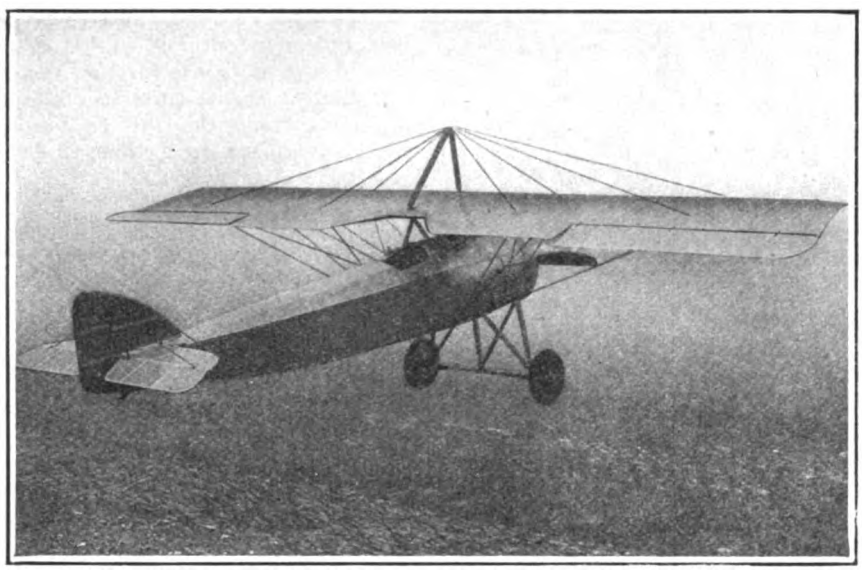


Fig. 1. The Morane-Saulnier Parasol A. R. Type Monoplane

A Clean-cut Monoplane

The French Morane-Saulnier, Parasol, A. R. Type, shown at Fig. 1, has a fuselage of a good streamline shape; the nose and front are covered with aluminium, doors in the side giving access to the engine, the remainder being covered with linen. This "Parasol" is a two-seater tandem, the pilot being in front the passenger and immediately behind the engine. The body tapers to a vertical strut at the rear, on which the rudder is hinged; the fuselage is simple and as lightly constructed as possible. The motor is an 80 h.p. Rhone provided with dual ignition. The landing gear is composed of a chassis of streamlined steel tubing welded by the oxy-acetylene process. Rubber shock absorbers bind the axle to the struts. The landing wheels have big tires to enable it to land on rough ground. The empennage is composed of a non-lifting fixed stabilizer, to which are fastened the elevator flaps. The ailerons are connected to the control-stick by rigid connecting rods, actuating shafts passing through the wings.

The Morane-Saulnier is very quick in answering to the controls, and capable of performing any "stunt". It flies at 153 kilometers (95.1 miles) an hour as a maximum speed, with a minimum of 80 kilometers (49.7 miles), and will climb to 6,000 meters. American pilots trained at Issoudoun will remember a modified form of this plane equipped with a 50 h.p. Gnome engine as a "rouleur" or penguin for preliminary training. The wing spread was reduced and the ailerons left off so the embryo pilot could not leave the ground.

The specifications are as follows:

Span	10 m. 565
Length	6 m. 767
Height	3 m. 405
Total area	21 + sq. meters
Weight of machine empty	400 kgs.
Weight of fuel	67 kgs.
Weight, useful	160 kgs.
Weight, total	627 kgs.
Load per sq. m.	28 kgs. 630
Engine	80 h.p. Rhone
Weight per h.p.	7 kgs. 840

The Dutch Spyker V. 3 Type

The well-known Dutch firm "Trompenburg" of Amsterdam, who built the famous "Spyker" car, is also building two models of planes, one of which is shown at Fig. 2. The manager is Henry Wynmalen, the pre-war aviator.

The latest model is illustrated and the specifications are as follows:

Span (upper and lower)	8 m. 10
Total length	6 m. 10
Height	2 m. 60
Total area	20 sq. m. 280
Weight empty	350 kgs.
Useful load	350 kgs.
Total weight	700 kgs.
Engine	Spyker 130 h.p.

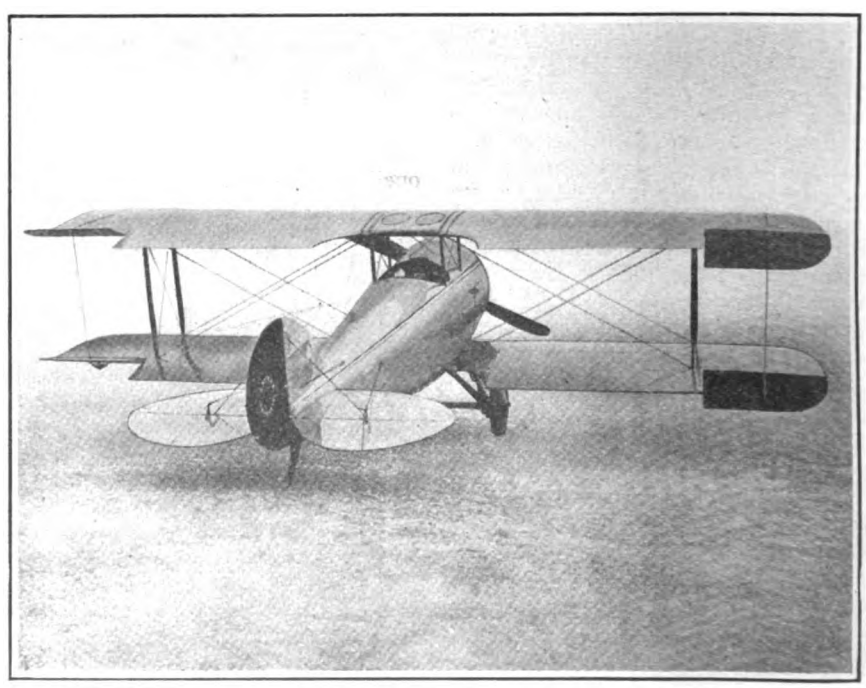


Fig. 2. The Dutch Spyker V-3 Type Biplane

Digitized by Google

Maximum speed.....190 km. hour
Minimum speed..... 80 km. hour
Duration ..... 4 hours
Safety factor 8

The Spyker engine is a 9-cylinder rotary engine of French Clerget type, giving 135 h.p. at 1100/1200 revolutions per minute. The bore is of 120 mm. and the stroke of 160 mm. Valves are mechanically operated by push rods, one exhaust and one inlet valve being provided. The pistons are of aluminum alloy. Hollow connecting rods are used with fixed gudgeon pins floating in bronze bushings in the piston. Cylinders are all steel and integrally machined, including the flanges. The ignition is of dual type and the total weight is of 138 kilogrammes.

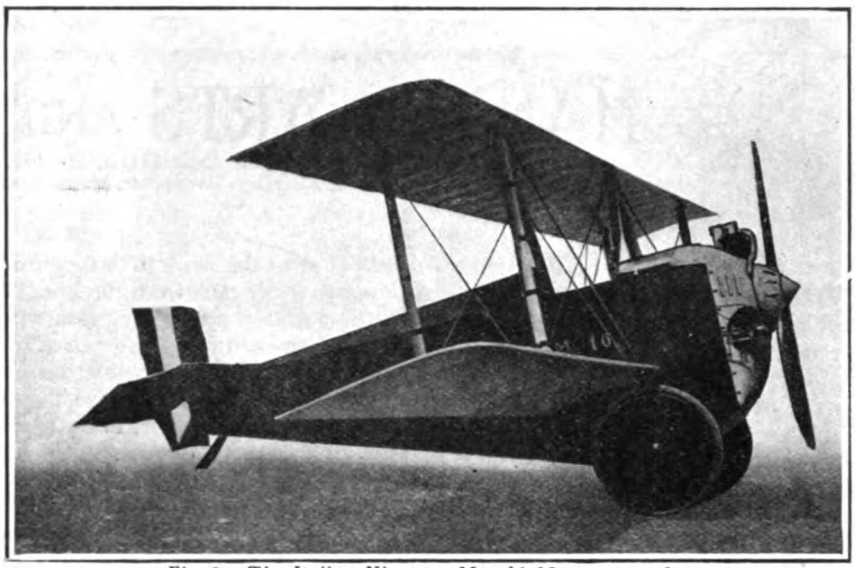


Fig. 3. The Italian Nieuport-Macchi M-16 sport plane

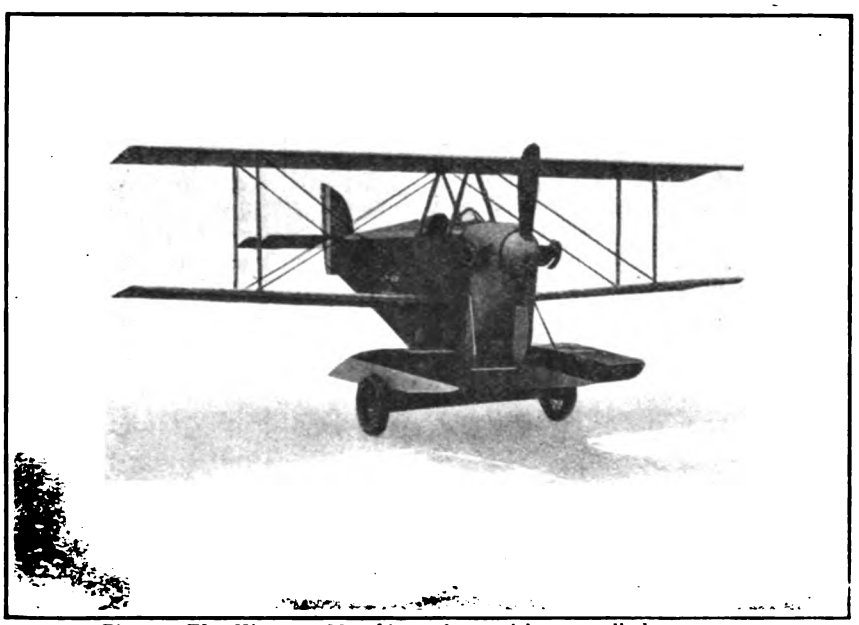


Fig. 4. The Nieuport-Macchi seaplane with two-cylinder motor

Surface ..... 12 s. m.
Engine .....30 h.p., 3 cylinder
Weight (empty) .....160 kgs.
Loading ..... 95 kgs.
Air endurance ..... 2 hours
Highest speed .....130 km. per hour
Climb at 1,800 m. in 26 min. 30 sec.

The Macchi Company has also built the M. 16 flying boat shown at Fig. 4, which is of absolutely the same type as the preceding one, except that a twin cylinder engine is used. The two floats can be easily substituted for the wheels of the landing gear shown on the land machine.

The Italian R. 6 40 H.P. Triplane

Ricci Bros. of Naples have built a single-seater sport plane that is very small, it is the "R. 6 40 h.p. triplane" and has also been called the "flivver" of the air. Its construction is shown

(*Continued on page* 533)

The Italian Nieuport-Macchi M. 16 Sport Plane

This is a single-seater with a biplane body, a pusher screw, and a monoplane tail. The smallness of its dimensions and the low power of the engine are so unusual that it has been called "the air motor-cycle". The upper wings are fixed to the double cabane, whereas the lower are attached to the fuselage, which is of rigid trellis construction, and though of a simple construction, is very strong. The fuselage itself is fitted with a comfortable cockpit for the pilot.

This compact craft, shown at Fig. 3, was originally built for sporting purposes, but it can be used for training cadets as it is inexpensive as well as for perfecting the already qualified pilots. The machine is said to be very manoeuvrable and is easily handled.

These are the specifications:

Span ..... 6 m.
Total length ..... 4 m. 20

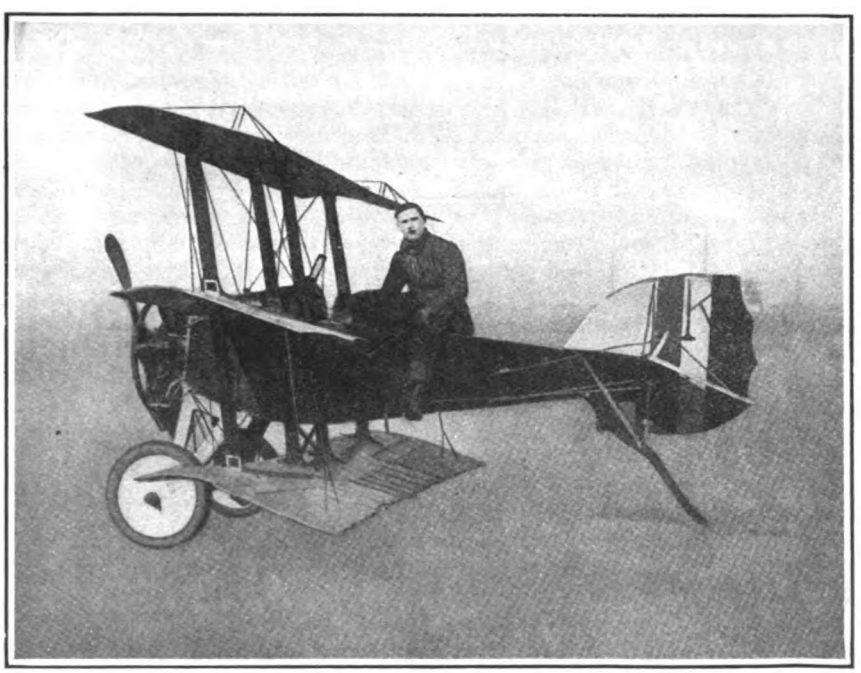


Fig. 5. Italian Ricci 6 forty horsepower sporting triplane

Digitized by Google

MANUAL ARTS AND CRAFTS

PROJECTS FOR THE SCHOOL, HOME OR SHOP

SLAT FURNITURE

THIS method of construction is specially adaptable for boys that have that manly desire to create worthy projects for the home. It is excellent for beginners, as it trains the hand and the eye in a most skilful manner. For developing the ability to saw accurately, it has no equal, as a boy appreciates the fact that all his efforts count. Quick, concrete results stimulate the youth more than any other fact, therefore a boy just naturally glories in watching the growth of his own handiwork. The more one studies these problems from the educational as well as the practical aspect, the more it is appreciated that to keep a boy interested results in a development of skill, stamina and courage. Skill is acquired by diligent and intelligent practice, stamina from properly directed energy, courage is born of repeated successes.

These projects are especially designed to develop the art of sawing close to the line, thereby eliminating that tedious monotony of chopping, cutting, scraping and planing to the line. With a little concentration (called care) one can soon acquire the skill to saw within a sixteenth of an inch from the line. Begin by marking across the grain with a pencil sharpened flat similar to a knife, using the try square to guide the lines. Squaring around the stock so that the lines will remain parallel to the saw cut on all four surfaces is an excellent guide for all; even the expert uses this method when he is particular or wishes to eliminate any possible chance of a "slip up." Therefore it will surely repay the amateur to draw the lines on all four surfaces until he finds himself so skilful that he can saw both straight and square by sighting.

The design at Fig. 1 is an octagonal Taboret, very useful when used as a sewing basket, smoking stand, or plant pedestal. This project requires a little more than 5 square (board) feet: No. 1, 1 piece, ¾" x 12" x 33" to 36", and 1 piece, No. 2, ¾" x 12" x 36" long. Establish the working edge (standard edge so called) straight, smooth and square on No. 1 piece, then carefully gauge a line on both sides 1¾" from the working edge. In most cases with experienced workers, both edges are planed straight, square and smooth, then gauged from both edges. This saves a little time in the operation. Rip saw near the line, allowing not less than 1/16 of an inch, watching the lines on both sides.

Time may be saved by laying out the position of the shelves and cutting these pieces to length before cutting to width. Now lay out the octagon as indicated in Fig. 4. There are several ways to do this. This method is given because it may be done by the compass or the radius may be laid off by the rule on the sides of the square. First, establish the working edge, then lay out the square as large as the stock is wide,—that is, the width of board after truing up will determine the size of the square (shelves). Then draw diagonals as indicated, the distance from this intersection to the corner which equals the radius as shown in Fig. 4, rising all four corners of the square as centers of their respective arcs. The shelves may be laid out separately or one may be cut out, planed true, then used as a pattern to draw out the others. Care must be taken to have them match; that is, when

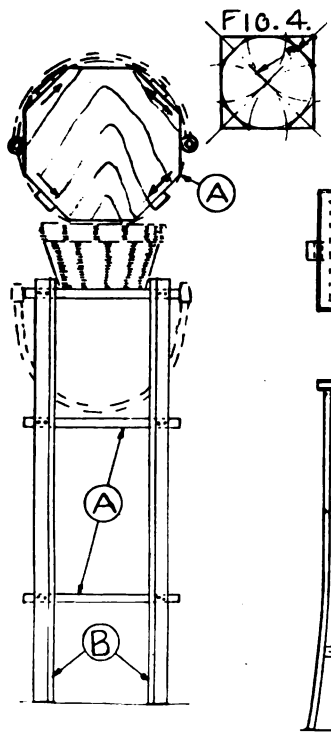


FIG. 1.
OCTAGONAL TABOURET

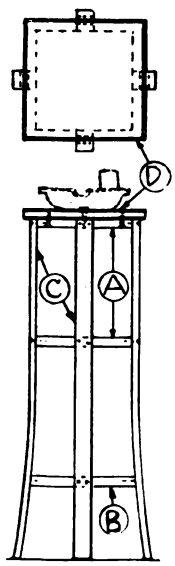


FIG. 2.
SQ. TOP STAND

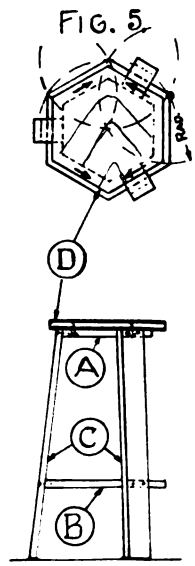


FIG. 3.
HEXAGONAL STOOL

ALL DIMENSIONS IN INCHES

FIG. 4.

FIG. 5

SLAT FURNITURE

Designed For The Beginner Dr. C. E. MULLERMAN
MANUAL TRAINING INSTRUCTOR N.Y. CITY SCHOOLS

LISTS OF MATERIAL

FIGURE 1.
UTILITY TABOURET

A	3	SHELVES	¾	x 12 x 12	(11¾ sq.)
B	4	LEGS	¾	x 1¾ x 33	

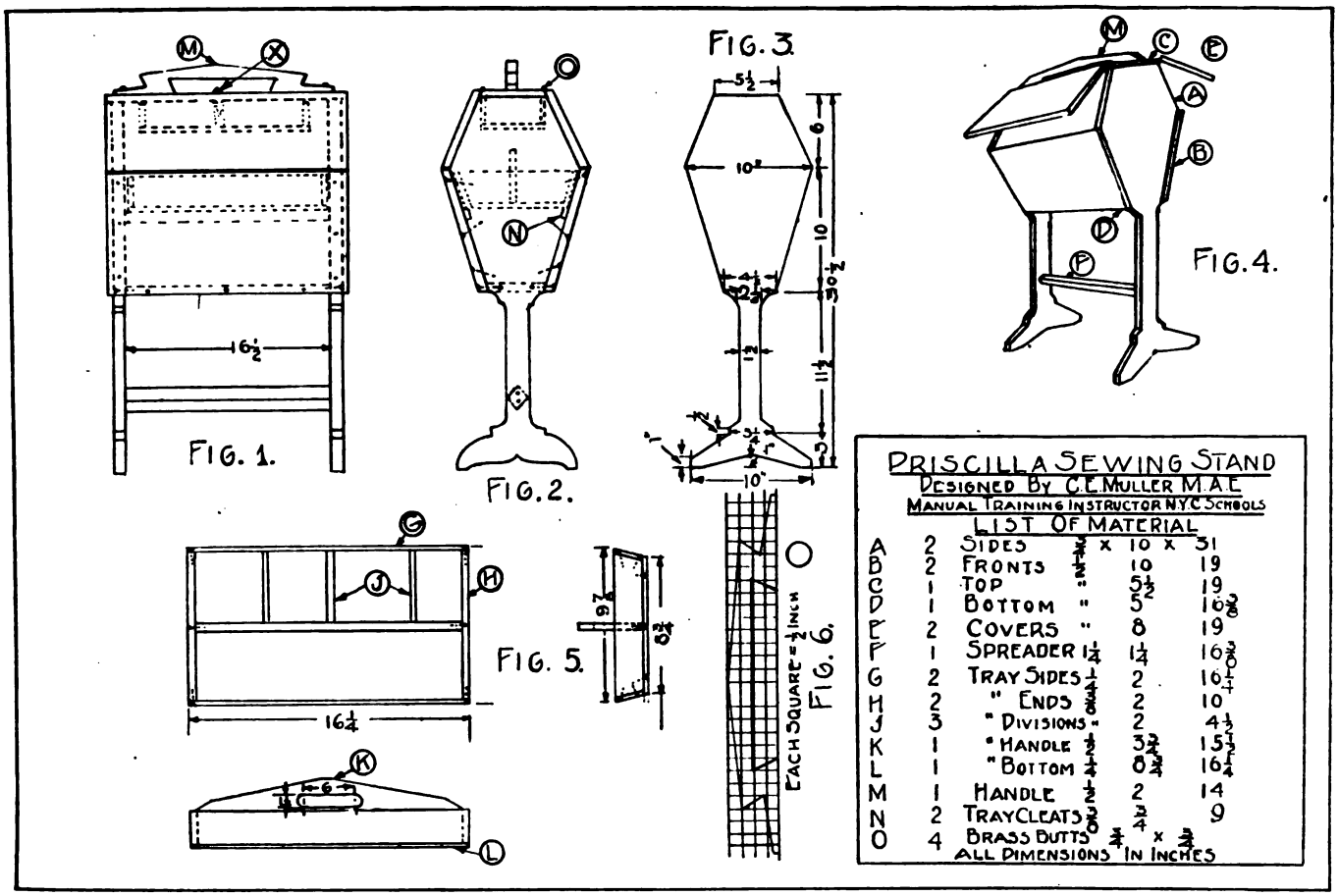
FIGURE 2
JARDINAIRE STAND

A	2	HEADERS	¾	x 7½ x	7½
B	1	SHELF	=	8½	8½
C	4	LEGS	=	1½	26
D	1	TOP	=	9½	9½

FIGURE 3
CONVENIENT STOOL

A	1	HEADER	¾	x 7 3/16 x	8¼
B	1	SHELF	=	9½	11
C	2	LEGS	=	2	18
D	1	TOP	=	8 5/8	10

Digitized by Google



planed (temporarily nail them together and plane as one) they should be so marked that they remain in the same relation to one another. If this is not done the legs will not lay straight, but be slightly bowed. This may be done by marking the corresponding corner of each shelf. By sawing accurately to the line 90% of the work is accomplished. When sawing or planing be sure to go with the grain, especially at the corners as indicated by the small arrows, Figs. 4 and 5.

The legs are nailed on to the shelves with two 1¾" to 2" No. 16 wire brads. These should be lock nailed, as explained in the next project, at each place of contact. Care must be taken and trials made frequently to insure that the shelves set perfectly level (horizontal with the floor) as the project stands upright.

The designs at Figs. 2 and 3 are of practically the same construction and need but little additional instruction. The principal difference between Fig. 1 and Figs. 2 and 3 is that the legs do not project above the top but are nailed to a header which allows the top shelf to project. This gives a more finished appearance, also extra strength. The top shelf is fastened by wood screws that protrude upward through the header.

The lower shelf of Fig. 2 is bevelled to fit the flare of the legs. The header and lower shelf of Fig. 3 are bevelled likewise. This method permits chamfering the edges of the top shelf as described and diagramatically shown in the next issue. Set the brad heads in about 1/16 of an inch. Putty of the same color as the stain should fill the holes. Stain the project as desired. See the former issue for a number of home-made stains and methods of application. It may then be finished with 1 or 2 coats of shellac, wax or varnish as described in the August edition.

PRISCILLA SEWING STAND

THIS sewing stand is a very attractive and convenient receptacle for mother's or sister's fancy work and embroidery. The appreciation shown by them surely compensates for the little time and expense required in its construction. A handy person can produce one of these stands in an incredibly short time. One especially apt in woodwork can easily complete this project in 8 to 10 hours, including the staining. Chestnut wood is particularly recommended for this project, as it has very attractive grain and exemplifies the antique; also it is soft and easily planed and cut.

Select two pieces of stock ⅝" to ⅞" x 10" x 31", temporarily nail together, establish the working edge, then square the ends to length. If the sawing is accurately done, it need only be sandpapered with No. 2, then with fine sand-paper when the project is complete. If the design of Fig. 3 is used a cross-cut saw will suffice for the entire job, including the handle K of the tray, which may be made similar to M and then nailed or glued on the tray partition.

The fronts B and top C, Fig. 4, are made to extend beyond the sides A to give it the Colonial aspect and are lock nailed, as indicated in Fig. 2, with nine 1½- to 2-inch No. 16 wire brads set and puttied. The bottom D is a plain butt joint depending only on the nailing as indicated. The covers E are hinged at the top with two ¾" x ¾" brass butt hinges. Care must be taken to allow for the proper bevelling for the joint. The spreader F must be substantial, as it may be used as a foot rest. If this component is made diamond shape or even square, set with the diagonal vertical, it will add to its appearance. A strip ¾" by approximately 2" with chamfered corners will suffice. This also acts as a brace for the legs of the stand.

The tray, Fig. 5, is simply butt-jointed, then lock nailed with approximately 36 1¼-inch No. 16 wire brads. The partitions are in number and position to suit one's fancy and are usually used to hold the scissors, thread, needles, etc. Of course this tray is removable, allowing access to the space beneath that is used to hold the fancy work. When in a hurry, this fancy work may be placed on top of the tray. Two cleats running the full length of the tray should be glued or bradded to hold the tray in place, or four small blocks, approximately ⅜" x 1" x 1", may be glued in the corners in lieu of the cleats. Some folks prefer that the tray be minus the handle so that the

(*Continued on page* 566)

Digitized by Google



CHEMICAL NOTES, RECIPES AND FORMULAS



ACTIVE NITROGEN

NITROGEN may be described as one of the most peculiar of the elements. Under ordinary conditions, when it is isolated or in the elemental condition, it is quite difficult to make it combine with another element. But in its combinations it goes to both ends of the scale, forming ammonium compounds by combining with hydrogen and at the other end combining with oxygen. The alkali and alkaloids which it forms are very powerful basis and these are due to its hydrogen combinations; its oxygen combinations lead to nitric acid, one of the most powerful of the mineral acids. Recently an allotropic form of the nitrogen has been studied called active nitrogen. By passing the normally almost inert gas through a tube, in which a cascade of Lyden jar discharges are maintained, the gas glows and is said to be activated. The glow persists for a while. Ordinarily nitrogen gas forms a good atmosphere in which to preserve phosphorous, sulphur, selenium and other elements, but if the activated and glowing nitrogen as it leaves the part of the tube in which a spark is produced is caused to pass over many of the elements strong reactions occur which are not always understood. Ordinarily sulphur is a very inert substance as far as nitrogen is concerned, but it reacts with a blue flame or glow with active nitrogen and a green material is deposited on the sides of the tube. This is thought to be mainly nitrogen sulphide. Arsenic gives a green glow and produces arsenic nitride. If the glowing nitrogen is passed over metallic sodium the metal may be said to burn, forming the nitride, and similar results are maintained with other metals. Mercury, as might have been anticipated, produces an explosive compound. Nitric oxide acts in a most enigmatic manner forming, when mixed with active nitrogen, a higher oxide, the peroxide. There has been considerable controversy as to whether the nitrogen must be chemically pure to be capable of activation. Minute traces of oxygen seemed to have a favorable catalytic effect and a number of other gases in minute quantities increase the reaction and to produce it in any quantity about 1/10 of 1 per cent of one of the catalyzing gases must be present.

THE SMOKE PROBLEM OF SALT LAKE CITY

SALT LAKE CITY feels that its atmosphere is subject to contamination from smelters, the nearest of which is eight miles distant. Sulphur dioxide is discharged from these smelters throughout the year, and as it is a true gas it diffuses into the atmosphere. The United States Bureau of Mines is co-operating with the State of Utah in the City of Salt Lake in the investigation of the condition of its atmosphere with reference to this impurity. From the data obtained it appears that there is only about 0.1 part or less per million of the obnoxious gas in the air. It is believed that much of this is due to the chimneys of the city, which discharge at least fifteen tons of sulphurous acid into the air daily. Even with all this it leaves the air many times purer than the London, San Francisco or Berlin air. An interesting feature of the work was the collecting of samples of air at different high levels by the use of an aeroplane. These latter investigations were not so extensive as might have been desired, but they show great purity in the upper layers of the atmosphere. The general purity of the air so far as sulphurous acid is concerned was proved by all the tests.

CEMENT FOR FASTENING BRASS TO GLASS

FOR cementing brass to glass the following recipe will be found to answer very well: Take resin soap, made by boiling one part caustic soda and three parts of resin in five of water, and knead it into half the quantity of plaster of paris. This cement is used largely for fastening the brass tops on glass lamps. It is very strong, is not acted upon by petroleum, bears heat very well and hardens in one-half to three-quarters of an hour. By substituting zinc white, white lead or slacked lime for plaster of paris, it hardens more slowly. Water attacks only the surface of this cement. As it sets shortly after mixing, only as much as may be needed for immediate use should be made at one time.

FATS FOR SOLDERING

MANY workers who use the soldering iron to any extent prefer a soldering paste instead of the fluid. To them the following will be of interest:

1. Soldering fat or grease is commonly a mixture of resin and tallow with the addition of a small quantity of ammoniac. It is particularly adapted to the soldering of tinned ware, because it is easily wiped off the surface after the joint is made, whereas if resin were used alone the scraping might remove some of the tin and spoil the job.

2. The following is a well tried recipe for soldering grease: In a pot of sufficient size and over a slow fire melt together 500 parts of olive oil and 400 parts of tallow, then stir in slowly 250 parts of resin in powdered form and let the whole boil up once. Then let it cool and add 125 parts of saturated solution of sal ammoniac, stirring the while. When cool this preparation will be ready for use.

PLASTIC DRESSING FOR WOUNDS AND BURNS

INDUSTRIAL plants are now using the ambrine treatment for burns, scalds and all surface wounds which proved very successful for casualties incurred in the world war.

The dressing is a compound of wax and resin, and is solid when cold. It is heated to about 150 degrees Fahrenheit and applied by means of a special atomizer, or it can be gently daubed on with a soft brush. A plastic dressing, impervious to air, is thus formed, which does not adhere to the wound and which promotes the healing process without appreciable contraction. Disfigurement and scars are prevented to a greater extent than was possible under the old methods.

TO WELD SPRING STEEL

AN experienced blacksmith has used for years the following in welding steel springs: Just before the steel comes to a welding heat, he placed a small piece of Russian sheet iron—such as stove bodies are made of—on the joint; this melts and runs into the joint so that the weld is perfect. This Russian iron undoubtedly acts the same as welding plates which are made of iron wire mesh screen impregnated with a fluxing compound.

BELT CEMENT

PUT 15 pounds of best glue in a kettle and pour over it 5 gallons of cold water. Let it stand a few hours or over night in a cold room, after which dissolve by gentle heat. Stir in one pint of Venice turpentine and add one gallon of Martin's belt cement. Cook for four or five hours by gentle heat, being careful not to boil the mixture. A water or steam jacketed kettle should be used to avoid burning. If too thick, mix with water.

MARKING GRADUATED SURFACES

THE scale is varnished over with a little thin shellac varnish, so as to sink into all the cuts. When this is dry, a black varnish of lamp-black and shellac is spread on, so as to fill all the cuts. This is allowed to thoroughly dry. When hard, the work is driven in the lathe, and the superfluous varnish polished off with the fine flour emery cloth until only that in the cuts is left. This gives a very distinct marking and fine finish to scale.

A new way of determining the lead in copper is the placing of a small amount of it in a cavity in a positive graphite electrode of an arc. When a current is turned on the lead line is watched on the spectroscope and the time required for its disappearance gives the basis for the estimation. Fourteen to 227 seconds are cited as the time required for different amounts and the determination is accurate enough for factory work.

A direct way of determining mercury consists of suspending a coil of copper gauzes in the solution which is kept in motion until all the mercury is precipitated thereon. It is then washed and dried and weighed; it is then heated in an atmosphere of hydrogen and weighed for a second time. The loss is mercury; as little as one-tenth of a milligram of mercury can be thus detected.

The S. J. Peachy cold vulcanizing process for India rubber has attracted much attention. A solution of India rubber in benzole or naphtha is charged with sulphuretted hydrogen so as to be completely or partly saturated. In another vessel a solution of sulphurous oxide in the same solvent is prepared and the two are mixed. This forms a stiff jelly and on evaporation of the solvent fully vulcanized rubber is obtained. Its quality and degree of vulcanization are said to be perfect. It can be used to produce a leather substitute by mixing it with scraps of leather, and such material, used for the soles of shoes, is said to be more durable than true leather. It can be made to act as a cement so that it is quite possible to make such an article as a pair of shoes without a single stitch in them. It is very fully protected by patents.

Digitized by Google

EUROPEAN SPORT PLANES

(*Continued from page* 529)

at Fig. 5 and the specifications are:

Span (upper and lower)	3 m. 50
Total length	3 m. 75
Height	2 m. 30
Total area	11 s. m.
Weight empty	150 kgs.
Useful load	110 kgs.
Total weight	260 kgs.
Engine	Anzani 40 h.p.
Maximum speed	150 km. per hr.
Minimum speed	40 km. per hr.
Duration	3 hours
Safety	8
Weight of load	175 kgs.
Total weight	340 kgs.
Load per sq. m.	33 kgs. 300
Load per h.p.	9 kgs. 710
Maximum speed	81 miles
Endurance	10 hours

Of the planes illustrated and described, the small Macchi-Nieuport seaplane would seem to be a type that could be easily made by the amateur mechanic and that would be an excellent type for any one who wishes to teach himself to fly with minimum danger.



Fig. 6. The Austrian W.K.F. sport plane

The Austrian W.K.F. Sport Plane

The Wiener Karosserie und Flugzenfabrik of Vienna have built a sport plane which flies very well and was designed by Ober Ingenieur F. Gchieferl to meet the demand for a small single-seater aeroplane, the actual running costs of which would be reduced to the minimum. The engine is a German Fiero engine, 3 cylinders W. Type similar to the Anzani "Channel" type. The two valves (inlet and exhaust) of each cylinder are overhead, worked by a single rocker.

The fuselage has four longerons and is entirely covered with linen. The front stagger is very apparent, and gives good visibility to the pilot. The wings are braced with single strand wire; the ailerons are fitted on upper plane. Its specifications follow:

Span (upper plane)	5 m. 50
Span (lower plane)	5 m. 50
Length overall	4 m. 40
Height	2 m. 10
Total area	10 sq. m. 24
Engine	Hiero 33 h.p.
Weight empty	165 kgs.

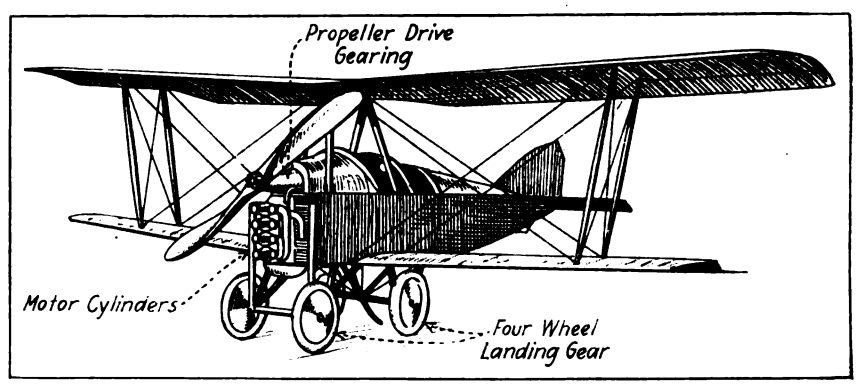
bers are of duraluminum. The longerons are of U shape, forming the outline of the body. The fittings are of sheet steel. The landing gear has been designed for greatest factor of safety. The chassis has four wheels to reduce danger of turning over, and is constructed very strongly.

The unique arrangement of the engine, which is located vertically at the front of the fuselage, necessitates a gear transmission to the propeller shaft. A brake operated by the pilot permits a quick stop of the machine from rolling after landing. This machine lands at 25 miles per hour, and recently a landing was made at Le Bourget aerodrome, France, in which the plane came to a full stop in 33 feet. This machine carries two persons, the passenger seat being at the center of gravity so that the machine may be flown as a single-seater without disturbing its balance. It is equipped with dual controls.

Specifications: Span, upper wing 26 feet; span, lower wing, 21 feet; length, total, 18 feet; area of wings, 204.7 square feet; weight, empty, 485 pounds; useful load, 440 pounds; weight, loaded, 925 pounds; weight per square foot, 4.5 pounds.

This aeroplane may be used by any sportsman as it is handled almost as easily as an automobile. It is extremely economical and will last a long time. Its construction permits use under all climate conditions, and it is much more enduring than any wood and fabric construction would be.

The Henry Potez Type A-4 motor



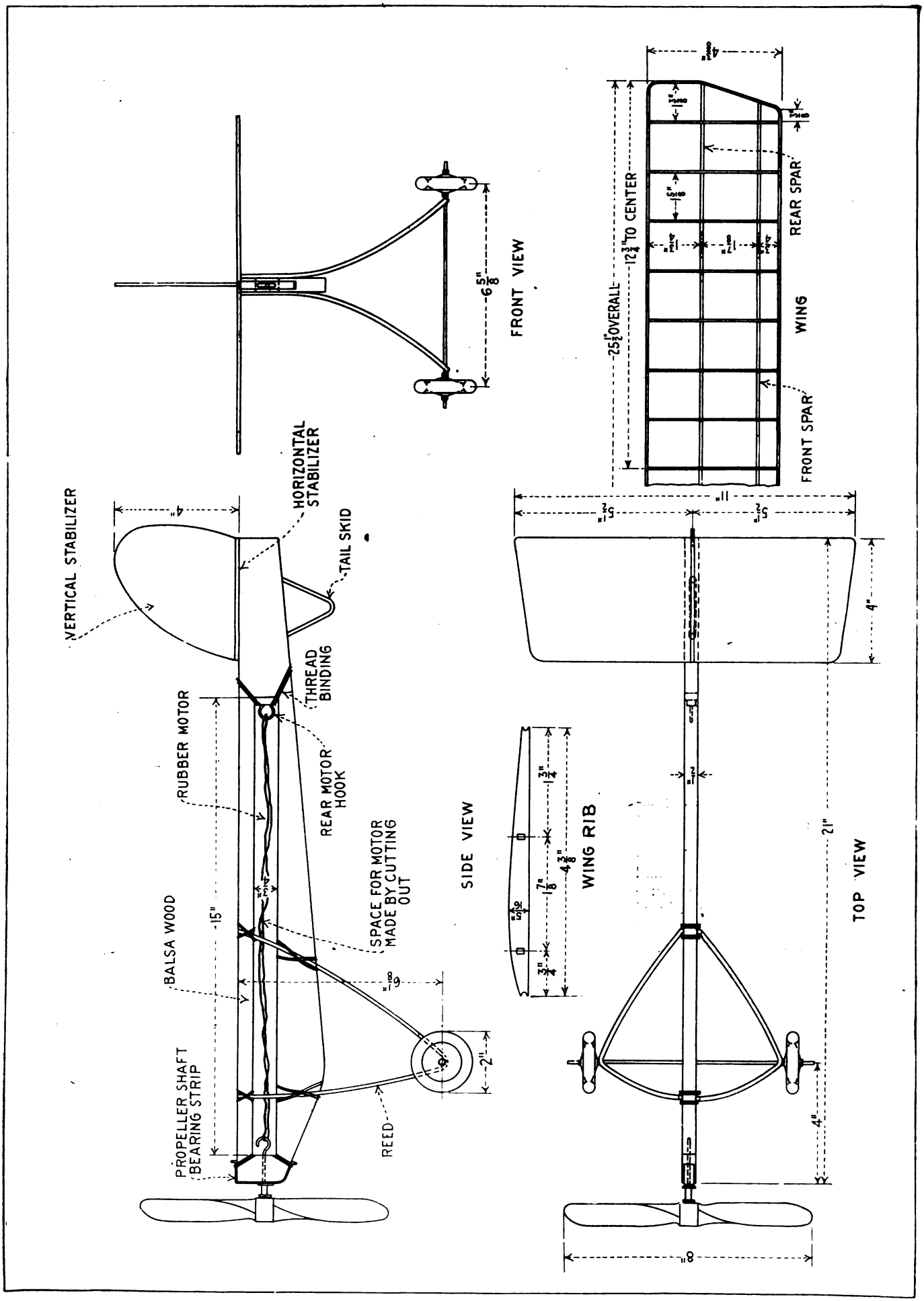
The Potez Type VIII biplane has an unconventional engine installation

POTEZ TYPE VIII BIPLANE

THIS is the little biplane which has been making a name for itself in France. It is a sport-type aeroplane, equipped with the Potez 4-cylinder, air-cooled engine of 50 horsepower. This aeroplane is all metal, the fuselage consisting of sections of duraluminum, secured to the longerons similar to the construction of a ship. It makes a very substantial and rigid construction and, of course, will not deteriorate. All the surfaces and wing frame work mem-

used in this aeroplane is of very simple design and is strongly built. It is the first of its kind, being constructed similar to an automobile engine. It is a 4-cylinder type, air cooled and gives 50 horsepower. By its unusual location a uniform cooling is given each cylinder. The crankcase is vertical, the propeller shaft connecting at the top end with the crankshaft by gears. The weight of the engine is given as 220 pounds; r.p.m. of engine, normal, 2,200; r.p.m. of propeller, 1,100. Fuel consumption, 3.9 gallons per hour.

Digitized by Google



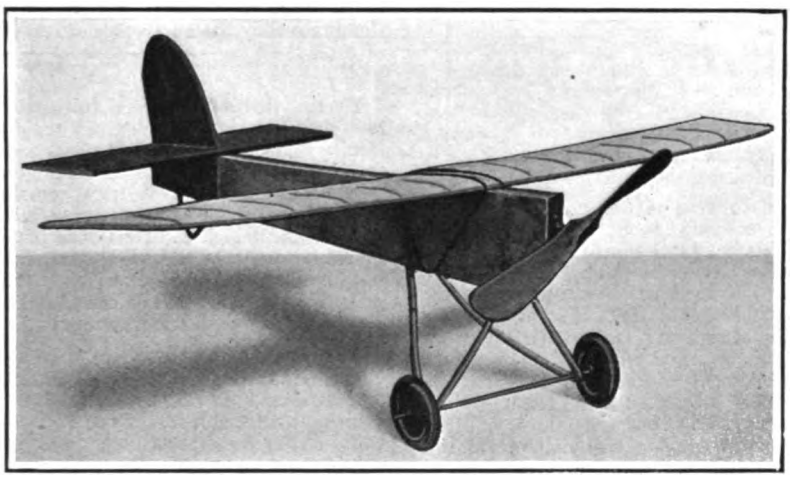
Digitized by Google

A 25-Inch Spread Monoplane

By H. C. Ellis

THE fuselage of this simple and easily made model is cut from a piece of Balsa 21 in. long, 3 in. wide and ½ in. in thickness. A portion of the fuselage is cut away as shown in the drawing to admit the rubber motor. This is best accomplished by using a sharp knife and care should be taken in cutting the Balsa or too much may be cut out, thereby weakening the fuselage.

The propeller is 8 in. in diameter and has a pitch of 22 in. Sheet brass, 1/16 in. thick, is used for a propeller hanger and is shaped and bound to the fuselage as shown in the drawing. A plain bearing propeller shaft is used as a mounting for the propeller. The rear rubber hook is of 1/16 in. steel rod which is bent to shape, and fastened to the rear of the fuselage by binding and gluing as shown in the drawing. Ten feet of ⅛ in. flat rubber is used for the motive power.



The completed model of the simple 25-inch spread monoplane

The landing gear is constructed of ⅛ in. reed and is shaped and bound to the fuselage at the points shown in the drawing. A 1/16 in. steel axle, threaded and fitted with nuts, is bound and glued to the landing gear. The wheels are 2 in. in diameter. There are several types of wheels on the market that may be used. The fuselage is drilled at the points shown to take the tail skid which is ⅛ in. reed.

The stabilizer and rudder are cut from ⅛ in. Balsa. Small nails or brads and glue are used to fasten them to the fuselage. Solid ribs of 1/16 in. spruce or Balsa are used in the construction of the main plane. Dowels ⅛ in. in diameter is used for the spars in the main plane. The edges of the main plane are of ⅛ in. reed. Care should be taken in assembling the main plane so as not to have it warped. The ribs should be glued to the spars and reed wing edges. After the glue is dry, cover the planes with paper which may be purchased from several of the model supply houses selling model aeroplane supplies. After the wing is covered the dope should be applied. The main plane is fastened to the fuselage by a rubber band, a simple and secure method of fastening that has the advantage of economy and yet that permits the main plane to be shifted to secure correct balance.

After the rubber motor has been placed on the motor and propeller hooks, the sides of the fuselage may be covered over with bamboo paper, which is doped or varnished, to seal the opening in which the rubber motor is placed and obtain a smooth, unbroken fuselage with minimum air resistance.

STATISTICS SHOW FLYING IS SAFE

THE airplane is the fastest machine man has ever built, but fast as it is, it has not yet caught up with its reputation for danger. That reputation was acquired when the plane was in its infancy, when man was just beginning to master the air, and in the mind of the average man it has not yet been downed. One reason why this belief in the danger of aviation persists, is that man has clung to the earth for ages untold and it does not seem quite natural to him suddenly to take to the air.

Just as people a few years ago regarded airmen, so prehistoric races must have regarded the first men to venture on water in coracles. The average busy man has no time to read of the exact science of aeronautics which now has made the airplane safe. He sees in the papers occasionally a story of an airplane accident and reads it, not stopping to think of the thousands of miles safely flown that day by other planes. But he probably skips a few briefer accounts of accidents to automobiles because these are too common to interest him.

In substantiating this statement that airplanes are safe we find our best argument in statistics collected here and abroad by governments. It should be borne in mind that these figures deal principally with land machines, and that flying boats are admittedly safer than airplanes. The reason for this is that flying boats can always land on water while airplanes are dependent on landing fields which, at the present time, are far from numerous. The flying boat is not compelled to fly high for safety's sake. It can skim along two or three feet above water for hours when fog or low clouds make high flying hazardous. The boat can always land safely if the fog descends to the water or becomes too thick, while the airplane is not so fortunate.

The British Air Ministery, to get back to the subject, collected statistics on all commercial flying in that country for the last seven months of 1919. The results amazed even pilots and engineers who had long regarded the risk in flying as negligible. The figures covered 35,330 flights by 403 machines of a total time in the air of 8,368 hours, during which time 593,000 miles were traveled. In all this flying in good weather and bad, one passenger was killed in every 16,666 passenger hours in the air. To put it differently a single passenger might expect to fly about 1,180,000 miles—47 times around the world—before becoming the victim of a fatal crash. That sounds utterly absurd to the landsman, yet the British Government stands back of the figures.

The pilots, who tested experimental planes, did stunt flying and ran other unnecessary risks, showed .48 deaths per thousand hours, as compared to the passenger rate of .06 per thousand hours.

Coming nearer home, figures compiled by the Post Office Department show to the end of 1919, 405,000 miles flown with the loss of three pilots. These pilots, of course, ran many risks, for they carried the mail through rain, snow, and fog that blinded them.

Even in training pilots the figures are exceedingly low. From the beginning of the war until the end of 1918, 17,690 men learned to fly in the U. S. Air Service. They spent 705,243 hours in the air. One man was killed in every 2,310 hours, or one to about every 160,000 miles. With these positive proofs of aviation's safety before us, American airplane manufacturers are going ahead building planes, confident that the realization will soon come everywhere that man can take care of himself as surely in the realm of the birds as in the realm of the fishes.

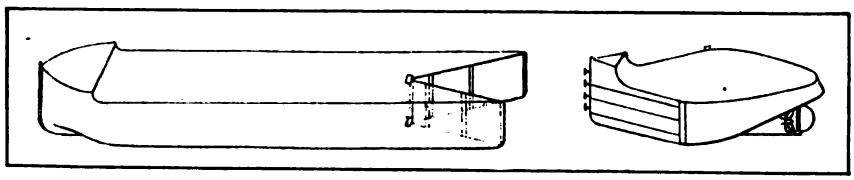
Digitized by Google

EVERYDAY SCIENCE NOTES

BY PROF. T. O'CONOR SLOANE

NEW SYSTEM OF PUSHING BARGES

AN interesting system has been developed for pushing barges. A substitute for the tug boat, the Constant pusher, is illustrated, as regards the principle of its operation herewith. The general principle is clear from the cut. The smaller part contains the engine and propeller. The securing of the two together is done by T-headed bolts which are indicated projecting from the head of the pusher. Four of them are shown. These bolts enter through a slot into a vertical channel at the apex of the reetrant angle



in the stern of the barge. When the two parts have been brought as close together as possible the T-bolts, whose heads hitherto have lain in the vertical plane and which passed through the slot into the channel, are turned through 90°, which brings the T-heads across the slot. The two sections of the boat are then drawn together, by nuts from the interior of the pusher, connecting the two units solidly together. The idea is that the pusher can be shifted around from one hull to another so as to keep one hull in motion and doing work while the other is being loaded or unloaded as the case may be. On the old Morris Canal in this country the canal boats used to be made in two sections bolted together, capable of rapid detachment from each other. They were pulled by animal power. On the Mississippi River in this country the pushing of cargo barges has been very extensively applied.

It has been found that the industrial production of helium for use in balloons at Fort Worth and Petrolia, Texas, is so expensive as to be impractical. It cost more to manufacture the gas than to build the airship. Six millions of dollars have already been spent on the plants.

Coke ovens are subject to several kinds of corrosion due to impurities in the coke. Sodium chloride and sodium sulphate have generally to be looked for and as they volatilize owing to the heat of the charge penetrate and this integrates the brick lining. Iron oxide has been found in the bricks, probably due to the volatilization of the iron in the coal as iron chloride by reaction with the sodium chloride. This also is a source of injury. Silica bricks have been found to measurably solve the problem.

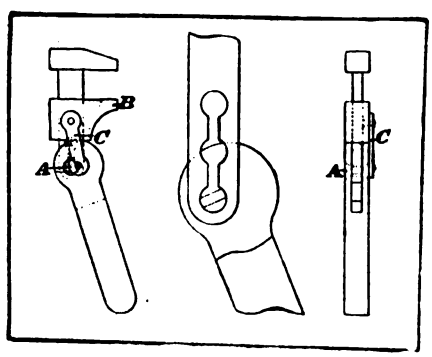
Considerable attention is now given to the shaking or beating of cement bags to recover the cement ordinarily adhering to them after emptying. By a recent concrete road contractor in Wisconsin one million cement sacks were cleaned and thereby two hundred barrels of cement were recovered. The sacks were reduced in weght to one-half or one-third their weight before cleaning so that the freight on the return bags was reduced.

The Germans, during the war-time scarcity of coal, have employed unburned bricks in building. It is claimed that five or six weeks of drying of bricks made with the proper color of clay will give material adapted for ordinary house construction. It is exciting considerable attention in England. Of course, such bricks are very much cheaper than the burned bricks. Plaster adheres to them perfectly and they are not found to be objectionable from dampness.

A red coloring matter used by the Chinese in coloring food products, notably cheese, has long been kept a secret. It is now found that it is produced by the cultivation on rice of microscopic fungus. This fungus attacks the grains of rice, and penetrates them, so that when they are ground up an effectual and innocuous red coloring material is produced. As far as the investigation has gone the secret of the preparation is in the conditions of temperature and humidity required for the successful cultivation of the fungus.

ADJUSTABLE WRENCH

THE spanner or wrench which we illustrate has its jaw, B, pushed up against the nut or bolt which may be between it and the upper jaw by the movement of the handle, which has a cam-shaped end. The



link, C, is an auxiliary for drawing back the jaw, B, when the handle is pulled in the other direction. There are several holes in the shaft of the wrench so that the handle, A, can be shifted up and down to accommodate different sized objects.

The Minister of Public Works of Buenos Ayres has been presented with a report of experience with a gliding boat on the Lambert system. It is understood that the report is very favorable and that the adoption of this system is recommended for river use on many rivers of the Argentine. It is proposed to construct the boats in government shops, importing the machinery only.

Lignite briquettes are to be placed on the Canadian market, it is hoped, under the auspices of the Alberta Government. The Government experts are working on a method to extract tar from the oil-bearing sands of Alberta to use in the cementing of the briquettes.

A very curious coincidence, and it may eventually prove to be more, is that the magnetic elements, iron, nickel, and cobalt have nearly the same atomic weights, namely: 55.8, 58.7, and 59. Manganese is also slightly magnetic and its atomic weight is 54.9. A new magnetic copper-manganese-aluminum alloy has an average atomic weight of 56.3.

Electrolytic iron has been investigated by the chief research chemist of the British Ministry of Munitions. It is found that this iron is not so pure as it is generally supposed to be, and it may contain pin holes, lumps of included matter, cracks, developed and incipient. He thinks that these troubles can be largely eliminated, by control of the deposition process, but as at present produced it is not considered a safe iron from the engineering standpoint.

A question of pressure per unit area came up at a recent discussion at a meeting of the British Royal Institute. If the edges of two knife blades are pressed together the area in contact is so small that there is no trouble in producing a pressure of over 300 tons to the square inch. The same may be produced in a Brinnell hardness tester. The gas pressure in large calibre guns rarely exceeds 20 tons to the square inch, which is about 2,500 atmospheres. It is calculated that if a hole 56 miles deep were made in the earth the pressure at its lower point would be about 24,000 atmospheres and the pressure at the center of the earth is put at about 6,000 tons to the square inch. Pressures comparable to these and temperatures in the neighborhood of 17,000° have been momentarily obtained in making diamonds. It is evident that the sinking of the proposed 12-mile shaft for purposes of investigation may involve very serious problems.

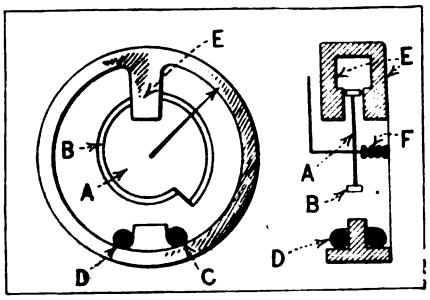
From all parts of the world news is being received of the appraisal of available waterpower. In Brazil 148 waterpowers are reported which could supply 30 millions of horsepower. From Canada comes a report that the Government of Ontario proposes to spend 17 millions of dollars in waterpower development. In the State of Washington 100 miles from the city of Seattle, a 36,000-kilowatt power station for that region is being installed upon the Stagit River. The power line will work at 160,000,000 volts. From Iceland comes the estimate of 1,000 millions available horsepower and the Iceland Waterfall Commission may grant a concession to a Dano-Norwegian company for the utilization of waterpower for the production of nitrogen and for an electrification of the whole island. It is even proposed to construct a 200-kilometer electric railway running from the port of Reykjavik to the East through the agricultural district, which will be, when constructed, the first Icelandic railroad.

Digitized by Google

It is interesting to note that American Sperry gyroscopic compasses are to be installed in two steamships being built in Great Britain.

ELECTRICAL METER

AN apparatus for indicating the strength of an electric current whose construction is such that the indicating hand can rotate practically through 360° is illustrated in the cut. A disc made of soft iron is shown provided with an index hand. The flange B follows the spiral periphery of the



disc. The controlling magnet has a pole C whose windings are indicated by D and opposite there is a double pole EE. Between its parts the periphery of the disc and its flange rotates. A spiral spring F pulls the disc in one direction so as to make the index hand indicate 0 when no current is passing, but when the current passes the magnet pulls against the pull of the spring and the whole is calibrated so that the movements of the index hand gives the amperage.

The Germans have developed great ingenuity in the production of substitutions ("Ersatz"), and one of their patents proposes the making of artificial silk from muscular tissue of animals. The flesh is macerated in a particular solution which separates the muscular fabrics by dissolving the material which cements them together. This gives filaments, short and flexible, which are transferred to a liquid which straightens them as if by a species of tanning. The fibers which are several inches long have been made into artificial silk. They can be impregnated with india rubber so as to make a fabric impervious to water. The artificial silk thus prepared can be used for the manufacture of insulating fibre, balloon cloth and the like. It is said that it can be made quite cheaply.

In a recent lecture before the London Chemical Society the fact was noted that it would be possible to produce 10,500,000 cubic feet of helium per annum at Calgary, Can. The cost of the plant would be less than five million dollars and the gas would be produced at not more than $0.04 a cubic foot. This, of course, is the gas which will have to be used in dirigibles, sooner or later as it removes the risk of fire. In the valley of the Fraser River in Western British America, a flow of natural gas has been found containing 99% of nitrogen. This gives a raw material for the fixation of nitrogen which may eventually prove of great importance.

The Railway Committee of the American Railway Engineer Association in examining the tensile strength of old rails got as high a reading as 57,000 lbs. per square inch in the flange of an 85-lb. rail that had been in service some nineteen years. This indicates an absence of any flaws and shows that if the right material is put into rails and if rightly handled in the manufacturing process, flaws will not develop.

It has been found in San Francisco Harbor that while a creosoted pile would not be attacked by the teredo, yet if a piece of untreated wood is nailed to it the teredo will enter the untreated wood and will grow to the length of an inch or more and will then bore into the creosoted pile. The zone of greatest activity was where the pile emerges from the bottom and it rapidly decreases from that point upward. The teredo never enters it below the mud.

Ninety-five per cent of the total known vanadium in the world is in a mine in Peru, known as Minas Raga on the eastern slope of the Andes not far from the great Cerro de Pasco mine. There is supposed to be in sight in this mine ore enough to supply eighteen thousand tons of metal. The ore averages about 19 per cent vanadium.

It is stated that lightning strikes loamy soil twenty-two times where it strikes a chalk soil, such as exists in the South of England, one time. A sandy soil has an intermediate liability to lightning stroke.

There has naturally been a great increase in India rubber plantations, so much so that the question of what to do with the seeds of the tree has come up. It is found that the kernels of the seeds of the Para rubber tree are rich in oil, resembling linseed oil, and the oil cake left after the extraction of the oil is a good food for cattle.

In Iceland there has been reported a very violent earthquake affecting the port of Reykjabik. Iceland has undoubtedly suffered more from volcanic and seismic disturbances than any other equal area of the earth's surface. The volcanoes have had a way of pouring out vast quantities of gravel, ruining the arable land which at the best is limited there. Recently Iceland has been attracting considerable attention as a possible field for the exploration of water power, the perpetual ice and snow deposits on its mountains offering great possibilities in this direction.

In Canada there has been published a table of the durability of furs, which originated with a Cornell University professor. Twenty-three different furs are cited, the sea and land otters and the wolverine, the fierce rodent called the glutton, being most durable. These three are taken as having a durability of 100%. At the other end of the line is the rabbit skin with only one-half of 1% durability attributed to it. In other words, the much used rabbit skin is 200 times inferior in resisting wear to the three furs named above. Other much used skins are seal skin 80%, martin and skunk both 70%, sable 65%, muskrat 45%, ermine 25%.

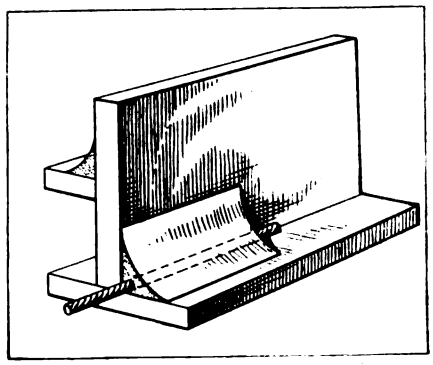
The remains of a fossil elephant have been found in the Chagny sands near Lyons, France. The bones are almost complete and the elephant was over 13 ft. high, with tusks slightly curved only and nearly 8 ft. long.

In France it has been found that the laundresses are very subject to consumption and that tuberculosis is responsible for half their deaths. This is attributed to infection from clothes, which have been worn by consumptives, bedclothes from their beds and the like. It is recommended that such articles should be at once plunged into disinfecting solutions before going to the laundress.

A curiosity in freezing occurred in Philadelphia. A cast iron column supporting an elevated sidewalk gradually filled with water from rain. In the cold weather it started to freeze and in its expansion the ice was extruded from the bottom of the column which was lifted up together with the sidewalk, which it supported, through a distance of about eight inches. No harm was done. On the restoration of the column to its proper position by melting out the ice, the the top was made water-tight, so as to prevent the recurrence of the accident.

IMPROVED FILLET

THE very simple improvement in flexible or wax fillet for pattern makers has been deemed worth a patent. It will be



seen that by having a cord located in the heart of the fillet, O, as shown, the manipulation, the fastening and the strength of the fillet will be materially increased.

The American Locomotive Co. has been building locomotive engines at Schenectady for the Italian State Railways. Each is fitted with an apparatus for burning pulverized fuel, similar to those installed on the Lehigh Valley Railroad, where mixtures of anthracite and soft coal are in use. In Italy lignite is to be used and its analysis in round numbers is, ash 10%, volatile matter 40%, fixed carbon 30%, and water 20%. This analysis brings out the poor quality of lignite as a fuel, but Italy has little or no coal of her own.

The Rolls-Royce Automobile Works, at Derby, England, have recently been visited by the English Institute of Automobile Engineers. The works cover an area of between twenty and thirty acres. The output is about thirty-five cars per week. This is a great contrast to the American quantity production of cars, which runs up to thousands in a week in a single factory. This is actually a hand-made car and the comment on the methods by an English authority is to the effect that it is built up of machine parts finished manually, and that much of the labor in this connection seems to be superfluous, and the same is said about a number of refinements which the car embodies.

The erosion of guns has been studied during the war and an approach has been made to the cause. During firing a hardening of the surface of the bore takes place, especially on the driving surface of the lands but which effects lands and grooves alike and spreads to the powder chamber. This induces the formation of small cracks, which marks the beginning of the erosion. Even a few rounds bring about this damaging hardening of the metal of the bore. The getting rid of it can be done only, as far as known, by the use of steel which will not be so effected.

In petroleum wells where the air lift is used, it is said that the inflow of water is increased and that an emulsion is produced with heavy oils. If the water present is between 5% and 20%, it separates with much difficulty. In one case, however, the separation of the water was effected by giving an additional 20% of water which made the breaking up of the emulsion easy.

Digitized by Google



RADIO TELEPHONE AND TELEGRAPH APPARATUS



A Short Wave Regenerative Receiver

Easily Made Is This 150- to 600-Meter Set, Fitted With a Tickler Coil for Amplification

By M. B. Sleeper

Illustrations by the Author

NOW that the experimenters are getting on the scratch line for the long distance, short wave work for which everyone is preparing, every man wants a regenerative set. There is a certain amount of choice between various circuits in use at present, but if the majority favors the type using no condenser in the secondary, it is probably because the manufacturers have specialized on it.

While we are on the subject of the variometer-tuned secondary set, it might be well to clear up a question that seems to lurk unspoken in the minds of many experimenters—a sort of skeleton in the closet question, ignorance of which no one wants to admit. "What does the secondary variometer do? How can it tune the circuit to a given wavelength, when there is no capacity in the circuit?" Yet the variometer does tune, and very sharply.

The answer is simply this: The condenser effect between the grid and filament furnishes the capacity, a small amount, about 0.00002 mfd., but enough to make the secondary circuit oscillatory. To tune to 300 meters with such a capacity, requires only 1.3 mh. inductance.

Because the tube is depended upon to furnish the capacity, a large variation in inductance is required to cover any considerable wavelength range. Since only a part of the inductance is adjustable, the balance acting as the coupling coil, the variation of the inductance and, consequently, the wavelength range, is quite limited.

Therefore, to make the set of wider utility, the equipment described in this article is designed to operate with a 0.0005 mfd. variable condenser in the secondary circuit.

Again, a straight tickler coil is employed instead of a tuned plate circuit. The reason is a constructional one. A tickler is much easier to make than a variometer.

General Description

Figs. 1 and 2 show the front and rear of the receiver, mounted on a panel 5 by 10 by 3/16 ins., with a complete circuit in Fig. 3. In the primary, the thirteen taps give a wavelength range, with a 0.0003 mfd. antenna, up to 600 meters. On the first secondary tap, a 0.0005 mfd. condenser will give a range of approximately 150 to 450 meters, and on the second tap, 250 to 700 meters. Thus the set is adapted not only to 200-meter work, but to the reception of 600-meter commercial stations as well.

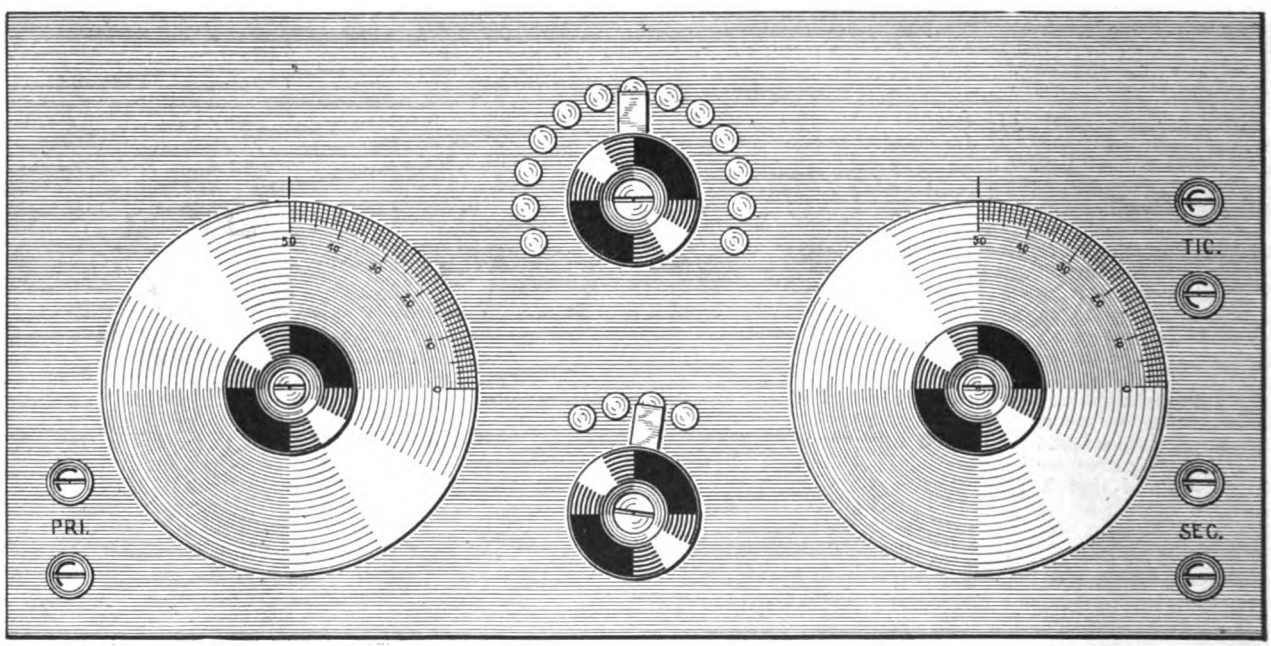


Fig 1. *A regenerative receiver mounted on a* 5- *by* 10-*in. panel*

In the plate circuit of the audion the tickler is connected, preferably with a 0.001 mfd. fixed condenser around the telephones and B battery, although this is not shown.

The Primary Coil

A tube 3½ ins. in diameter and 2¼ ins. long is needed for the primary coil. This is wound for 1.7 ins. with 20 No.

Digitized by Google

38 high frequency cable, giving 38 turns per inch, or a total of 65 turns. These are tapped as follows:

Tap 1..15th turn
Tap 2..18th turn
Tap 3..21st turn
Tap 4..24th turn
Tap 5..27th turn
Tap 6..30th turn
Tap 7..35th turn
Tap 8..40th turn
Tap 9..45th turn
Tap 10..50th turn
Tap 11..55th turn
Tap 12..60th turn
Tap 13..65th turn

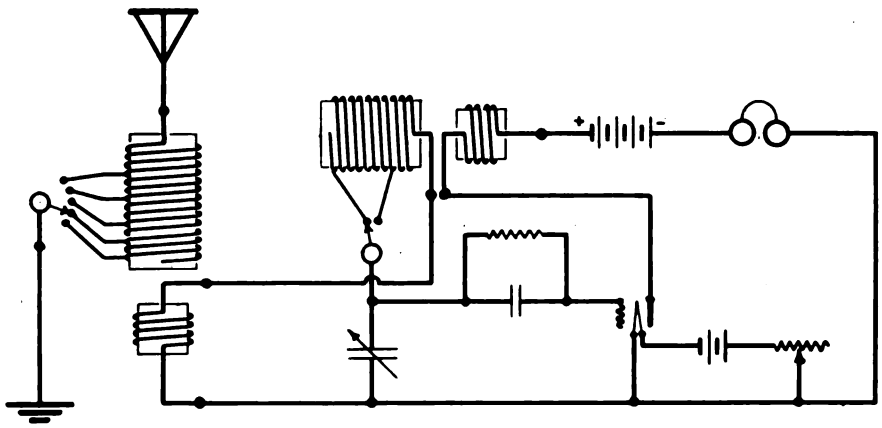


Fig. 3. Connections for the regenerative receiver

Short, threaded brass pillars or angles of ⅜- by 1/16-in. brass strip can be used to mount the primary tube. This must be accurately and securely fixed. Otherwise, because of the small clearance, the secondary coil will touch the primary tube.

The Secondary Coupling Coil and Tickler Coil

The construction of the secondary coupling coil and tickler are identical, both as to the method of mounting and the size of the coils. The tubes are 3 ins. in diameter, and 1¼ ins. long, wound with 20 No. 38 high frequency cable. Each section is ⅜ in. long, with a separation of ⅜ in. between them.

If the bearing at the panel is carefully made, no rear support will be required for the shaft of either the coupling or tickler coil. For each coil, two brass washers, ¾ in. in diameter and 3/16 in. thick are cut and threaded at the center with an 8-32 tap. The brass shaft, of 3/16 in. rod, is threaded at one end for a distance great enough to take one washer, the adjusting knob, and a nut to clamp the handle against the washer. Then, from the other end, the rod is threaded to within the thickness of the panel from the other threads. The washer under the handle bears against the front of the panel, while the other washer bears against the rear, leaving the unthreaded part of the rod to run in the hole in the panel. A lock nut holds the rear washer in place, and maintans a small amount of friction.

Two sets of nuts hold the coil in position on the shaft. Leads, run in Empire or soft rubber tubing, can be wound afound the shaft and brought off to the terminals.

Secondary Loading Coil

The secondary loading coil, in series with the coupling coil, provided coupling to the tickler, independent of the primary-secondary coupling. The tube is 1¾ ins. long by 3½ ins. in diameter, wound for 1 in. with 20 No. 38 cable. Starting at the rear end near the tickler, a tap is taken off at the tenth turn, and connected to the first point of the secondary switch, as can be seen in Fig. 3.

This coil should be mounted in a manner similar to that used for the primary. With this coil completed and in place, and the set carefully connected with No. 14 bare copper wire, all joints soldered, the set is ready for use. A condenser, mounted as shown in some of the preceding articles, and a vacuum tube mounting, complete the set. If 5- by 5-in. panels are used for the audion and condenser, the set can be made up neatly with the 5- by 10-in. panel below, and the two smaller ones above.

(*Continued on page* 547)

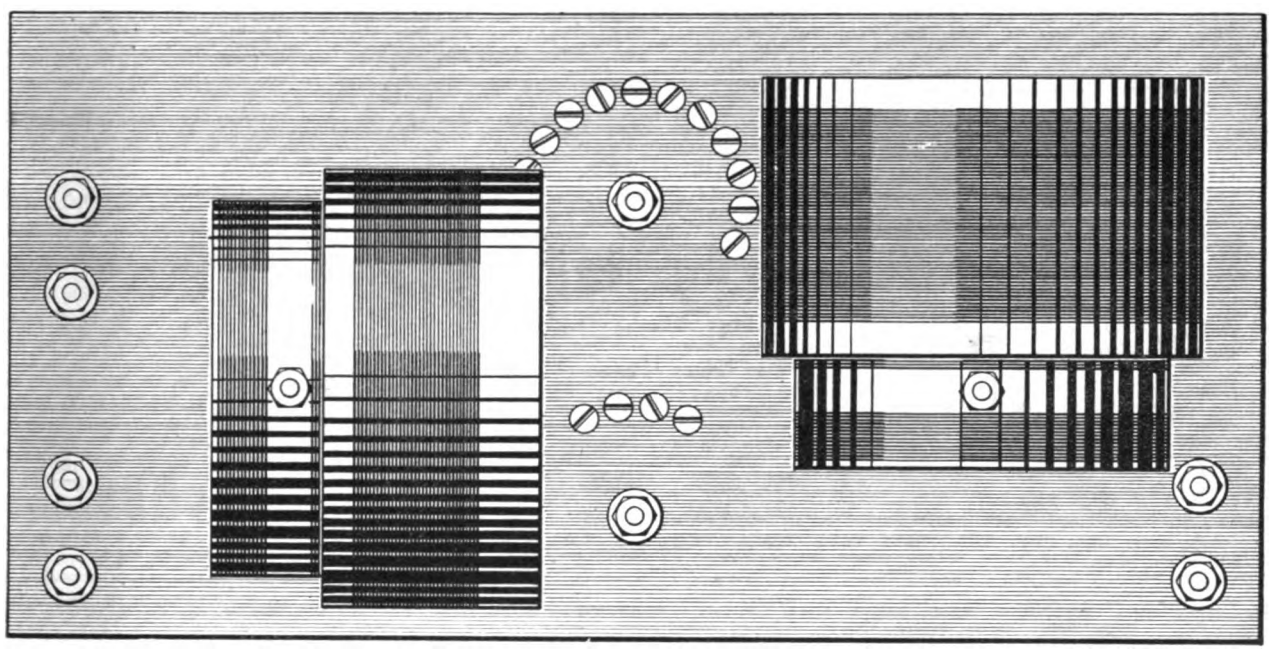


Fig. 2. This shows the mounted coils on the rear of the panel

Two methods of tapping can be employed. One is to wind the coils without taps. Then mark with ink where the taps should be. Unwind the wire, scrape at each marked point, and solder on leads. The other way is to bring out a loop for each tap, and tie a knot in the loop. This holds the wire securely at the tapping point while the coil is being wound. When the work is completed, the loops are cut to the proper length and soldered to the switch points. A better method is to make short loops, and use No. 14 bare copper wire leads to the points and other connections.

Digitized by Google

English Radio Equipment

Details of Radio Apparatus from Marconi's Wireless Telegraph Company, Ltd.

AMERICAN opinions of English radio equipment vary between the conviction that they are far behind the times to beliefs that they are considerably in the lead. Mr. Philip R. Coursey of London has been kind enough to furnish EVERYDAY ENGINEERING with photographs, circuits, and data on some of the apparatus built by Marconi's Wireless Telegraph Company, Ltd. This article, and others to follow, will show the American experimenters and engineers just what is going on across the ocean.

The ½ and 1½ k. w. tube transmitters have been selected for the first article, as there is now such interest in this type of equipment. These sets are shown in Figs. 1 and 2, with diagram of connections for the ½ k. w. set in Fig. 3.

The first striking feature of construction is the cabinet style of mounting. When the set is not in use, the operating table is turned up, completely enclosing the apparatus. A door is also provided to cover the vacuum tube section, to keep the brilliant light from the eyes of the operator.

It will be seen that the ½ k. w. set has three panels, one at the left carrying the transmitter controls and antenna current meter, the center panel for the tubes, and the right hand panel for the receiving set and six-step amplifier.

Upon going over the circuit in Fig. 3, it will be found that there are points of similarity as well as difference between this set and the conventional types employed by American manufacturers. Starting at the input side, the potential on which the set operates is 85 volts at 150 cycles. The primaries and secondaries of the filament lighting transformers, 13 and 12, and 26 and 25 are designed to step down the 85 volts to 10 volts. The practice of operating filaments on a. c. is not new, but seldom used here.

Through transformer 28, 27, 500 volts are applied to the plates of the oscillating tube, 8, and the modulating tube, 11. In this circuit a single rectifier, 24, is placed. Because of the high frequency, 150 cycles, of the supply current, it is only necessary to use one rectifier. Condensers 21 and 23, of 0.25 to 0.5 mfd., shunt out any alternating current component, and the modulation choke coil, of about 1.5 henries, also smooths out the intermittent rectified current.

The modulation tube, 11, connected in the usual manner, can be controlled by a telephone transmitter, 16, or, for modulated telegraph sending, a buzzer, 17, according to the position of switch, 18. A key, 19, is used with the buzzer. When, however, the set is operating on undamped wave telegraphy, the sending is done by key 20, which, during telephone or buzzer modulation, is kept closed.

A plate current ammeter, indicating the current through the oscillator tube, 8, is connected between the plates. The air-core high frequency choke coil, 9, prevents the high frequency current in the oscillating circuit from backing up into supply circuit.

Distinctly different from American practice are the antenna and oscillation circuits. The lack of variable condensers is particularly noticeable. Direct coupling to the antenna is obtained by the switch from the plate lead, in which condenser, 7, of about 0.01 mfd., is connected. This prevents the short circuiting of the direct current to the

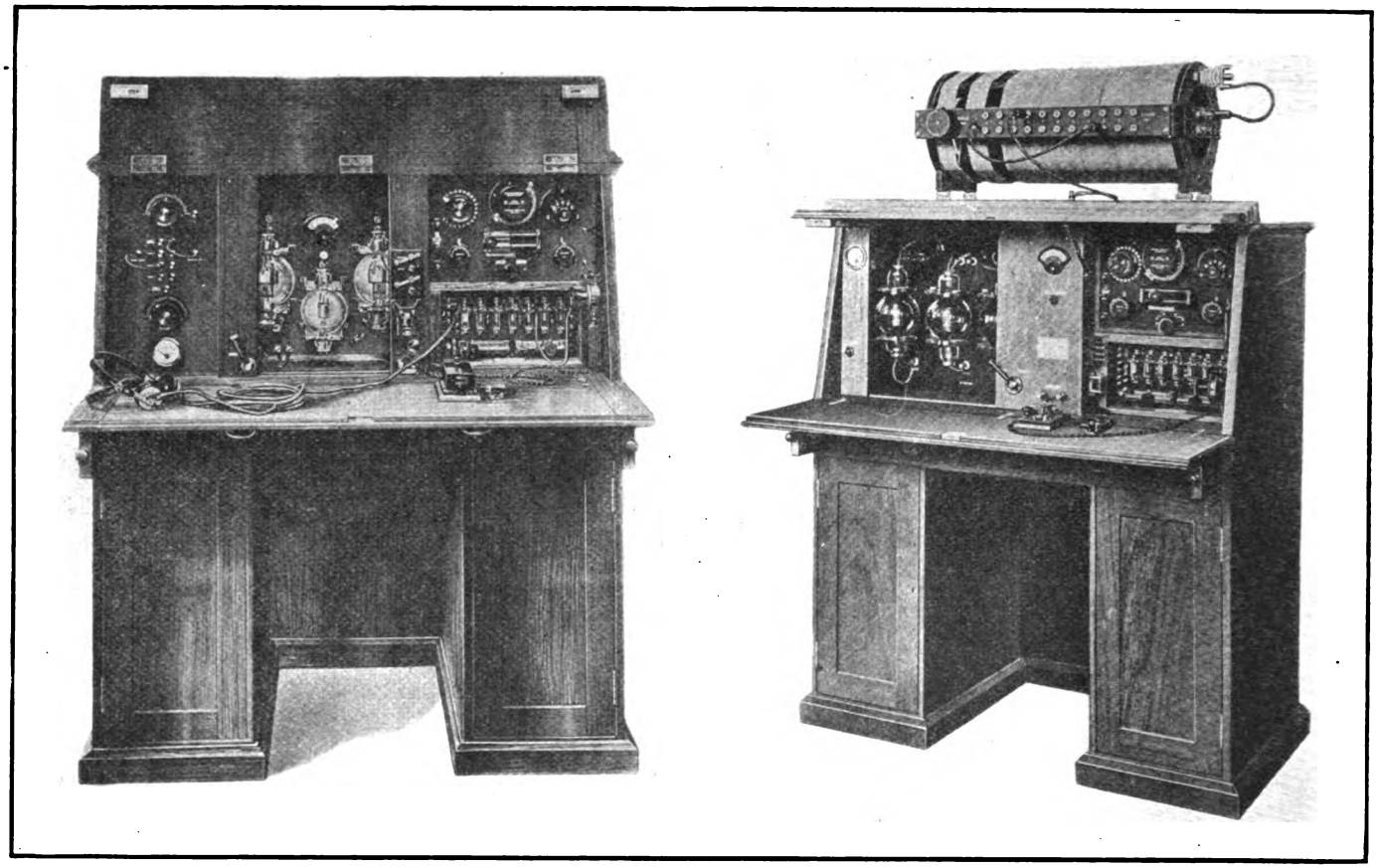


Fig. 1 The ½ k. w. installation looks quite different from the American sets

Fig. 2. A 1½ k. w. set which can be depended upon to cover 500 nautical miles

Digitized by Google

ground, but passes the high frequency current. Coupling to the grid is obtained by coil 3 in the grid circuit. The condenser 6 and the resistance 5 constitute a leak circuit. A plug switch gives a rough adjustment of the antenna wavelength, and a variometer, 1, a fine control.

In the ground circuit, a few turns of wire, 4, are coupled to a coil which is in series with the radiation ammeter.

The tuning adjustments can be seen in Fig. 1, on the left hand panel. At the top is the antenna variometer, with the two plugs, for the antenna and plate connections, and 9 jacks, while below are the grid coil and radiation meter. On the center panel, the transmitting tubes are mounted at the outside, with the rectifier at the center, and, above, the plate current meter. Changes from buzzer to telephone modulation are effected by the upper two-pole switch, just at the right of the tube panel.

Two keys are furnished for the telegraph sending. The larger is for undamped wave work, while the smaller operates the modulation buzzer. When the change-over switch, mounted at the left of the center panel, is put on receive, the transmitting instruments are disconnected from the supply line, but a considerable charge is retained in the smoothing out condensers. Therefore, an insulated discharge button is provided, between the center and right hand panels, to short circuit the condensers. This does away with the possibility of being shocked if any of the live parts are touched just after transmitting.

The transmitting range, on 1,000 to 2,000 meters, is conservatively estimated by the manufacturers as 100, 130, and 300 nautical miles for telephone, buzzer, and undamped wave sending, when an antenna 220 ft. long by 100 ft. high, having a natural period of at least 360 meters, is employed.

Essentially, the 1.5 k. w. set is similar to the 0.5 k. w. type just described. As shown in Fig. 2, the inductance is outside the cabinet. No antenna variometer is used, but rough and fine taps, one at the end, and the other at the front. The plate coupling plug is also inserted at these taps. The grid coupling coil is at the left hand end.

An interesting refinement is the modulation transformer. The primary coil has a center tap which acts as a common return for the transmitter, connected at one end, and the buzzer, with the key in series, at the other end of the primary winding. A battery is inserted in the common return. Therefore, no switch is needed to change from telephone to buzzer modulation.

This set, operating at 1,200 to 3,000 meters on an antenna having a natural period of about 400 meters, is rated at 250, 350, and 500 nautical miles for telephone, buzzer modulated, and undamped wave transmitting respectively.

In the succeeding articles, British amplifiers, receivers, airplane apparatus, and other transmitting sets will be described and illustrated.

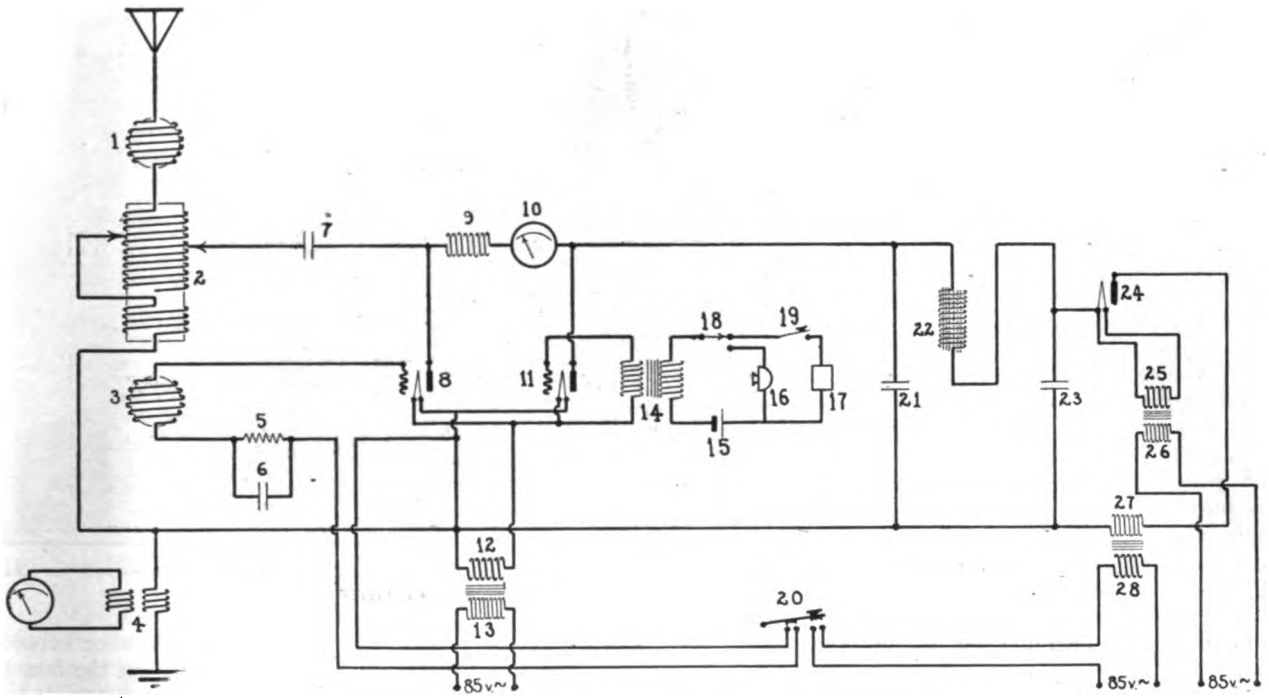
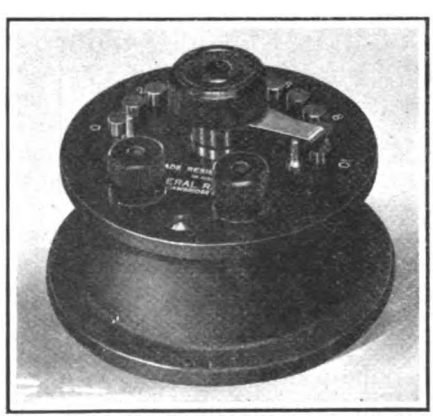


Fig. 3. Complete diagram of the ½ k. w. tube transmitter. This varies from the circuit of the 1½ k. w. set only in small details

RESISTANCE BOXES

THERE are many uses in the laboratory for small resistance boxes such as shown in the accompanying illustration. While this one is of a manufactured type, they can be made easily and inexpensively.

For resistances up to 10 ohms, if only a small current-carrying capacity is required, No. 30 Advance wire can be used. It is only necessary to make a small loop for each 1-ohm step, soldering the ends to the switch points underneath the panel. Such a winding, if the sides of the loops are close together, is practically non-inductive.



When larger wire or more resistance per step is needed, the wire can be wound in the usual non-inductive manner on a small thin piece of bakelite. Fibre should not be used as it absorbs moisture.

These little boxes are adaptable to antenna resistance measurements if a small vacuum tube generator is used to excite the antenna.

It is not necessary to make them non-inductive if only direct-current measurements are to be made. Then the wire may be wound on short lengths of hard rubber or bakelite rod.

Digitized by Google

Precision Radio Measuring Instruments

Instruments from the General Radio Company Which Combine Utility with Great Accuracy

THE General Radio Company, specializing on laboratory equipment of high precision, has recently brought out three instruments of special interest to experimenters. From the photographs and description a number of excellent ideas can be obtained also for the construction in the experimenter's shop of equipment for his own work.

Standards of Inductance.

In Fig. 1 is shown the standard inductance made with values of 0.05, 0.20, 1.0, and 5.0 mhs.

The design of this standard by means of which extreme accuracy is obtained is quite interesting. Those who have attempted to build cylindrical coils of exact values appreciate the difficulties attaining to construction of standards of that type. Moreover such coils have large outside magnetic fields, a factor which introduces considerable errors into measurements.

Both of these difficulties have been overcome in the General Radio inductance standards. As can be seen from Fig. 1, two D-shaped coils are used one of which is mounted below the main supporting plate and the other on a circular bakelite plate. High frequency cable is of course employed to give a low high frequency resistance. The shape of these coils produces a very small external field. The form of winding is referred to as astatic.

Practically no metal is in the field of the coils with the exception of the necessary non-magnetic screws and nuts. The formwound coils are bound with tape to prevent any change in their shape and are firmly secured to the bakelite plates.

When the instrument is assembled a final adjustment of the inductance is necessary to give the accuracy which is not obtainable by ordinary manufacturing methods. This is obtained by varying the mutual inductance between the coils. For this purpose the four screws which hold the upper-round bakelite plate are loosened and the plate rotated until an exact value is obtained. The accuracy of this adjustment gives a value of inductance having less than one tenth of 1% error.

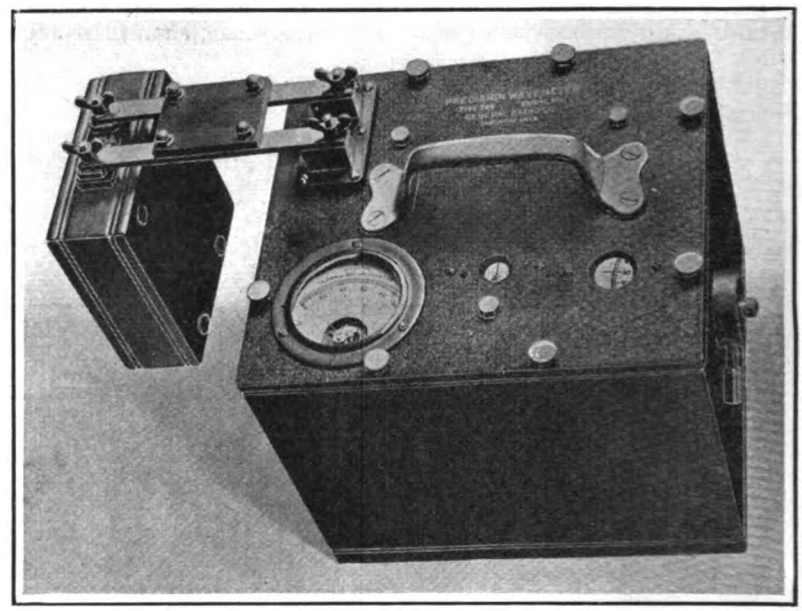


Fig. 3. The simplest circuit, with the fewest instruments, is employed for this wavemeter

The continuous capacity of the two small sizes is 2.5 amps., the 1.0 mh. coil, 2 amps., and 5.0 mhs. coils, 1 amp.

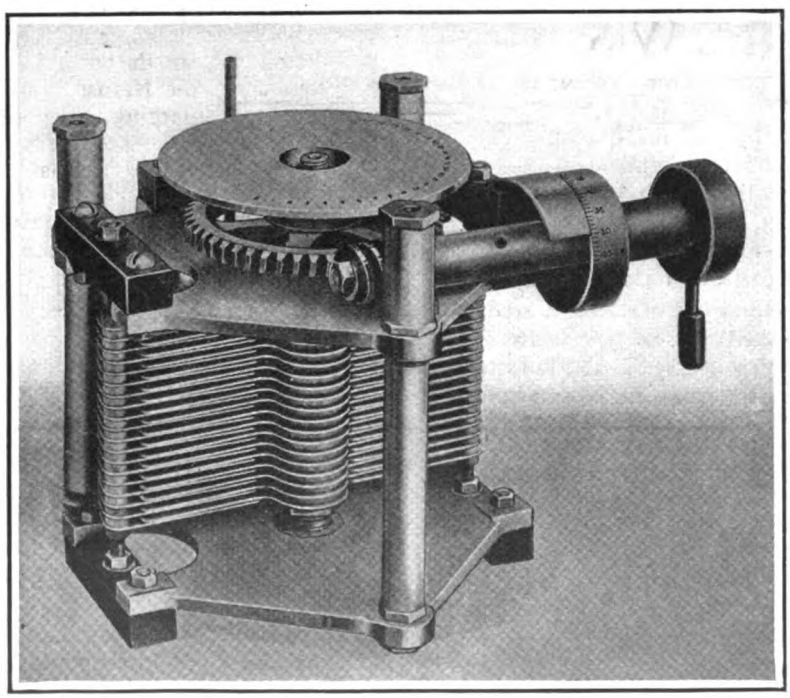


Fig. 2. The design of this condenser, giving great strength and low losses, is quite unusual

A Precision Condenser.

For laboratory measurements the ordinary condensers show losses and variations in adjustment which are not in evidence when the condenser is used for ordinary receiving work. Not only must the bearings be absolutely accurate to insure an unchangeable calibration but a vernier adjustment is necessary, and losses through insulation between the fixed and movable plates must be negligible to give the lowest possible phase difference.

The General Radio condenser is constructed to attain the ultimate in these respects. Heavy aluminum plates widely spaced are the first steps toward permanence of adjustment. The supporting pillars as shown in Fig. 2 gives a strength to assure the calibration against variation from jars and hard use. Aluminum end plates are provided but the insulation between them and the rotating plates is not located at the bearings according to usual practice, but at

Digitized by Google

points in a weak dielectric field. As little insulating material as possible is used to keep down losses from this source. Conical brass bearings with a steel shaft tend to reduce wearing.

An interesting feature is the worm adjustment of the rotating plates. At first thought it might appear that considerable play would be present between the worm and gear, either from inaccuracies of manufacture or wear under use. Such an occurrence is guarded against by using a spring tension to hold the worm against the gear. This method is similar to that employed in the precision dividing engines.

The scale on the main shaft covers 180% but it is divided into twenty-five equal parts. On the worm shaft is a second scale of one hundred equal divisions. Since a rotation of the worm moves the variable plates one division on the large scale, the setting of the condenser can be read to one part in twenty-five hundred of a semicircle.

The copper lined mahogany case in which the condenser is mounted provides perfect shielding. This case fits into a strong carrying box furnished with a handle and lock.

As a result of the care employed in the design and construction of the precision condenser it can be seen for purposes of measurement that the condenser is equivalent to two parallel condensers, one fixed, containing all the losses and the other a perfect variable condenser. Potentials of one thousand volts can be employed without danger of a breakdown. A calibration curve made from twenty-six points readable with an accuracy of one tenth of 1% is supplied with the variable condenser.

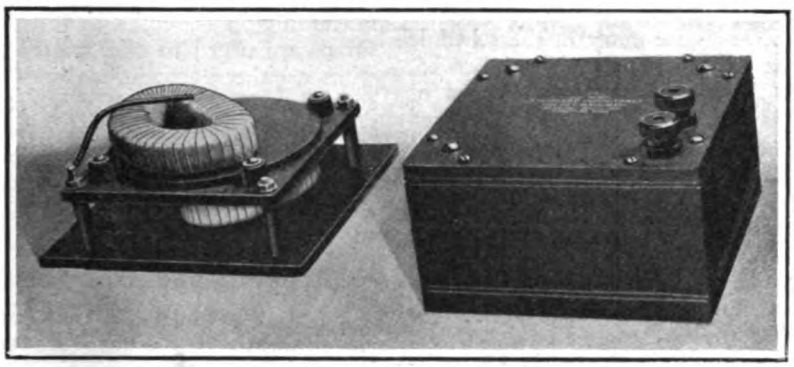


Fig. 1. An exact value of inductance is obtained by adjusting the mutual inductance between the upper and lower coils

The Precision Wavemeter.

This wavemeter, to eliminate errors and variations due to elaborate circuits, contains only a condenser, of the type just described, a type 425 Weston thermogalvanometer, and the inductance coil. With five coils a range of 75 to 24,000 meters can be obtained. No exciting means is furnished, for, in accurate work, such excitation is not required. The use of a buzzer calls for a special calibration, when it is in use, and at best causes errors of too great a magnitude for such a precision instrument.

By the elimination of losses in the condenser and wiring, and by winding the inductance coils with high frequency cable in a manner to make the distributed capacity minimum, an accuracy is obtained which permits the determination of the resonance point for undamped waves to less than one-half a division on the vernier scale, which is equivalent in wavelength to 1 part in 10,000.

The wavemeter is carried in a mahogany case, fitting in a strong whitewood carrying box which also holds the coils and calibration data. Mahogany boxes, with bakelite ends, are used to mount the inductances. The general design of the instrument is intended to combine strength with accuracy of reading.

The wavelength calibration is made at 24 points for each coil, and a capacity calibration at 26 points on the condenser is also furnished.

BOOK REVIEWS

Wireless Telegraphy and Telephony. By H. M. Dowsett, M.I.E.E. 331 pages, 305 illustrations, cloth bound, 8½ by 5½ ins. Published by The Wireless Press, Ltd., American representatives, The Wireless Press, Inc., New York City.

The sub-title of this book, "first principles, present practice, and testing", summarizes the contents, for, in a practical and useful way, these phases of radio are treated, making it a valuable book for experimenters in general and operators in particular.

In the first two chapters, electrical phenomena are discussed, serving as an introduction to the three following chapters which take up spark discharge apparatus, continuous wave generators, and the vacuum tube. The sixth chapter is devoted to high speed communication methods.

Ten chapters, constituting the balance of the valume, describe the principles involved, and various methods employed to measure current and electromotive force, resistance, capacity, inductance, frequency, dielectric strength, decrement, and the direction, distance, and strength of received signals.

The value of this book lies not in new material presented, but in the practical nature of the treatment.

An Electron Tube Transmitter of Completely Modulated Waves. Scientific Papers of the Bureau of Standards No. 381. By Lewis M. Hull, Associate Physicist. 13 pages, 9 illustrations, paper cover, 10 by 7 ins. Sold by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5c.

Of interest to experimenters, as well as engineers, is this new paper from the Bureau, for it describes a vacuum tube set which uses 500-cycle alternating current for the plate voltage supply. In this way, complete modulation is obtained, and no control tube is required. Although capacity, direct, or inductive coupling can be used from the generating circuit, inductive coupling was used for this set. An efficiency from the plate voltage step-up transformer to the antenna of 35% was obtained. Constants and dimensions for the instruments are given.

It is interesting to note that heterodyne reception is required in connection with this transmitter.

Wireless Transmission of Photographs, second edition. By Marcus S. Martin. 143 pages, 77 illustrations, cloth bound, 8½ by 5½ ins. Published by The Wireless Press, Ltd., American representatives, The Wireless Press, Inc., New York City.

To Mr. Martin's unique book on the transmission of photographs by radio has been added, in the second edition, a discussion of the Nernst lamp, data on films, and enlarging, and notes on optical lenses which enhance considerably the value of the original manuscript.

While no practical use has been made of photograph transmission, Mr. Martin sets forth the details of what he and others have accomplished, and opens to experimenters and inventors a most fascinating field of work. Moreover, a solution of the problem, capable of commercial application, would be of great value to newspapers, as it would enable them to reproduce photographs and news, from distant sources, simultaneously.

NOTICE

Do not fail to read the announcement of the Transatlantic Sending Tests on page 544. If you are not in a position to participate in these tests yourself, you can at least assist another man who wants to try. The accomplishment of this feat will be the greatest achievement of experimental radio communication.

If you can't assist in one way, you can in another. Get in on it somehow.

Digitized by Google

Experimental Transatlantic Sending Tests

The Next Long Distance Record for a 200-Meter Set Will be Transmitting Across the Atlantic. "Everyday Engineering" is Making Arrangements for the Tests

TO cross the Atlantic ocean, by one means or another, has called forth the greatest skill and daring in several lines of engineering work. Columbus in his sailing ship, Fickett in his steam propeller vessel, Marconi with his radio signals, Read piloting a flying boat, Alcock and Brown in a land machine, and, last of all, the crew of the British dirigible, have made their marks in the history of the pioneers, as well as in engineering accomplishments.

It is hoped that, during the coming winter, the next transatlantic conquest will be recorded, that is, the transmission, from a 200-meter, 1 k. w. experimental station, of radio messages to England.

At first thought, there might seem to be no real purpose for this work, and no useful result attained by it. The same judgment might be rendered of the Olympic contests. There is always the desire in the heart of every man to do something first. But of more importance than that is the fact of being first to attain the degree of efficiency or proficiency required for the task.

The first experimenter to transmit across the Atlantic will set a new standard for 200-meter sets. His name will never be forgotten as long as there are radio experimenters.

Of real benefit to everyone engaged in the work, however, will be the publicity thus obtained through the newspapers all over the country. The increased interest in the work of the experimenters, and the respect which they will command will greatly strengthen their position.

This is the reason that EVERYDAY ENGINEERING is making the first proposal for the attempt, and is working out plans which will insure the co-operation of English receiving stations.

Announcement is made now to give everyone sufficient time to prepare for the tests, which will start on February 1, 1921. The elements of the contest are as follows:

1. Any man, or group of men, can enter. In the latter case, credit will be given to the man who engineers the work. Those connected with radio companies may enter if they carry on as individuals apart from the organizations in which they are employed.

2. The only limits on the transmitter are that the input, measured at the source of power supply, shall not exceed 1 k. w., and the wavelength shall not exceed 200 meters.

3. Those wishing to enter the contest must communicate with the Radio Editor, EVERYDAY ENGINEERING MAGAZINE, in order to be allotted places in the schedule, the details of which will be announced later.

4. Names for entry in the schedule will be accepted up to November 15, 1920. Suggestions for the method of conducting the tests will be entertained until October 15, 1920. Complete details of the schedule will appear in the January, 1921, issue of EVERYDAY, in circulation on the first of December. This allows two months before the tests are made. News of the preparations will be published as fast as they are completed.

5. Prizes to be awarded by individuals and manufacturers, and the conditions under which they are to be given, will also be published.

CAN YOU ENTER THE COMPETITION?

Special efforts of this sort are necessarily expensive. There are experimenters who will not be dismayed by the cost of fitting up and carrying out tests to obtain the high degree of efficiency required. Others may feel that their present equipment is sufficient.

So many times, however, contests are won by those who work with limited facilities, who do their utmost with what they have. There will be some contestants who will apply to friends to help them. In some towns, civic pride will prompt contributions in an effort to bring the honor of achievement to that locality.

As is true in all engineering efforts, the man with the greatest energy and resourcefulness will win.

REGISTRY FOR THE CONTESTS

Individuals, groups of workers, and clubs should send in their names as soon as possible so that there will not be any confusion near the closing date. The following information must be given:

1. Name of contestant, individuals comprising group and man supervising the work.

2. Address and call of station, if already in operation.

3. Longest transmission ever accomplished on 200 meters with 1 k. w. by operator.

4. Type of transmitter to be used. (An answer to this question is requested but not required.)

As fast as they are received, names of entrants will be published in EVERYDAY. The January, 1921, issue will contain a complete list of the contestants.

PRIZES

To promote the interest in this contest, individuals, clubs and manufacturers are urged to offer prizes to the winner, either unconditionally or under such circumstances as may be set forth by the donor. Many manufacturers will undoubtedly wish to create interest in their products by offering prizes if some of their products are used by the successful contestant.

POSSIBILITIES OF ACCOMPLISHMENT

When it is considered that commercial transatlantic stations use several hundred kilowatts to transmit across the ocean, it may seem that the proposal to use only 1 k. w. is rather far fetched.

In 1901, Marconi did it with 25 k. w. To be sure, it was on a long wavelength and at the shortest separation between this continent and England. Nevertheless, the English experimenters who will co-operate with us have wonderfully sensitive receiving apparatus.

Mr. Philip R. Coursey, of the *Radio Review* and *Wireless World*, whose aid has been requested in handling the receiving arrangements, will have no difficulty in enlisting the most able English operators and the best equipped stations.

BOOK REVIEW

PRACTICAL AMATEUR WIRELESS STATIONS. Compiled by the Editor of *The Wireless Age*. 136 pages, profusely illustrated, paper cover, 9 by 6 ins. Published by The Wireless Press, Inc., New York City.

Mr. J. Andrew White, who selected the material for this volume, calls it an "experience book", containing the best ideas of thirty-three experimenters. Each of the forty-seven chapters takes up a separate problem, giving instructions and illustrations of the methods required. No special sequence is followed, as in a text book, for this is simply a collection of helpful and interesting ideas, most of which concern the actual construction of radio apparatus.

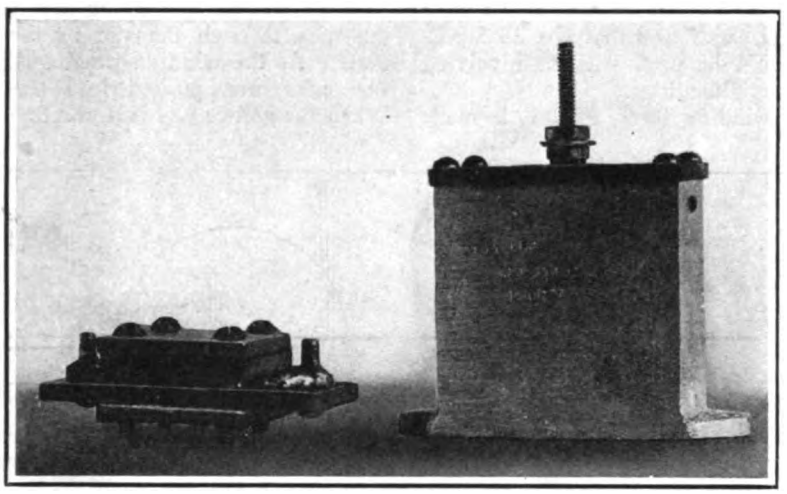
There are chapters on regenerative receivers, long wave sets, different types of panel receivers, amplifiers, detector construction, instrument details, and installation notes in the first half of the book. The second half deals with sending equipment such as panel transmitters, transformer design, vacuum tube transmitters, spark gaps, keys, and other instruments.

Digitized by Google

SMALL DUBILIER MICA CONDENSERS

TWO types of small mica condensers, distributed by the Pacent Electric Company, are shown in the accompanying illustration. The open type, at the left, is made in various sizes for use in receiving circuits and vacuum tube transmitters. In transmitting sets, they are useful to shunt around the grid leak, to keep the high-voltage plate potential out of the antenna tuning inductance, and for similar purposes.

The larger condenser, enclosed in an aluminum case, is for smoothing out direct current or rectified alternating current. The capacity is 0.25 mfd. One terminal of the condenser is grounded to the case, while the other is connected to the protruding screw in the bakelite top. Lugs on the base are drilled so that it can be fastened down readily on the table or inside a cabinet.



BOOK REVIEW

EMERGENCY WAR TRAINING FOR RADIO MECHANICS AND RADIO OPERATORS. Issued by the Federal Board for Vocational Training, C. A. Prosser, Director. 75 pages, 8 illustrations, paper cover, 9 by 6 ins. Published at the Government Printing Office, Washington, D. C.

Written in 1918 for the purpose of training men who were waiting to be called into the army, to prepare them for radio work, this book has completed the work for which it was intended. However, it is still valuable to those, particularly, who are learning the code, or teaching others.

It contains twenty-four pages of operating exercises, carrying the lessons from simple words to complete messages in the form of army communications, in a quantity which precludes the possibility of memorization from continued use.

The questions on theory and operating will be found helpful to those preparing for examinations.

Instruments for Undamped Wave Transmitting Sets

FOR some time articles have been published, papers written, and arguments put forth concerning interference on short waves. The conclusion is invariably that interference will be remedied through the general adoption of undamped waves transmitting sets. But, with the articles, papers, and arguments, the reduction of Q R M stops, because of the difficulty in buying equipment at reasonable prices which cannot be made in the ordinary experimenter's shop. This same difficulty is responsible for the limited use of the radio telephone.

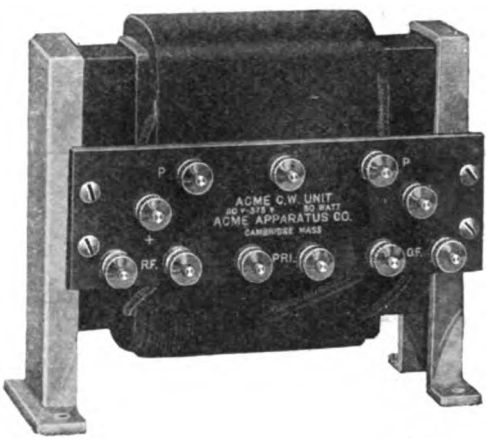
The number of possible circuits for tube transmitters is running a close race with the methods of copying P O Z with one bulb.

Experimenters who have listened on a particularly good night and have experienced the painful process of copying long distance through the beehive of broadly tuned 200-meter stations are looking forward for the ray of hope which will light the way to the grave of Q R M.

More than that, we all want to speak as well as buzz, but there is the stone wall of high voltage plate potential.

Tubes can be purchased at reasonable prices as well as the other parts of the set, but a motor generator, if it can be obtained at all, represents a small fortune. To surmount this difficulty is like making a boy with a spark understand that, when he is going, the other stations must call it a day.

Now, however, a new instrument, from the Acme Apparatus Company, is on the market which makes it possible, to use the words of the manufacturer, to change the common ordinary garden variety of 110-volt, 60 cycle current, to high voltage direct current of the correct value to supply the plate potential for vacuum tubes. Furthermore, the cost of device is even within the reach of those who haven't a wage earner in the family. The new instrument, a transformer, is shown in the accompanying illustration. The primary is wound for 110 volts, and the secondary to give two voltages each of 550 for the 200-watt tubes and 325 volts for the 50-watt tubes. The secondary winding is connected to two rectifying tubes utilizing both sides of the cycle.



The pulsating direct current is then smoothed out by means of a condenser and series choke coils of one and one-half henries.

This transformer has in addition two other windings which give 12 volts each, one for lighting the filaments of the rectifying tubes and the other for lighting the filaments of the power tubes. Both of these windings are provided with center taps. The rectifying tube filament winding is tapped so that the plate current is distributed to both halves of the filament, thereby preventing one-half of the filament there being overheated by this additional current. The power winding is tapped in the center so that the grid circuit will not become alternately positive and negative. Thus the oscillations in the transmitter are not modulated at any low multiple of the alternating current supply frequency. The manufacturers of this transformer also build supplementary equipment, including large choke coils, telephone modulation transformers, and separate filament heating transformers, the last being used where it is desirable to heat the filaments from 110 volts a. c. instead of a low voltage direct current supply.

A system of wireless telegraphy for press messages is shortly to be established between Helsingfor and Copenhagen. Though the Danish arrangements are now complete, the Finnish military authorities have not yet given their consent to the use of the Finnish wireless stations.

Digitized by Google

Variometer or Coupling Coils

Small, Pancake Coils Are Used on this Variometer to Replace the Usual Ball Types

THE design of the coils for the variometer described in this article is not greatly superior to the ball and hollow winding types but it offers some new thoughts for the experimenters and a different method of making a simple variometer where winding forms for the usual sort are not available. Actually this variometer is a modification of the figure 8 windings, in that the two halves of the figure 8 coils are replaced by two circular coils wound in opposite directions.

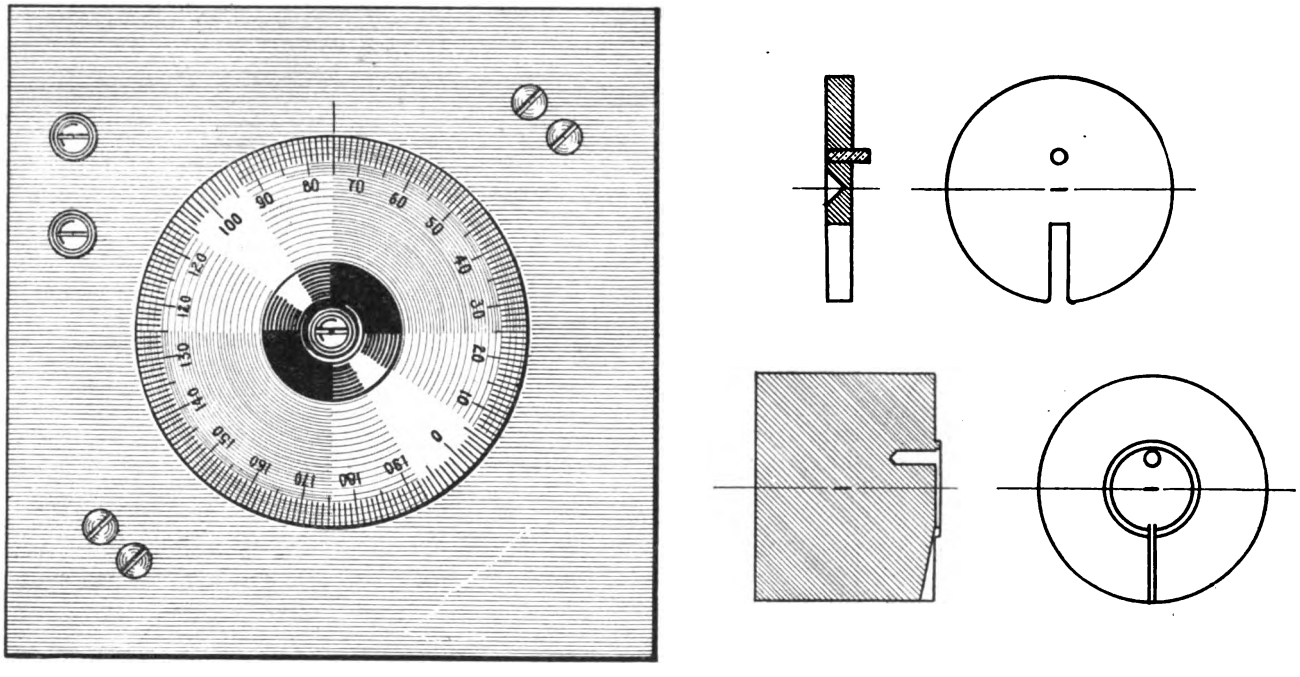


Fig. 1, left. The front of the panel of the completed variometer. Right. Cross sectional views of the form used for winding the coils

Fig. 1 shows the front of the completed instrument and, at the right, sectional views of the device employed in winding the pancake coils. Fig. 2 illustrates the appearance of the rear and side of the instrument, while in Fig. 3 there is a wiring diagram.

Essentially, the variometer is made up of a set of stationary coils in front of which another set is rotated. For experimental purposes, a 360-degree scale was used, divided into 200 parts. However, only one-half a revolution is needed to pass from minimum to maximum, so that a scale of 100 divisions, 180 degrees, is sufficient.

The coils are the most interesting and the only difficult part of the instrument. A number of experiments were made at the Everyday Engineering Laboratory on windings of this sort to determine first, if it was possible to make up a small pancake coil which would be self-supporting and would not be damaged during work of assembling the parts, and, second, how small wire could be without rendering the coil too secure. The latter factor is important for the size of the coils is limited and it is necessary to use small wire in order to obtain a fair amount of inductance. Otherwise, with too small an inductance, this type of winding would not be practical. As a matter of fact it was found that No. 26 S.S.C. wire could be used without involving any great difficulties.

The winding form, Fig. 1, is made in two parts, a main section which is put in the chuck of the lathe, and an end plate held by a center in the tail stock, and pinned to the other section. The form used for this work was cut from brass rod 1¾ ins. in diameter. The face of the main section was first turned true and smooth. Then it was cut back the thickness of the wire and turned down to three-fourths of an inch. The slight ledge on which the wire was wound was turned at an angle of 45 degrees to the face, and the protruding face was slightly counter bored and a saw cut made as shown in the cross-sectional views. The end plate is merely a washer with a slot cut in five-eighths of an inch. This work done the two parts were put together with the slot of one opposite the saw cut in the other, and a hole drilled just inside the circumference of the protruding face. A pin was then driven into the end plate and the hole in the main section drilled out so that the pin slipped in easily when the parts were assembled

To wind the coil, the main section was fitted in the chuck. The end plate, with its pin in place, set against the face, and the tail stock moved up so that the end plate was held firmly against the main section. Then a fine wire was held in the saw cut and the winding started by putting the end of the wire through the slot in the end plate. As the winding progressed, the fine wire was pushed into the cut. When the groove was full, the fine wire was brought around and twisted so that the coils could not unwind. Cutting off the wire and bending the end backward completed the coil.

The next step was to push back the tail stock and withdraw the end plate. Just a touch on the binding wire and the coil slipped off the face of the main section. Finally the coil was dipped in very hot beeswax. After cooling, it was found that the coil, though wound with No. 26 wire, was quite strong and firm.

The next step in constructing the variometer was to cut out a bakelite strip 5 ins. long and ¾ in. wide, to act as the support of the stationary coils and a bearing for the shaft which controlled the moveable coils. The strip was drilled, as shown in Fig. 2, for the screws, the shaft, and the holes through which threads were passed to bind the coils in place. Four more holes were drilled to take the terminals of the coils. They were made fairly large to

Digitized by Google

allow for variations in the position of the terminals. It will be seen that the ends of the coils are bent back squarely. This was done by holding the coil with a pair of parallel jaw pliers while the wire is being bent. Otherwise, the turns would have come loose. The coils were 2¼ ins. apart, center to center. Another strip four and one-eighth inches long and three-fourth inch wide was cut out to carry the moveable coils. These were fastened on in the same way.

At this point, flexible leads were soldered to the terminals of the coils. It will be readily understood that considerable caution was necessary to prevent the coil from coming apart during the soldering process. It was found, however, that since the binding threads were near the terminal points, they held the wires well enough so that, although the beeswax became soft, the turns did not come apart. A very hot soldering iron was used, so that just a touch was necessary to make the joint.

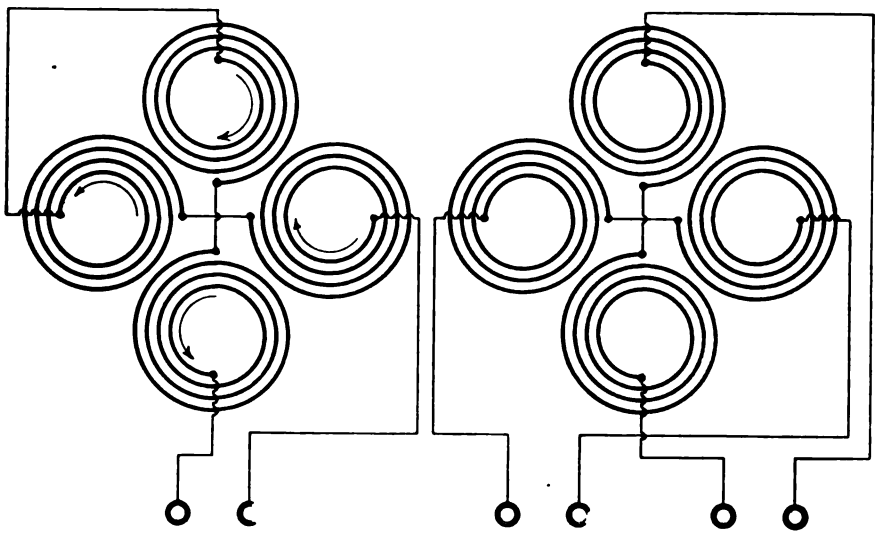


Fig. 3. At the left, the connections for a variometer. On the right, a diagram for coupling coils

Details of the assembly are given in Figs. 1 and 2. The bakelite strip for the rotating coils is held by a nut against a ⅜ in. length of ½ in. round rod, which is, in turn, locked by a second nut. Two washers were put on at the rear nut to act as spacers, so that the moveable coils were held 1/16 in. from the stationary coils. A washer and lock nuts on the end of the shaft kept the moveable section in place.

It will be noted that a 360 degrees scale divided into 200 parts is employed at the front. This is not necessary because only a half-revolution is required to pass from a maximum negative mutual inductance to a maximum positive mutual. The panel measures 5 x 5 ins. and, to insure sufficient strength, should be 3/16 or ¼ in. thick.

This type of variometer can be used as a coupling coil by connecting the windings as shown in Fig. 3. Then four binding posts will be necessary, two for the coils acting as a primary coupling inductance, and two for the other set of coils serving as the secondary coupling inductance. Again, this can be used as a secondary coupling and tickler coil.

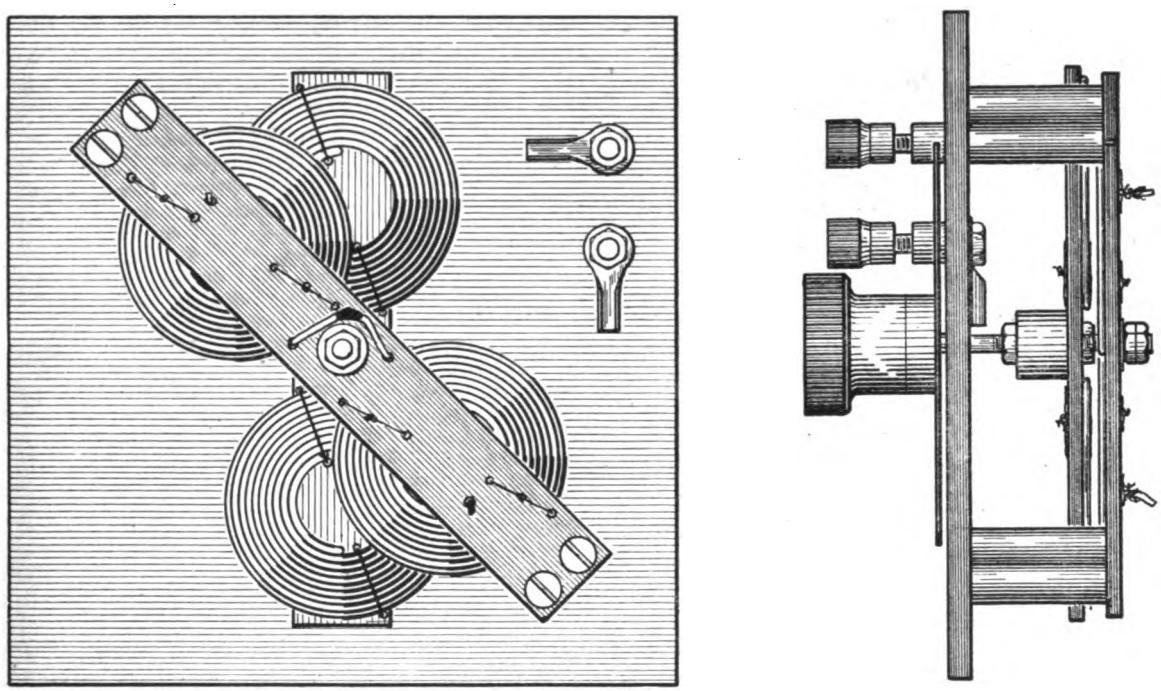


Fig. 2. Rear and side views of the instrument as it appears when finished, except for the connecting wires

REGENERATIVE RECEIVER

(*Continued from page 539*)

Operation

Tuning in the primary circuit, accomplished by the 13-point switch, will be found quite sharp. The secondary condenser, giving a facile control over a considerable range, saves just the amount of time which, with a receiver less easy to handle, causes the loss of a call. The coupling to the primary is usually made tight for listening-in, and loosened for sharp tuning.

If the tickler leads are of the correct polarity, regeneration can be readily adjusted, and will need practically no changing from 200 to 600 meters, another advantage over the tuned plate circuit which must be fixed for each signal.

Complaints about poor operation can often be traced to wornout B batteries. When anything goes wrong, the plate batteries should be examined first of all.

Digitized by Google

The Radio Department

A Discussion of Current Topics of Interest to Experimenters and Manufacturers

ONCE more experimental radio is having its preliminary yawn and stretch portending the resumption of activities. The demand for antenna wire and insulators is starting on the up-grade, which precedes a steep curve, to be followed by a flattening that operators will recognize by the saturation of the ether.

Just now, several thousand minds are formulating plans for the "real transmitter" or the "real receiver" which several thousand pairs of hands will make this winter. The accompanying pairs of ears are close to the ground, and pairs of eyes are carefully searching for the signs of the times which will indicate the optimum course leading to the paragon of efficiency.

This is the season at which the wiseacre, who has something so radically excellent that he won't let anyone see it, first makes his appearance. He should be carefully avoided as an undesirable denizen of the radio woods. New things never come from such men. If they have any ideas, they are always borrowed from someone who is not so selfish as to be secretive.

But to return to the "paragon sets." For sending, we shall have with us the spark coil and transformer, as always, and a new crop of vacuum tube transmitters. However, vacuum tube sets are now split up into several classes, namely, undamped wave, telephone, buzzer modulated, and a newcomer, the a.c. plate voltage type.

Since few of us can have everything, we must decide how we can get the most for what we have to give. The telephone is all very well for its intended purpose, but those who are out for distance will not select it. Undamped waves are too difficult to handle at the receiving end. Thus we find the choice lying between the buzzer modulated and the a.c. plate voltage types.

Buzzer modulation, if the set is operated on 110 volts a.c., calls for a step-up transformer for the plates, a step-down transformer for the filaments, smoothing-out coils and condensers, rectifier tubes, a modulation transformer, and a large choke coil. And there will be many to use them, too.

However, the man who wants most for least will have, instead of all the instruments just listed, a step-up transformer to change 110 volts a.c. to about 350 or 500, and a step-down transformer to give eight or ten volts for the filaments. Then he will apply the high voltage to the plates of as many tubes as he can get, connected in parallel, wire them to an oscillating circuit, and transmit on a 200-meter wave, modulated at 60 cycles or whatever is the frequency of his a.c. supply.

The note, to be sure, will be low, but the tuning extremely sharp, and the distance greater than that accomplished with the same tubes in a buzzer modulated circuit.

Experiments are now being conducted in the EVERYDAY ENGINEERING Laboratory, on a set of this sort, equipped with a step-up transformer which also doubles the frequency. The work has not progressed to a point at which the success of the frequency doubler is assured, but a very interesting article on a set using alternating current on the plate will appear in the October number.

Mr. A. H. Wood, Jr., has written an article for those who prefer the buzzer modulated and telephone set which will also appear in the October issue.

The regenerative receiver, for short wave work, will be even more popular this winter. Among the more advanced experimenters the Armstrong short wave radio frequency amplifier is promised wider use. Although it has been described in various periodicals, it has not received the favor which it merits. An article on this type of set is under way, and will probably be found in the October issue.

As for the man who is looking forward to Transatlantic work: If he wants the best, he will have a separate oscillator for undamped wave reception, and, perhaps, a few steps of radio frequency amplification, augmented by two or three stages of audio frequency amplifiers.

Designs for the tuning instruments and amplifiers will appear in EVERYDAY in the last issues of 1920.

THOSE who attempt the Transatlantic sending tests will have enough to keep them busy up to the first of February, 1921. The suggestion regarding a.c. plate supply offers a new possibility for long distance work.

Experimenters are urged to send in their ideas as to the way the schedule should be arranged and the winner selected, for it is desired that all experimenters share in the decisions as to the conduct of the tests, since they are open to all experimenters.

THERE are two things which every radio man should do as soon as he has his antenna up—he should measure the capacity of his antenna, and, if he is going to send, the resistance at 200 meters. It is impossible to design a receiver without knowing the capacity, just as it is meaningless to talk about two amperes or ten amperes in the antenna when the resistance is unknown. Also, it is desirable to measure the natural period so that the set can be operated at as little as possible above the natural period of the antenna.

Without this data, no experimenter can talk intelligently about his station. These three measurements, and simple ways of making them have been taken up in recent issues of EVERYDAY.

The man who talks and writes of antenna capacity and watts in the antenna has progressed a long way past the experimenter who looks blank when these terms are used.

RADIO experimenters as a whole are strictly practical, putting to their own use the efforts and products of others. From this great group of boys and men there are being and will be developed a few real scientists, men who seek knowledge because it is useful, in contrast to the many who confine their interests to useful knowledge.

A note of appreciation and understanding of such men is sounded in the conclusion of a booklet published by The American Telephone Company and The Western Electric Company, supplementing an exhibit prepared by them to reproduce the fundamental discoveries of the nineteenth and twentieth centuries which paved the way for the successful development of the wireless telephone.

"The efforts of the host of practical scientists throughout the world who are advancing the wireless art by the invention and development of better radio devices are manifested by the state of the art itself, but the work of the pioneer scientists, which has been of equal and perhaps greater value, is not so obvious. Indeed, the work of these pioneers is often overlooked by the very people, the public, who benefit most by their work. For instance, it is not very apparent that a Henry seeking to understand the laws of the electro-magnet, or a Faraday absorbed in the transformation which a beam of light undergoes in traversing a magnetic field, or a Maxwell, who, with paper and pencil, is making guesses as to the structure of the ether, is doing a work without which there could be no wireless telephone. This is a fact we cannot bear too much in mind. The number of Henrys and Faradays and Maxwells of whom the world is in possession at any one time is very limited, and because their labors, if not immediately, are certain eventually to find many applications, they should be given every aid and encouragement. Of this principle, the history of the wireless telephone is merely typical. By altering a few names and statements of fact, and in no wise changing the underlying thought, any one of many practical ap-

Digitized by Google

plications and processes might be substituted above for the wireless telephone. Take, for example, the incandescent lamp, the X-ray, radium, antiseptics and antitoxins, the fixation of nitrogen, and the modern methods of soil fertilization,—in every case we would find the evidence pointing to the conclusion that the abstract scientist and the reclusive philosopher of one generation are preparing the way for the technician of the next; that the scientific laboratory of one generation becomes the workshop of the next, that the "useless" theory of one is the practice of the next; in a word, that for guiding all research there is no higher principle than this,—'Know the truth, and the truth shall make you free.'"

THE RADIO CLUB OF BROOKLYN

THE Radio Club of Brooklyn, Inc., is an organization composed entirely of radio amateurs. All full members have first grade commercial licenses and all have more or less complete sets of apparatus. During the past winter several lectures have been given in the meetings by authorities on amateur radio telegraphy and telephony. Mr. Hewitt has been kind enough to describe his old set at Albany, with which he worked thirty-nine States in the Union, and gave various valuable hints on efficient rigs of all kinds; also, Mr. Earle Dannals, Chief Radio Electrician, U.S.N., has given some highly interesting and eye-opening talks on "Amateur Radio Telephones, Frequency Tuners, and the Theory of the Action of the Vacuum Tube, and on how to adjust Radio Spark Transmitters."

The members of the Brooklyn Radio Club have access to one of the best General Radio Wavemeters obtainable. There is a committee composed of some of the more experienced members of the club, which is at the service of any member should his transmitter need tuning. This committee is in communication with the Radio Inspector and it is its business to see that all the transmitters of members are adjusted in accordance with the law and at the highest point of efficiency.

One of the primary purposes of the Radio Club is to raise the standards of its members in their ability as operators, and in the operation of their stations.

Meetings are held every other Friday night in the rooms kindly loaned by Mr. Warren S. Benson at No. 4 Fuller Place, Brooklyn. All amateurs interested are advised and invited to come any meeting night, or communicate with the Secretary, Mr. Lloyd Jacquet, at 478-A 16th Street, Brooklyn. Telephone South 5649-W.

THE RADIO ASSOCIATION OF WESTERN NEW YORK

THE Radio Association of Western New York, with headquarters in Buffalo, held its semi-monthly meeting recently at its new rooms, at 389 High Street, corner Jefferson. This Radio Club has a large number of members who live in surrounding towns and who attend meetings regularly. The new impetus given radio work since the war has enabled the club to expand, both financially and in membership. The constitution and by-laws of this club are worked out in a clear and efficient manner and the club will be glad to mail a copy upon written request to any amateurs desiring the same for organization purposes. Any other radio club granting the same privilege to this club will be gratefully thanked.

The constitution calls for the suspension of meetings during the summer months, but the members have decided to continue meetings for the purpose of a summer campaign for members. It is planned to have every radio enthusiast enrolled in the club before the fall relay work starts, so that Buffalo will again be on the radio relay map.

Plans were laid to hold a luncheon and to invite and interest the prospective members in the organization. Any one wishing to do any long-distance work is bound to give full co-operation in order to reduce to a minimum the troublesome interference of the past. This club is desirous of subscribing to a club directory giving the name of club, location of same and the name and address of the secretary. All other radio clubs please write to the editor of this magazine and make a similar request.

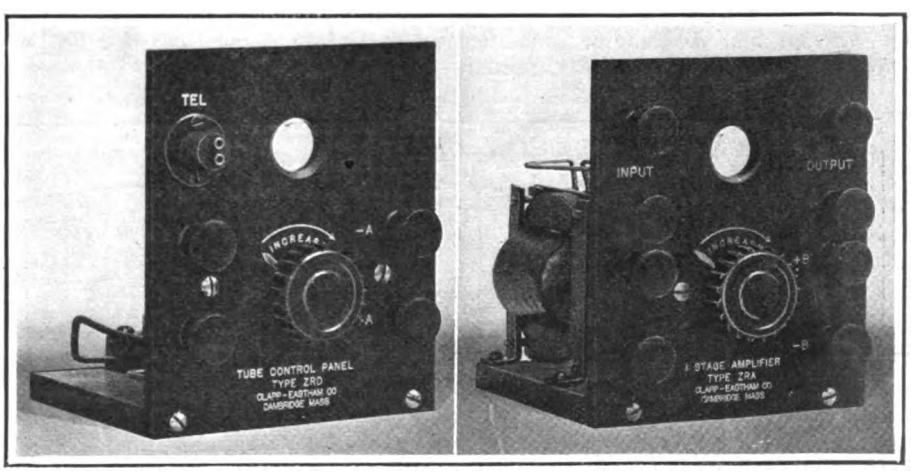
Address communications to John G. Rieger, President, 15 Fairview Place, or Elmer H. Kumpf, Secretary, 41 Amsterdam Avenue, Buffalo, N. Y.

We are informed by a Danish reader that the wireless station at Lyngby (near Copenhagen) transmits press to CQ at 11 a. m. G. M. T. on a wavelength of 4,100 metres C. W. and Meteorological reports at 7.50 a. m., 1.50 p. m. and 6.50 p. m. G. M. T. on 5,000 metres C. W.

Between the hours of 9 a. m. and 1 p. m., and 9 p. m. and 1 a. m. G. M. T., this station works with Stonehaven on 3,400 metres.

Detector and Amplifier Units

THE Clapp-Eastham Company, always on the watch for new apparatus in keeping with the demands of the experimenters, has brought out the detector and amplifier units shown in the accompanying illustrations. It is understood that a regenerative receiver, of a design conforming with these units, will be ready for the fall.



Both instruments are mounted on bakelite panels 4¼ by 5½ by ¼ in. Binding posts are arranged so that jumpers from one panel to another can be used, thus simplifying the wiring at the front of the set. At the rear, regular bus wiring, with Empire cloth tubing, is employed. This feature and the arrangement of the instruments makes the rear of the set as attractive as the front.

Quite original is the method of connecting the telephones to the detector. A small jack is provided into which the cord tips can be pushed. This does away with a special plug to which the leads would have to be soldered, and leaves the tips so that they can be used for any other methods of connection.

Another feature of these units is a new back-mounted rheostat by which the filament brilliancy is controlled. Binding posts are arranged so that either series or parallel connections can be used for the detector and one or more stages of amplification.

Digitized by Google

Small Dirigible for Commercial Use

THE small airship which is shown in the accompanying drawing has the distinction of being the first commercial airship to be sold in the United States. It is known as the Pony Blimp. The builders had in view the need for small, efficient, inexpensive airships, which might be used for commercial service or for purposes of sport. In the tests which have been carried on it has demonstrated its worthiness showing a quick response to the propeller and the controls, and decided economy in operation.

The Blimp is 95 feet long, has a maximum diameter of 28 feet and a height of 40 feet. Its volume is 35,000 cubic feet. The car, which is 12 feet in length can accommodate a crew of two people. Driven by its 40 horsepower engine, it has a maximum speed of 40 miles per hour, and a range, at full speed, of 400 miles, with a ceiling at 6,000 feet. This means that with two men aboard, and at an elevation of 6,000 feet, it can travel some 400 miles at a speed in still air of 40 miles per hour. Of course, by taking advantage of favorable winds, with the motor idle, the fuel may be conserved and the total range under such conditions may be increased considerably over 400 miles. For landing, the Blimp is equipped with mooring harness and anchors which permit ground stops to be made when desired for the replenishment of gas and supplies. The useful lift was 935 pounds, this including passengers, ballast, anchor, drag rope, parachutes and fuel.

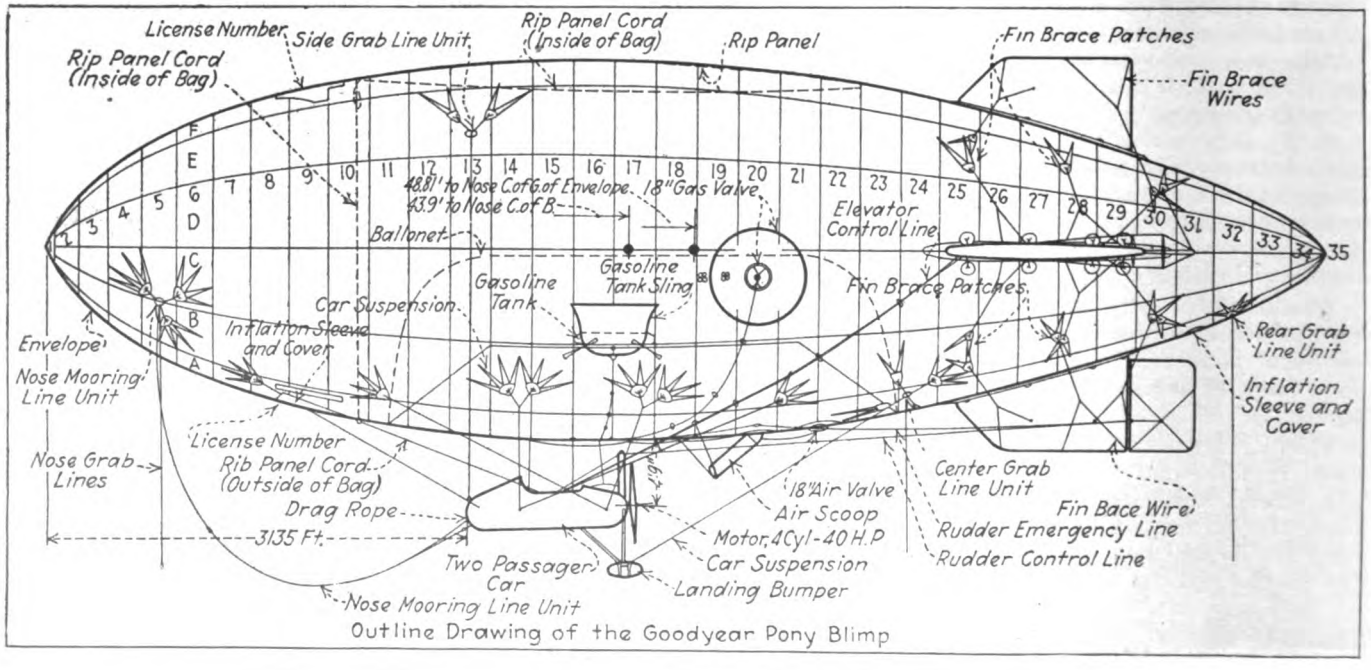
The 40 h.p. Ace engine (modified for airship use) consumed approximately 24 lbs. (nearly 4 gal.) of fuel per hour when running full out (about 2,000 r.p.m.) It throttles down nicely and runs with very little vibration. The fuselage is a wood veneer construction, light but substantial, normally holding two persons, but wide enough to accommodate a third passenger in the rear seat. There is plenty of space for wireless and other small apparatus. The drag rope is carried in a box in the nose. A small pontoon bumper which fits the single skid may be carried or not, as desired. A small size harpoon anchor has been developed for this ship on the same principle as has been successful in larger airships.

A new design of fuel pump is for pumping gasoline from the car up to the tanks. The same pump may be used for pumping fuel up a hose when towing the balloon. For oversea use a sea anchor is recommended consisting of one flexible unit of the Goodyear design. A rubber shock-absorber is used with either a sea or land anchor.

This airship is in no sense a toy. Although no larger than a medium size spherical and not as large as a standard type R kite balloon, this little airship carries a power plant large enough and efficient means of control to give it perfect freedom of motion in any ordinary wind, and in cruising radius it is in a class with ships many times its size. In the trials the ship handled very easily and conveniently, there being no appreciable troubles developed. The quick maneuvering qualities were particularly noticeable, it being possible to make sharp turns An angle of ascent of 42 degrees was obtained, and an angle of descent of 35 degrees. Landing the ship was exceptionally easy, it being handled on one occasion in a light breeze, by a ground crew of only two men.

AIRPLANE ECONOMY

ALTHOUGH a great deal has been heard of the efficiency of the aero engine, yet it is not so generally realized that the latter can vie with a car engine, even on the score of miles per gallon. A fair average petrol consumption for a stationary water-cooled engine would be about six pints per brake horsepower per hour. This means that a 30 h.p. engine would consume 2¼ gallons per hour. A single-seater aeroplane with this engine would be capable of anything from 70 to 90 m.p.h., and at the lower figure the mileage per gallon works out at 31. In actual practice results equal to this have been obtained, for in a non-stop flight from London to Turin, a distance of 650 miles, made by Mr. B. Hinkler, in nine and a half hours, on a Baby Avro fitted with a 30 h.p. Green engine and Zenith carburetor, the total petrol consumption was 20 gallons, giving a mileage per gallon of 32½, at an average speed of 68.4 m.p.h. This particular journey was the first of a series which totalled a distance of 2,250 miles covered in 34½ hours for a total petrol consumption of 75 gallons, the average distance per gallon being thirty miles, and the average speed 65 m.p.h. It is interesting to note that the four-cylinder 30 h.p. Green engine used on this flight was built in 1910, and was used in an early Avro triplane and later in the first Avro tractor biplane. Since its original appearance it has been fitted with aluminum pistons and a special camshaft.



Outline Drawing of the Goodyear Pony Blimp

Digitized by Google

HEAT TREATING ALLOY STEELS

PART 5

(*Continued from page* 527)

nickel. The steel has a high tensile strength, a high limit of elasticity and great hardness and because of this, battleship armor is made of it. It is also popular for automobile driving shafts.

A manganese steel may contain as high as 12 per cent manganese and 1½ carbon. This steel is too hard to be machined by ordinary edge-cutting tools. At the same time, it possesses great ductility and strength.

Chrome steel has a chromium content varying from 1 to 2 per cent and a carbon content ranging from eight-tenths of one per cent to 2 per cent. Nickel is often introduced, making what is known as a chrome nickel steel which is widely used in the manufacture of automobile and other machinery parts, such as crankshafts, transmission gears, etc. When this steel is hardened by sudden cooling and then tempered it has great hardness without being brittle.

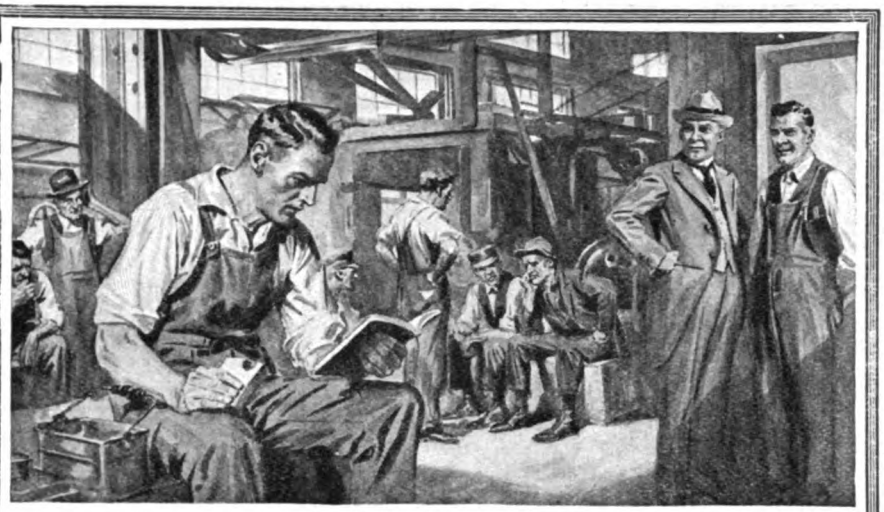
A steel containing from 3 per cent to 20 per cent of tungsten and from one-half of one per cent to 2 per cent of carbon is known as a "tungsten" steel. This has great magnetic retentivity and for this reason is widely used for permanent magnets in various forms of electrical appliances. Another good quality of tungsten steel is that it will retain its temper even at a red heat and for this reason it is capable of wide application for lathe, shaper and planer tools or for machining highly resisting alloy steel that would turn the edge of the ordinary carbon steel tool.

Molybdenum steel has about the same properties as tungsten steel, but less alloying element is required to obtain the same result. One per cent of molybdenum has the same effect as twice the amount of tungsten.

Vanadium is also used in alloy steel and it imparts the quality of making the steel practically fatigue-proof, i. e., parts made of vanadium steel have many of the good qualities found in chrome steel, with the additional one of being greatly resistant to vibratory stresses.

It is not the purpose of this series to go deeply into the metallurgy of steel, but it has been necessary to consider the subject briefly in order that the reader interested in heat treating may appreciate the many varieties of steel that he may be called upon to handle and so that he will realize that a method of treatment that will be very effective with one form may be detrimental to good results in working with another steel alloy of different character.

(*To be continued*)



"Keep Your Eye on Jim!"

"It's not alone what a man does *during* working hours, but *outside* of working hours—that determines his future. There are plenty of men who do a good job while they're at it, but who work with one eye on the clock and one ear cocked for the whistle. They long for that loaf at noon and for that evening hour in the bowling alley. They are good workers and they'll always be just that—ten years from now they are likely to be right where they are today.

"But when you see a man putting in his noon hour learning more about his work, you see a man that won't stay down. His job today is just a stepping-stone to something better. He'll never be satisfied until he hits the top. And he'll get there, because he's the kind of man we want in this firm's responsible positions. You can always depend on a man like Jim.

"Every important man in this plant won out in the same way. Our treasurer used to be a bookkeeper. The sales manager started in a branch office up state. The factory superintendent was at a lathe a few years ago. The chief designer rose from the bottom in the drafting room. The traffic manager was a clerk.

"All these men won their advancements through spare time study with the International Correspondence Schools. Today they are earning four or five times—yes, some of them *ten* times as much money as when they came with us.

"That's why I say that Jim there is one of our future executives. Keep your eye on him. Give him every chance—he'll make good!"

Employers everywhere are looking for men who really want to get ahead. If *you* want to make more money, show your employer that you're trying to be *worth* more money. If you want more responsibility, show him you're willing to *prepare* yourself for it.

For 29 years the International Correspondence Schools have been training men and women right in their own homes after supper, or whenever they had a little time to spare. More than two million have stepped up in just this way. Over 110,000 are studying now. Ten thousand are starting every month. Can you afford to let another priceless hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, mark and mail this coupon. It's a little thing that takes but a moment, but it's the most important thing you can do today. Do it now!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6090-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ELECTRICAL ENGINEER
- Electrician
- Electric Wiring
- Electric Lighting
- Electric Car Running
- Heavy Electric Traction
- Electrical Draftsman
- Electric Machine Designer
- Telegraph Expert
- Practical Telephony
- MECHANICAL ENGINEER
- Mechanical Draftsman
- Toolmaker
- Ship Draftsman
- Machine Shop Practice
- Gas Engineer
- CIVIL ENGINEER
- Surveying and Mapping
- MINE FOREM'N OR ENG'R
- ARCHITECT
- Architectural Draftsman
- PLUMBING AND HEATING
- Sheet Metal Worker
- Navigator
- CHEMICAL ENGINEER
- SALESMANSHIP
- ADVERTISING MAN
- Show Card Writer
- Outdoor Sign Painter
- RAILROADER
- ILLUSTRATOR
- DESIGNER
- BUSINESS MANAGEMENT
- Private Secretary
- BOOKKEEPER
- Stenographer and Typist
- Cert. Pub. Accountant
- Traffic Management
- Commercial Law
- GOOD ENGLISH
- Common School Subjects
- CIVIL SERVICE
- Railway Mail Clerk
- STATIONARY ENGINEER
- Textile Overseer or Supt.
- AGRICULTURE
- Poultry Raising
- Automobiles
- Spanish
- French
- Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

WIRELESS MANUAL

No. K-12
Ready May 25

We make a charge of 25c for it issuing a coupon receipt redeemable on a purchase of $5 or more.

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble.

Our 180 page combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments.

MANHATTAN ELECTRICAL SUPPLY CO., INC.

New York—17 Park Place
Chicago—114 So. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.

Digitized by Google

We're Prompt!

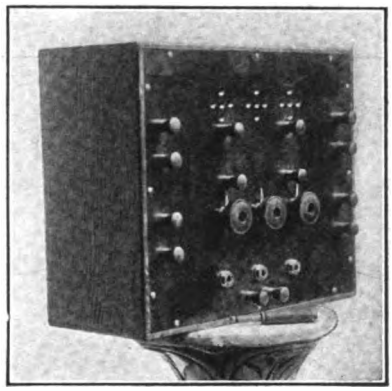
RECO QUALITY

You don't have to wait from three weeks to three months, for the apparatus you order. On everything except apparatus specially constructed to order, you'll have the benefit of

Shipment Guaranteed Within Twenty-Four Hours

Audions and Amplifiers

Audion Control . . $22
Without bulb or B batteries:—
1 Step Amplifier
Without Detector . $28
With Detector . . . $33
2 Step Amplifier
Without Detector . $45
With Detector . . . $50



10-Ampere Reco Key

Mounted on Italian marble base, with solid silver bar contact points, finished in brushed brass or nickel. Absolutely no side play in this Key. A great big special at $6.50 postpaid.

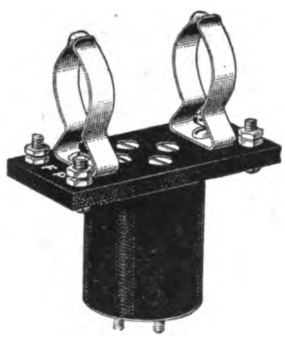
If you want a bright, snappy, monthly bulletin that means something; send us 6c in stamps.
NEW! An Adapter for Tubular Bulbs—fits any socket; is rugged—simple and 100 per cent. efficient, and positively vibration-proof—Immediate Delivery $1.50

Radisco Agents for the South
C. D. BLAIR
P. O. Box 859
Richmond, Va.

The Radio Engineering Co.
Baltimore, Md.

614 North Calvert Street

ATTENTION AMATEURS



The only practical adapter

Price $1.50

RADISCO AGENCY

We make up sets to specifications

Made by the
AMATEUR WIRELESS EQUIPMENT CO.
1390 Prospect Ave., Bronx, N. Y.

AWE NY CO

Catalogue sent on receipt of 10c, which may be deducted from first order.

Dealers write for proposition

PACENT ELECTRIC COMPANY

Builders and specialists in Electrical, Radio and Laboratory equipment.

SALES AGENTS
for
DUBILIER CONDENSERS,
DUO-LATERAL COILS,
GREBE APPARATUS,
MAGNAVOX PRODUCTS,
RAWSON METERS,
STANDARD VT BATTERIES,
and other first class equipment.

Telephone Beekman 5810
150 NASSAU STREET, NEW YORK CITY

RECOGNIZED AS THE LARGEST AND BEST

Service Radio School INCORPORATED

We will place out of town prospects in positions enabling them to pay expenses and tuition.

Write for Catalogue.

900-902 Penna. Ave., N.W., Washington, D.C.

WHY BEARINGS HEAT

ONE of the most annoying and disconcerting things that can happen to an engineer, or others in charge of machinery, is an experience with a bearing on an important piece of machinery which is heating.

If a bearing on a new piece of machinery persists in heating and the operator is satisfied that the oil he is using is not too light or too heavy, then the bearing may be out of line, or perhaps it has been designed with insufficient clearance. Overheating may also result when the clearance is too great, and trouble may follow because the bearing has high and low spots upon its surface. A very frequent cause of bearings running hot is foreign matter which may owe its presence in the bearing to any number of causes.

Faulty oil distribution is probably the cause of overheating as frequently as anything else. The oil may be fed into the bearing at the wrong point, or perhaps the grooves do not convey the oil to all parts of the bearing. Again, the feed pipe may not be of sufficient size to supply the bearing with an adequate amount of oil or the oil reservoir may be too small to permit of proper cooling. We have known many cases where a hot bearing was caused through an obstruction in the oil supply pipe restricting the flow of oil.

Unsuitable bearing materials and bearings which are not large enough to carry the loads brought upon them are often the cause of heating, and all the more annoying because they do not readily suggest themselves as the root of the trouble.

The sudden heating of an erstwhile well-behaved bearing may be due to recent rebabbitting or readjustment; that is, the clearance may be set carelessly, the interior surface may be imperfectly finished or the oil grooves may be improperly cut. A reduction in the amount of oil supplied to a bearing such as that brought about by a partially plugged feed line, the lowering of the oil level in a crankcase or reservoir of a ring-oiled bearing or the glazing of a lubricating pad may also cause a bearing to heat.

When the supply of oil is completely interrupted, overheating will prove especially serious and rapid. The supply of oil may be cut off through a feed pipe becoming plugged or through the oil reservoir running dry. Broken ring oilers, glazed pads, pads which have fallen away from the journal and the congealing of the oil in a system also cut off the oil supply. Dirt suddenly entering the bearing with the oil or from outside sources usually results in overheating. The more abrasive materials cause heating because they roughen the journal and bearing, but the softer materials are usually found

Digitized by Google

to have plugged the oil grooves and cut off the oil supply.

If the proper oil in sufficient quantities is being fed to the bearing, overheating must be due to mechanical disarrangements. For example, a bearing may have become knocked out of line or the bearing cap may have worked loose. Overheating may result from the bearing having become badly worn due to the above causes. Excessive loads are a common cause of hot bearings. A tightened belt or a shaft which has been sprung through dirt building up between the teeth of gears might be mentioned in this connection. Excessive loads may be thrown on the main bearings of the steam engine through insufficient cushioning in the steam cylinder, and too high compression in the internal-combustion engine has been known to bring about the same result.

The only way to obviate the continued heating of a bearing is to correct the underlying mechanical faults to which it is due. If sudden and unexpected heating occurs, any imperfections in the lubricating system should be set right, and when it is due to mechanical troubles, these should be corrected at once. Do not try to "manage somehow" with a heated bearing. Many preparations and devices have been recommended for reducing the temperatures of hot bearings, but these makeshifts are as ineffective as medicines given to cure a broken leg. If a suitable oil will not keep a bearing cool, it is time to make some repairs.—*Lubrication.*

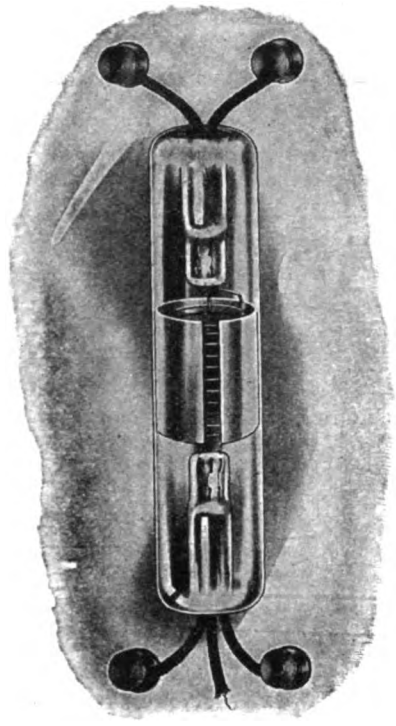
BAKELITE USED FOR AIRPLANE PROPELLERS

A SERIES of tests with Bakelite propellers has recently been completed by the Army Air Service. The results are reported to have been satisfactory. Several designs of propellers were used, but the micarta construction was more serviceable. These propellers were made by coating sheets of duck with Bakelite, then pressing five or six of these sheets tightly together to form a board that is sawed out in the shape of a propeller lamination just as wood laminations are cut. The Bakelite is then molded to an exact angle in a special mold under pressure at 350 degrees F.

The advantages discovered in the army tests are: Uniformity of texture, strength, absence of warping, elasticity, absence of metal hub, uniformity of all propellers made from the same mold, proof against abrasion, proof against moisture, including oil; freedom from checking and splitting, adjustable pitch feature resulting partly from elasticity, ease and rapidity of manufacture once the molds are completed.

AUDIOTRON

The Original Tubular Vacuum Detector, Amplifier, Oscillator



NOW FREE FROM ALL RESTRICTIONS

Dealers and Amateurs!—

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now licensed under Fleming Patent No. 803684 to be used only for amateur and experimental uses in radio communication. They are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

All patent questions have been definitely settled. Vacuum tube patents are basic and have been sustained by the Federal Courts. Be sure to get genuine AUDIOTRONS. They outclass any other form of detector and are absolutely free from all legal restrictions or difficulties. These new uses make it even more necessary to insist on the genuine. You can always tell a real AUDIOTRON by the name stamped plainly on the glass.

Insist on the name AUDIOTRON on every tube you purchase. Fully guaranteed by the AUDIOTRON Mfg. Co. (*Read the guaranty below.*)

Your last chance for an AUDIOTRON *or double filament* DETECTOR

Manufacturing reasons make it impossible to continue the present hand made AUDIOTRON. This type has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40.

The few thousand that will still be produced, will be of the same standard of excellence that has characterized every AUDIOTRON. Already recognized as the most sensitive detector on the market, these few that still remain, with all restrictions on amateur use lifted, are undoubtedly the greatest opportunity ever offered to amateur radio operators. See your dealer at once or order direct. Be sure to benefit by this last opportunity to secure a hand made super-sensitive double filament AUDIOTRON Detector, Amplifier, Oscillator.

$6.00 each

No Increase in price

The AUDIOTRON Exclusive Guaranty: **Each and every AUDIOTRON is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge. The only tube satisfactory enough to stand a guarantee.**

Dealers—

Get in touch with the AUDIOTRON Mfg. Co. at once. We will give you full information about settlement of all patent difficulties. ***You will also be interested in our new proposition for wide awake dealers.***

After the present supply is exhausted, new types of AUDIOTRON, manufactured entirely by machinery, will be offered for sale. Our extensive advertising during the Fall will establish definitely the superiority of the AUDIOTRON and will create new sales for you. Be sure to take advantage of our full co-operation at once. Prepare to cash in on the AUDIOTRON reputation, established since 1915.

Write us today for full details.

AUDIOTRON MFG. COMPANY
(Successors to the AUDIOTRON Sales Co.)

Dept. V Lick Building
San Francisco, California

OVER A THOUSAND

Amateurs have taken advantage of our offer of

INSTALLMENT PLAN

purchase of ANY piece of ANY make of apparatus parts, supplies and raw materials. If you are not receiving the "RVA" BULLETIN, you should send ten cents for it and receive the September issue as the first one (a 16 page issue) together with a loose leaf binder, Bargain supplements, etc.

J. DONALD VANDERCOOK & CO.

3 North York Street

ELMHURST ILLINOIS

Digitized by Google

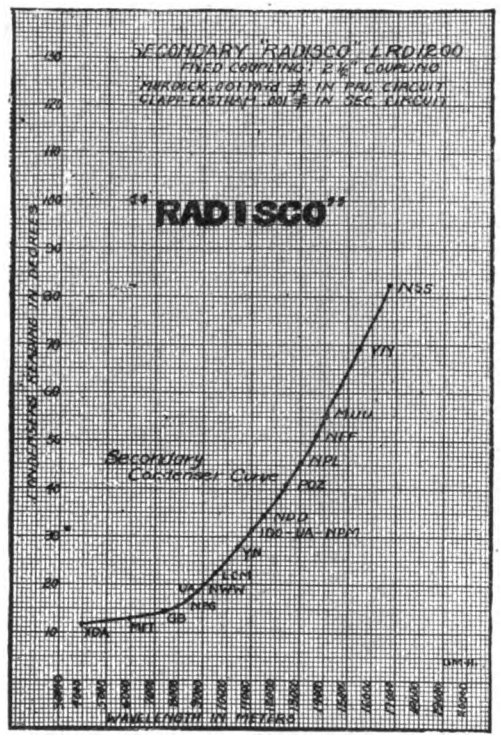
The Performance of Radisco Coils

Long Wave Work

EVERY radio man knows that the service derived from universal wound coils has been proven to be more efficient than bank wound or pancake inductances.

As a performer in long wave reception they rank highest, the curve illustrated herewith proves our contention; this curve prepared by a first district man shows the actual performance of Radisco Coils for long wave work.

The main features to be considered in purchasing coils, is the correct design, size of wire and character of insulation, another important point is structural strength, and last but not least is price consistent with the cost of manufacture.



Radisco Coils combine correct design and material, good appearance and reasonable strength, with creditable performance and prices that are not excessive. Made in 17 sizes, tapped and plain; wave length range from 200 to 20,000 meters; priced from 70c to $4.85.

You can duplicate such work with a set of these inductances, which can be had from any of our agents listed below.

In purchasing these coils be sure that the trade mark "RADISCO" is on every one you buy and be sure of getting serviceable apparatus of proven merit.

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace

ATLANTIC CITY, N. J.
Independent Radio Supply Co.,
118 So. New Jersey Ave.

BALTIMORE, MD.
Radio Engineering Co.,
614 No. Calvert St.

BIENVILLE, QUEBEC, CAN.
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street
Branch, 15 Temple St., Portland, Maine

BROOKLYN, N. Y.
Kelly & Phillips Electric Co.,
312 Flatbush Ave.

CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.

EUREKA, PEORIA, ILLINOIS
Klaus Radio Co.

KANSAS CITY, MO.
McCreary Radio Supply,
4th & Delaware Sts.

LOS ANGELES, CALIF.
The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.
K. & L. Electric Co.,
427 Olive Street

NEW ORLEANS, LA.
L. A. Rose,
121 Camp Street

NEWARK, N. J.
A. H. Corwin & Co.
4 West Park Street

NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.
507 Florence Ave.
"SHA"

OMAHA, NEBR.
O-B Radio Supply Co.,
406 Brown Bldg.

PHILADELPHIA, PA.
Philadelphia School of Wirless Telegraphy,
Broad and Cherry Streets

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington Street

PITTSBURGH, PA.
Radio Electric Co.,
3807 5th Ave.

SEATTLE, WASH.
Northwest Radio Service Co.,
1801 Sixth Ave.

SCRANTON, PA.
Shotton Radio Mfg. Co.,
P. O. Box 3
Branch, 8 Kingsbury St., Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street

ST. LOUIS, MO.
The Benwood Specialty Co.,
3424 Olive Street

TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street

WICHITA, KAN.
The Cosradio Co.,
1725 Fairmount Ave.

Responsible dealers: Write for interesting sales proposition on Radisco apparatus

If none of the above agencies are in your vicinity, or do not give you the desired information on these coils, communicate with

RADIO DISTRIBUTING COMPANY, Newark, New Jersey

COMPARING MAGNETO AND BATTERY IGNITION

CONSIDERABLE interest has often been expressed by engineers as to the relative power output of engines equipped with magneto and battery ignition, respectively. This question came up in the work of the Bureau of Aircraft Production, and in connection with it a test was made at McCook Field, Dayton, Ohio, for the purpose of determining the performance of a 180-h.p. Hispano-Suiza engine when equipped with Dixie magneto and when equipped with special Delco battery ignition. The difference in performance was so slight that only one power curve was plotted. (Engine Report No. 155. page 6.) This is in line with previous comparative tests made at McCook Field with both battery and magneto ignition; it was found that battery ignition and magneto ignition would give practically the same power on the same engine. The gasoline consumption also was found to be practically the same.

As regards weight, two magnetos, each weighing 14½ pounds, one starting magneto of 6 pounds and one switch of 1 pound, make a total of 36 pounds, while for the Delco battery ignition, two Delco units, including distributors, breakers, coils, etc., weigh together 30 pounds, ignition battery 10 pounds and switch and regulator 2 pounds, giving a total for battery ignition of 42 pounds, or 6 pounds in favor of the magneto.

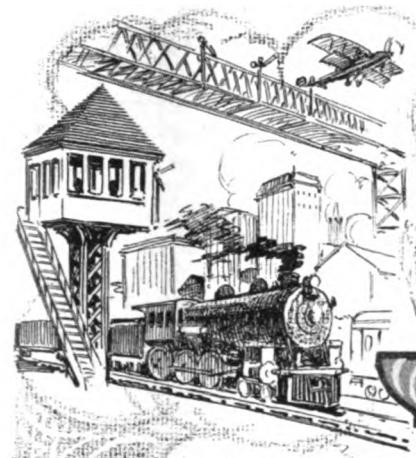
AIR SERVICE AERIAL AMBULANCE

THE new ambulance has a fuselage designed primarily for the transportation of the sick or wounded, providing space for two litter patients, a medical attendant and a pilot.

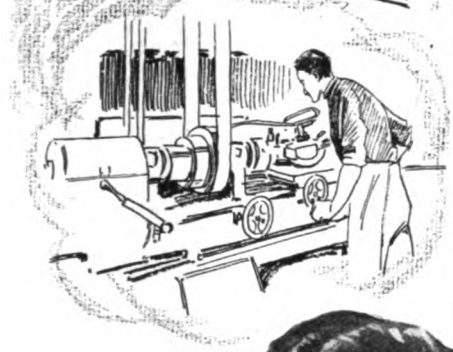
The basis for this new ambulance is the DH-4 aeroplane, with several modifications. The landing gear has been moved forward about twelve inches and the dihedral angle increased to 2.75 per cent. The wings have a 12-inch stagger and the angle of incidence is 3 degrees.

Necessary accommodations for the wounded are provided by increasing the depth of the fuselage behind the pilot's seat and dividing the space thus provided into an upper and lower compartment by means of a longitudinal partition. These compartments are reached through doors running their entire length, opening on the side of the fuselage. Each compartment is furnished with a Stokes litter, which can be securely fastened in its compartment and is easily handled by two men. Adequate light and ventilation is provided by means of windows in each compartment.

Digitized by Google







LEARN WIRELESS

At Home Quickly and Easily

WIRELESS is the hinge upon which swing the doors to success. It is the very foundation of the road which leads to many professions, vast in scope, big in responsibility, satisfying in progress and salary.

A trained Wireless Operator with initiative and ambition can easily fulfill his ideals for a successful future; one including a position filled with vital enterprise, adventure, and financial success.

Attractive Work—Alluring Salaries

Radio offers interesting work in pleasant environment, besides substantial salaries. Radio Operators' salaries start at $125 a month with all living expenses—board, lodging, laundry, etc. —paid. When totalled and added to salary, it means $200 or more a month, at the very start. Advancement to higher positions with bigger pay is readily accomplished. One of our recent graduates is getting $6,000 a year.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, wireless offers unequalled opportunities. On shipboard you are rated as an officer, living and eating with the officers, and mingling with the passengers. All without one cent's expense to you! Land Wireless positions are just as attractive if you prefer them.

Instrument Furnished Every Student

We furnish all necessary books and equipment *with our course.* Our famous Natrometer—automatic transmitting and receiving set—is among this outfit. This instrument sends you messages at varying speeds just as you would receive them from distant wireless stations—and is operated entirely without the use of "aerials".

BOOKLET FREE—It explains how we helped hundreds of ambitious men and women, and how we can give you a thorough Wireless training in your spare time, at home, by mail, and help you secure a worth-while position.



NATIONAL RADIO INSTITUTE
Dept. 278 14th & U Sts., N. W., WASHINGTON, D. C.

SEND THIS COUPON TODAY

NATIONAL RADIO INSTITUTE
Dept. 278 14 & U Sts., N. W., WASHINGTON, D. C.

Send me your FREE book "Wireless The Opportunity of Today". Tell me about your Home Study Course in Wireless Telegraphy and Telephony —the free post-graduate course—and your Special Instrument Offer.

Name .....

Age ..... Address .....

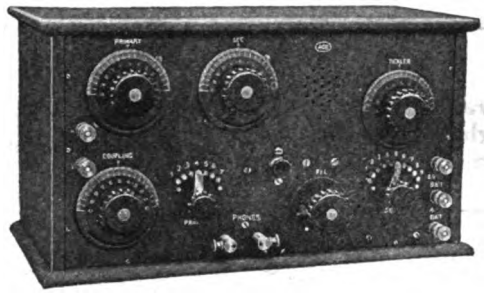
City ..... State .....

Digitized by Google

LET'S FINISH THAT SONG

(Continuation of last month's storm)

(Tune—Battle Hymn of the Republic)



First you write a little letter,
It's addressed to Doctor Ace.
You will never find one better
For he always sets the pace.
He will give you all the data
So you may get in the "race".
Then you'll get the signals too.

EXPERIMENTERS—Ask your dealer about our high grade goods including latest C-W Apparatus.

DEALERS—You are missing the ACE line if you fail to have our goods in stock. Ace Apparatus sells itself—REMEMBER—

"You may pay more. But you can't buy better."

THE PRECISION EQUIPMENT CO.

Dept. B, 2437 Gilbert Avenue, Cincinnati, Ohio

That Radio Instrument

When you are looking for some distinct part of a radio station and you have been unable to locate it elsewhere, come to us and you will find it here, anything in radio that is a necessity, we have it.

Apparatus of all responsible manufacturers, whose quality and service have been proven.

Here are some of the Instruments kept in stock:

Filament Ammeters for Radio Work, made by Roller Smith, 0-1, 0-2 Amperes. List Price $6.20, Special $6.00.
Loose Couplers, $5.00, $10.00, $15.00, $19.00.
Tuning Coils, 4,000 Meters $4.75; 1,250 Meters, $3.50.
Murdock Variable Condensers, .001 Mfd. $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 Mfd. 70c; .003, 90c.
Oscillation Transformer (Murdock Type), $5.00.
Lightning Switch, 600 V-100 Amp., $5.94.
Switch Points, 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
White Metal Dials 3", 50c.
Binding Posts, 8c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; DeForest Type, $1.50.
Western Electric Phones, $12.00.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Leads of other Apparatus on Hand.

The above list does not do justice to our complete stock and it cannot be appreciated unless you send for our catalog, which will be sent to all who wish it upon receipt of 10c.

AMERICAN ELECTRO TECHNICAL APPLIANCE COMPANY

DEPT. EM., 235 FULTON STREET NEW YORK CITY

STUDY WIRELESS *in* BOSTON

THE CENTER OF EDUCATION

Under former U. S. Radio Inspector for New England District. We teach both SPARK and ARC telegraphy and the WIRELESS TELEPHONE.

Best equipped Radio School in New England. Positions secured for graduates. Massachusetts Radio men are in demand by all radio operating companies. Send for free literature.

FALL TERM BEGINS SEPT. 13th

18 BOYLSTON ST. Tel. Beach 7168

There has been a telegraph school at 18 Boylston St. over 18 years.

MASSACHUSETTS RADIO AND TELEGRAPH SCHOOL

Arthur Batcheller R. F. Trop
G. R. Entwistle

RADIO APPARATUS

Distributors of reliable Radio apparatus for experimenters in every branch of the Radio field!

"Pittsco" The sign of service.

PITTSCO

"Remember" We carry an immense stock.

Honey-Comb Coils

LITZENDRAHT WIRE.		(While they last.)
LL-75	330-1030 meters	$1.60
LL-100	450-1460 "	$1.70
LL-150	660-2200 "	$2.00
LL-200	930-2850 "	$2.10
LL-250	1300-4000 "	$2.30
LL-300	1550-4800 "	$2.50
LL-400	2050-6300 "	$2.80
LL-600	4000-12000 "	$3.00
LL-750	5000-15000 "	$3.20
LL-1000	6200-19000 "	$3.50
LL-1250	7000-21000 "	$3.90

Note:—These are the genuine DeForest litz coils.

Transmitting Condensers

(Dubilier)

Type	Watts	Cap	Price
D-100	250	.007	$18.00
D-101	500	.007	$30.00
D-102	1000	.007	$45.00
D-103	1000 Spec.	.007	$50.00
D-150	For C. W. or spark coil transmitters,	.0024 MF., 8000 volts	$ 5.00

F. D. Pitts Co. Boston, Mass. Transmitting Transformers

(New Type Acme)

Acme	250 Watt	mounted	$16.00
"	250 "	unmounted	$13.00
"	500 "	mounted	$22.00
"	500 "	unmounted	$18.00
"	1000 "	mounted	$33.00
"	1000 "	unmounted	$28.00

F. D. Pitts Co. Boston, Mass. Continuous Wave, Power Transformers

(For Wireless Telephone)

Acme	200 Watt	C. W. Power trans. unmounted	$16.00
"	200 "	C. W. Power trans. mounted	$20.00
"	50 "	C. W. Power trans. mounted	$15.00
"	50 "	C. W. Power trans. unmounted	$12.00

F. D. Pitts Co. Boston, Mass. Modulation Transformers

(For Wireless Telephone)

Acme A-3	unmounted	$4.50
" A-3	semi-mounted	$5.00
" A-3	mounted	$7.00

F. D. Pitts Co. Boston, Mass. Quenched Gaps

Amrad G-1	1	K. W. type	$29.75
" G-2	½	K. W. type	$18.85
" G-3	¼	K. W. type	$13.50

F. D. Pitts Co. Boston, Mass.

Important! Every article sent to any part of the U. S. A. Postage prepaid. We want your business. Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

12 Park Square Dept. F.

BOSTON, MASS., U. S. A.

Digitized by Google

Indicating QUALITY



The Corwin Indicating Dial

recognized by Radio Men as a popular and needy addition to any set, has been further improved and now comes in two sizes, three inches and three and seven-eight inches in diameter. This larger dial (3⅞ in.) fills the general demand for an indicator to fit the standard one-quarter inch shaft; quality and workmanship better than ever.

3 in. dial only, 75c.
With knob $1.30
3⅞ in. dial only, $1.00
With knob $1.70
Sent postpaid anywhere.

For sale at all Radisco Agencies

Ten cents brings our latest catalog to you, describing the above dial and all standard radio apparatus.

A. H. CORWIN & CO.
Dept. F5, 4 West Park Street
NEWARK, N. J.

"POROX"

"Trade Mark"

High grade Batteries made up in single transparent Celluloid and Pyralin cells for model and radio work.

Special Batteries made to order also duplicating of foreign batteries.

Prices on request.

ALBERT MULLER
8758 Queens Boulevard
Jamaica, Long Island, N. Y.

READY FOR IMMEDIATE SHIPMENT

"BROWN" Super Sensitive Radio Phones

Latest Improved Adjustable Steel Reed Cone Diaphragm Type. Light weight 10-ounce, the most comfortable and most sensitive phone in the world.



BRITISH ADMIRALTY STANDARD
4,000 Ohms ..... PRICE $20.00
8,000 " ..... " 22.00
Resistances from 5 Ohms to 24,000 Ohms to Special Order

ALSO WESTERN ELECTRIC VT-1 TUBES AT $11.00 AND VT-2 AT $19.00 EACH

RAWSON ELECTRICAL INSTRUMENT CO.
CAMBRIDGE 39, MASS.



DUCK'S No. 14 264 Pages
Electrical and Wireless Catalog
JUST OFF THE PRESS
175 Pages of Wireless Instruments

Any radio amateur will tell you there is no catalog to take its place, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

THIS UNRIVALLED CATALOG MAILED TO ANYONE UPON RECEIPT OF 12c IN STAMPS OR COIN, which may be deducted on first dollar purchase.

Great cost of catalog and low prices prohibit distribution otherwise

What This Big Catalog Contains

175 pp. Wireless Apparatus for Commercial and Experimental use;
10 pp. Raw Material;
2 pp. Transformers;
9 pp. Auto and Stg. Batteries;
8 pp. Telegraph Instruments;
42 pp. Motors and Dynamos;
8 pp. Flashlights;
2 pp. Medical Batteries;
3 pp. Ammeters and Voltmeters;
20 pp. Electrical and Mechanical Books.

THE WILLIAM B. DUCK CO.
244-246 Superior Street, Toledo, Ohio

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE 749 C Street, Valparaiso, Ind.

"ASK ANYONE WHO HAS USED IT"

USERS ARE PROVERS

"My Brandes sets brought in Coast stations louder and clearer than the other phones with which the station was supplied." (Name on request.)

Brandes Wireless Headset



Superior, 2000 ohms, $7

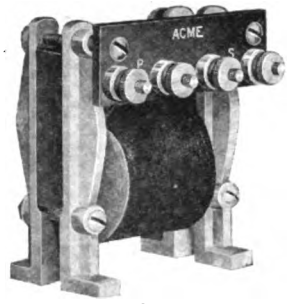
TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

SEND 4c FOR CATALOG M

C. BRANDES INC. 32 Union Square, Room 822, New York

WIRELESS RECEIVER SPECIALISTS

Digitized by Google



ACME
AMPLIFYING TRANSFORMER } $5.00

HAVE YOU SEEN THESE?



ACME
AMPLIFIER $13.00
DETECTOR 10.00

Ask your dealer to show them to you
Ask us to send you our bulletins

ACME APPARATUS COMPANY

24 WINDSOR STREET,
CAMBRIDGE 39, MASS.

Transformer and Radio Engineers and Manufacturers

DEALERS: *DELIVERIES ARE INVERSELY PROPORTIONAL TO DEMAND. ORDER NOW!*

TUBE CONTROL PANELS

of unit size, 5½" High 4½" Wide



Beauty and convenience have been incorporated in the design of these Panels to an unusual degree. The detector panel has a plug connection for the telephones which takes your regular phone tips. The amplifier panel has binding posts making it very easy to connect two of these together as a two stage amplifier. Both instruments will give you the utmost value for your money and the name Clapp-Eastham Co. engraved on the bakelite panel carries with it almost 13 years development experience in the Radio Field. Catalogs mailed for 6c stamps.

Tube Control Detector Panel Z. R. D. .$13.00
One Stage Amplifier Panel Z. R. A... 18.00

Order one or both panels from your dealer to-day

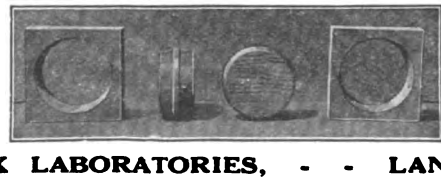
CLAPP-EASTHAM COMPANY

131 Main Street **Cambridge, Mass.**

MAKE YOUR OWN REGENERATIVE RECEIVER USE WILCOX VARIOMETER PARTS

SET NO. ONE contains carefully turned wooden parts as illustrated.

Price $2.50 Postpaid



SET NO. TWO contains all parts for variometer including a 3" dial.

Price $5.00 Postpaid

THE WILCOX LABORATORIES, - - LANSING, MICH.

WHAT CALORIZING IS

SEVERAL years ago one of the large electric companies instituted a research for the development of some processes of treatment that would render metals more resistant to oxidation at high temperatures. At the present time the process has reached a stage where this company is using it regularly; it has been tried out in several other connections, notably that of soot-blowers already mentioned, and it seems so promising that a company has been formed for the sole purpose of commercializing it.

The process to which the name "calorizing" has been applied depends upon the high heat resistance of aluminum oxide. The parts to be treated are packed to a retort with an alumina mixture and other chemicals whose identity is not for the present divulged; hydrogen gas is introduced into the retort, and the temperature is then brought gradually up to 1,650 degrees Fahrenheit in the electric furnace. After holding the heat at this point for a proper time, the retort is allowed to cool slowly, the introduction of the hydrogen still continuing. When cold, the treated parts are withdrawn and cleaned. It is then found that the alumina has penetrated the surface metal of the treated parts to a greater or less degree, depending upon the time through which the process is allowed to extend. A homogeneous protective alloy is thus formed with the surface metal, not unlike an amalgam. This alloy shell is strongly resistant to the oxidizing influence of heat, and at the same time no physical change is apparent in the calorized portion of the metal, with the exception of the mild anneal resulting from the heating in the furnace. In particular, there is not the slightest tendency of the protective shell to strip or otherwise to behave as anything other than an integral part with the metal beneath it.

Where high temperatures in combustion are employed, ranging up to 1,800 degrees Fahrenheit, calorized metal is said to give most excellent results. The ideal temperatures for its use range from 1,100 to 1,750 degrees Fahrenheit, and at 1,800 degrees the resistance to oxidation from heat very slowly diminishes. Close-grained cast iron, black and wrought iron, steel, nickel, nickel-steel, brass, bronze and copper have been successfully calorized and a much longer life incorporated in their use in high temperatures. A large application is seen in relation to calorizing of annealing and carbonizing boxes, pyrometer protection-tubes, retorts, super-heaters, vaporizers, burner collars, pipe and tubing and a multitude of other uses among many industries. Calorizing is not a preventive of atmospheric oxidation or oxidation from moisture.

Digitized by Google

PEDIGREES

Have you ever traced your pedigree?

If you have, you probably discovered that you are the lineal descendant of some great family or individual whose achievements have stood out in history.

How you swelled with pride when you traced the red blood in your veins, the blood of these wonderfully aristocratic men and women.

Just as you take pride in your pedigree, we take pride in ours; going back to the very beginning of the business world, we find that our pedigree runs to the most royal of all royalty.

The House of Service

From the very start we have devoted our time to "Service"; we have breathed it, lived it, talked it, and as we grow our ideal grows with us—we uphold our pedigree, our one doctrine to all who will let us.

Not only have we traced our pedigree, but the pedigree of our apparatus.

Pedigreed apparatus is the best you can buy, no better can be had, old established, tried and true, instruments of quality, that will give you service at all times.

Why not come to us for the next instrument you need and we will show you—just what we mean by pedigree.

We list one of the most complete stocks of Radio apparatus; which includes every manufacturer of responsibility.

Our special department of small parts, just installed, is unique in the fact that we cater to accessories in radio, every necessary part, including Contact points, switch points, knobs, switches, bushings, etc.; you should not fail to see our special display of these parts, in the first show case on the right as you enter our showrooms.

You can secure a more comprehensive idea of our service, individual and mail order, by paying us a visit or sending twenty-five cents for catalog, the cost of which will be deducted from the first order of five dollars.

If you are looking for something in electrical apparatus, we have it, including a most complete line of heating appliances.

From Nothing to Something

?

YOU WILL DO IT
YOU WILL DO IT
YOU WILL DO IT
YOU WILL DO IT

Watch next month's issue

Our word of honor to you is our guarantee. Let us prove it.

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Secretary J. STANTLEY, Treasurer

DEPT. F.6. 6 WARREN STREET NEW YORK

Digitized by Google

DE FOREST



DeForest Portable Buzzer
"Radiophone"*
Type OT-5

A WIRELESS Telephone for Automobiles, Motor and Sail Boats, Camps, Surveying and Exploring Parties, Forest Patrol, Farms, and all isolated places. Operates on two 6-volt storage batteries; no outside source of power required. Easily transported; entire Transmitter, including batteries, weighs less than 60 pounds. Range on ordinary Amateur aerial, is 5 to 10 miles; can be materially exceeded under proper conditions. Operates with any suitable Receiver and Audion Detecter; with or without Audion Amplifier, depending on the range to be covered and loudness of reception desired.

Without Storage Batteries

Price Including Vacuum Tubes $135.00
F. O. B.—New York

Investigate this new DeForest production now. Order at once to insure early delivery; either thru your regular dealer or direct from us.

*"Radiophone" name Copyrighted.

DE FOREST RADIO TEL. & TEL. CO., 1415 Sedgwick Ave., New York City
Inventors and Manufacturers of High Grade Radio Apparatus
Lee DeForest, Inc., 415 Third St., San Francisco, Western Distributors

DE FOREST



No. 7623—Price $1.35

Ask Your Dealer for these
"Standard Products"



Miniature Jack and Plug—Price $1.50 Per Dozen

RICHTER & BYRNE, *Manufacturers*
198 Roebling St., Brooklyn, N. Y.
Pacent Electric Co., Inc., Sole Eastern Agents
150 Nassau St., New York, N. Y.

Federal
Radio
Accessories

Are the Recognized STANDARDS for Their Respective Uses.
BULLETIN 102 W.A.
Gives full description. Besides it contains valuable information on
AMPLIFICATION
of Radio Signals
Send 6c in Stamps today and receive this Bulletin.
FEDERAL TELEPHONE AND TELEGRAPH CO.
1756 Elmwood Avenue
BUFFALO, N. Y.

RADIO MEN
THE
Mutual Purchasers Association
will save you money on all
WIRELESS APPARATUS
Write Dept. E10 for details.
Mutual Purchasers Association
2-4 Stone Street, New York

REWINDING A. C. MOTORS
And all methods for connecting and reconnecting are clearly shown in the ELECTRICAL WORKERS FRIEND. 60 diagrams with detailed explanations solving every rewinding and reconnecting problem. Electricians and Experimenters will find this book exactly what the name implies "The Electrical Workers Friend." Price $4.00 Cash with order or (C.O.D.—U.S.A. only).
HENRY F. BOSSHART
P. O. Box 68 Homewood Sta. Pittsburgh, Penna.

A NEW DETECTOR
That can either be used as a Panel Unit, as advocated by this magazine or "on the table," and only one knob is used for Position and Pressure. Instantly adjustable to any spot on the crystal. Price includes tested galena Base 5 ins. by 2½ ins. $2.50. Base 5 ins. by 5 ins. 3 cups $3.00.
Just write for information and list
THE BARWICK RADIO SUPPLY CO.
89 Britannia Ave. Hamilton, Ont., Can

Arnold
Loose Couplers
Combination Loose Coupler Parts and accessories.
Send 4c stamp for literature which is sure to interest you.
J. F. ARNOLD 2062 Lexington Av., N.Y.
Established 1910

We want a subscription agent in every Radio Association throughout the country. Liberal terms. Address Circulation Manager, Everyday Engineering Magazine, 2 West 45th St., New York City.

INDIA AND BRAZIL MICA

MICA commonly occurs in pegmatites, which consist of large crystals of feldspar and quartz, mica constituting but a small proportion of the total rock mined. Much of the feldspar thus thrown out during the process of mining is pure and of high quality, and the Bureau of Mines has suggested that much of it could be utilized for ceramic purposes. Encouragement is given to such utilization by the fact that several mines now worked for mica were formerly operated for the production of feldspar. Where mines are not readily accessible to railroads feldspar utilization might not be feasible, for it is a much lower priced product than mica and cannot, therefore, bear as heavy transportation expense. Where mines are located close to railroads, however, such utilization would tend to reduce the cost of mica mining and at the same time assist in the solution of the waste-disposal problem.

Methods of mining mica in India are very primitive. In place of using explosives, fires are built and water thrown on the heated rock surface. Iron wedges are driven into the cracks thus formed, and the rock masses reduced and removed. After separation from adhering rock, the mica "books" are taken from the pits by women or coolies, who carry them on their heads to the cobbing sheds. The cobbed and sorted mica is carried in baskets on bullock carts to the main offices, some of which are distant a seven-day trip from the mines. India mica is of very high quality, and, for the most part, the trimming and grading are done much more carefully than in America.

The principal mica deposits of Brazil are situated in the states of Bahia, Sao Paulo, Goyaz and Minas Gereas. Some of them are of wide extent and sufficiently rich in mica to render mining operations attractive. Production increased from 1,435 kilos, valued at $1,152, in 1910, to 15,348 kilos, valued at $12,964, in 1914, and to 53,743 kilos, valued at $55,859, in 1916. Exports from the state of Sao Paulo alone in 1917 amounted to 10,771 kilos and in 1918 to 11,604 kilos (1 kilo equals 2.2 pounds). The product is shipped to England, France, Germany, Italy and the United States.

The best product of Brazil is termed "ruby clear mica," which, according to some experts, compares favorably with India ruby mica. In view of the increasing demand for electrical mica, the quality of the Brazilian product justifies greater development, but the deposits are handicapped by poor transportation. Thus in 1912 the mica was worth only one-eighth to one-twelfth as much in the Sao Paulo market as when delivered in England.—U. S. Bureau of Mines.

Digitized by Google

WHAT IS NEW IN AVIATION

(*Continued from page* 505)

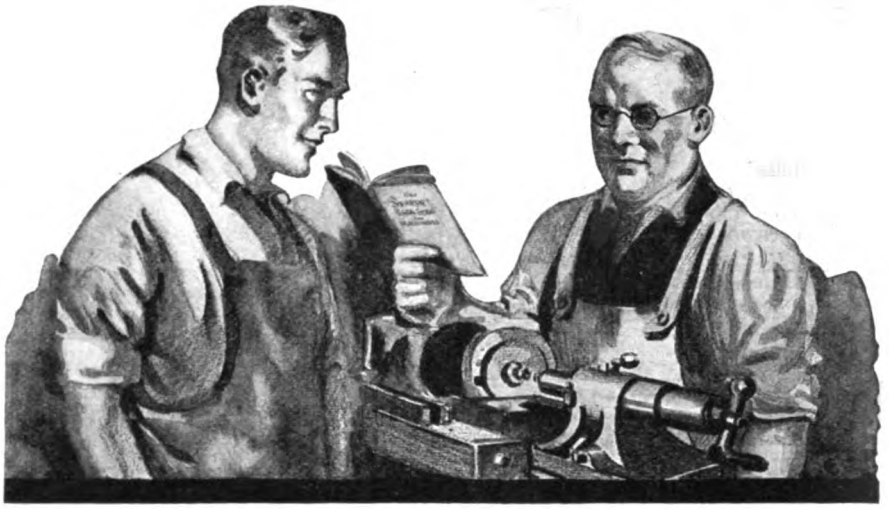
equal and a dihedral angle is given to the bottom plane only. The ailerons are constructed on the firm's patented system of balance which was first fitted to the large four-engine machine, with the result that this large machine can easily be controlled by one pilot without the use of servo motors or other contrivance. The overall span of the planes is 75 ft. and there is no stagger. It is proposed in a short time to fit the new high lift plane system which has been evolved by this firm. Experiments along these lines are proceeding.

The fuselage is devoted entirely to carrying the crew, passengers and for cargo. The pilot and engineer are seated on the extreme nose of the machine in a comfortable cockpit, in which all engine controls, instruments and other apparatus necessary for the working of the machine are arranged within easy reach of the pilot or engineer, as required. The dashboard carries a full set of instruments, and provision is made for Marconi wireless gear to be fitted if required. Both pilots and engineer's seats are comfortably upholstered, and the rudder bar is adjustable both as to height and distance from the pilot. A partition immediately to the rear of the pilot divides the forward cockpit from the main fuselage saloon or cargo space. This saloon occupies three complete bays of the fuselage and measures 4 ft. 6 ins. wide by 6 ft. high by 22 ft. long. The whole of this space is provided with flooring which is of a new type, considerably lighter and stronger than previously used. Adjustable Triplex Safety Glass windows are fitted in the sides of the fuselage, and seating accommodation provided for 15 passengers, each of the passengers having a window immediately next to him.

As previously mentioned, no struts or internal structure of any description occur throughout this saloon. A large side door is provided for access to the saloon, and steps are provided which can be adjusted to position from inside the saloon if necessary. For cargo purposes, trap doors can be arranged in the cargo space, as required. The fuselage is constructed in three sections. The front section comprises the pilot's cockpit, with all the instruments and controls. The second section contains the passenger saloon or cargo space, and the third and last section extends from the rear end of the saloon to the rudder post, either of these sections being easily changeable.

The engine nacelle framework is of steel tube, and is so arranged that the engine stands outside the wing hinges. The gasoline tanks are carried on the same framework but behind the en-

(*Continued on page* 563)



Starrett Books - Vol. II

75¢



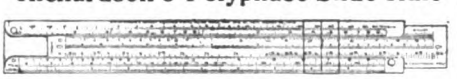
"What you want to know is right here"

That's why machinists are buying the Starrett Data Book. It's practical. Just the things you want to know—and only those things—ready for use when you want them. Information about cutting speeds, change gears, drill and tap sizes, screw and gear cutting, decimal equivalents, etc.—all in a handy book that you can keep in your kit or carry in your pocket, ready for constant reference.
Bound in red Athol leather, 180 pages. Size 4½ x 7. Price 75c at your hardware dealer's or direct from us. Ask for Catalog 21 "MB" too, it's free.

THE L. S. STARRETT COMPANY
The World's Greatest Toolmakers
Mfrs. of Hack Saws Unexcelled
ATHOL MASS. 42-70

Use Starrett Tools

Richardson's Polyphase Slide Rule



has the regular A, B, C and D scales, also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.
Price of the Richardson's Polyphase Slide Rule, in case, with a 100-page Instruction Book, $2.00.
An ideal slide rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.
Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10 each. Instructions in Logarithms and Trigonometry free with every catalogue.
GILSON SLIDE RULE CO., Niles, Mich.

STURDY

Bang - proof, knock - proof, weather-proof, thief-proof — that's what you'll say when you see this handy, compact



UNION GARAGE TOOL CHEST

Union Tool Chests are durable, handsome, of the best workmanship and finest material. There are 24 sizes and styles to choose from—an economical chest for every mechanic's needs. Sold on "Satisfaction or Money-Back" guarantee.

WRITE FOR FREE CATALOG

and let us tell you more about Union Tool Chests.

UNION TOOL CHEST CO., Inc.
34 Mill Street UNION TOOL CHESTS Rochester, N. Y.

EVERYDAY ENGINEERING MAGAZINE
Is the Only Publication That Meets the Needs of the Experimenter and Home Mechanic. It Tells How to Make and Do Things, and Why Things Are Done. Subscribe Now.

Digitized by Google

MODEL AIRPLANE ENGINES

3 Cylinder Rotary Compressed Air Engines.

⅜ in. bore, ½ in. stroke
½ in. bore, ½ in. stroke
⅝ in. bore, ½ in stroke

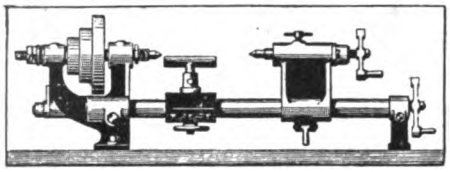
6 Cylinder rotary steam engines, steel cylinders, tobin bronze pistons, aluminum crank case.

½ in. bore, ½ in. stroke

Send stamp for descriptive circular.

MODEL MACHINE SHOP CO.
415 East 71st St. New York City

THE EXPERIMENTER'S SHOP



SHOP TOOLS AND EQUIPMENT

Rough and machined castings for 6" lathe

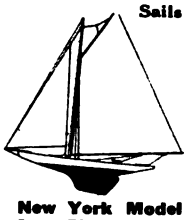
DESIGNS FOR MODEL BOATS

Drawings of famous ML-80 British Destroyer

Send stamp for catalog

HUHN MFG. CO., 552 Elm St., ARLINGTON, N. J.

OH—Just What I Wanted Real Model Racing Yachts



Sails Faster Than You Can Walk

Sport for Men and Boys. Construction Set — complete — 30 INCHES LONG, WITH RIGGING, FITTINGS and HEAVY LEAD KEEL, ready to assemble. 5 SCREWS, 20 BRADS and Yacht is built. Also same Model finished ready to sail. Just printed, book on "Model Yacht Sailing," sent for 25c. and your dealer's name and address, giving full instructions of the Sport; how to sail, rig, nautical terms, etc., etc.

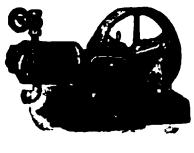
New York Model Boat & Mfg. Corporation
Dept. EM, 18 Broadway New York City

"Richards' Made"

Complete Construction Sets from which you can build successful SAILING MODELS. Circular tells the rest. Send for it.

WM. RICHARDS
747 Tremont Ave. New York City

Small Steam Engines and Boilers



GAS and GASOLINE ENGINES

⅛H P. up; Pumps, Gears, Model Makers' Supplies, Castings, Etc.

Catalog and List sent for 15c stamps (or coin preferred.)

Modern Engine & Supply Co.
342 Monadnock Block, Chicago

MODEL ELECTRIC MOTOR YOU

can build this working model. All parts furnished complete with Blue Prints. No Extras required. $2.00. Blue Prints only 25c.

A. F. CASSEL
52 W. 130th Street, New York City

Real Radio Apparatus

COMMERCIAL EXPERIMENTAL wicony RADIO PRODUCTS EDUCATIONAL LABORATORY

Standard and Special

To the amateur and experimenter desiring Standard apparatus, we offer our complete line such as we supply to the U. S. Navy and Army, high grade commercial and foreign governmental institutions.

Our Radio and Audio Frequency-Multi-Stage amplifiers represent the highest development in this line.

WIRELESS IMPROVEMENT COMPANY

Radio Engineers—Manufacturers and Distributors

47 West Street New York

"Contractors to the U. S. Navy and War Depts."

"CW" EQUIPMENT

MOTOR GENERATOR SET

Direct coupled, 4 bearing unit. Drive Motor of induction type, 110 v., A. C. S. P., compound wound D. C. Generator, 48 commutator bars, output 500 v., 175-200 watts, continuous. Set mounted on substantial oak base and furnished complete with field rheostat regulating output voltage. Delivery Oct. 1, 1920.

Price F. O. B. Boston, $130.00

D. C. GENERATOR

Output 500 v., 175-200 watts. Delivery Oct. 1, 1920.

Price $70.00

SPECIAL S. P. A. C. MOTOR

Operates on 110 volts, 60 v. A. C. current. Rated at ¼ H.P.—guaranteed to develop 1/3 H.P. continuously. Draws 4.5 amperes, 1750 R.P.M. **Price $27.50**

"Bulletin 14"—108 pages—over 100 illustrations—sent upon receipt of ten cents. A Rebate Certificate good for 10 cents on first dollar order is inclosed

ATLANTIC RADIO CO.

INCORPORATED

Main Office: 88 Broad Street, Boston, Mass.

Portland Branch: 15 Temple Street, Portland, Me.

BE SURE AND ORDER YOUR OCTOBER COPY OF EVERYDAY ENGINEERING MAGAZINE EARLY

WHY NOT SUBSCRIBE AND BE SURE OF RECEIVING EVERY COPY AS ISSUED. SEE OUR SPECIAL OFFER ON PAGE 572. VALUABLE BOOKS GIVEN AWAY.

Digitized by Google

WHAT IS NEW IN AVIATION

(*Continued from page* 561)

gines, and a fireproof partition is arranged between the tank and the engine. No bracing wires or struts pass through the fuel tanks, and both the engine and tank are very readily removable when required. The oil tank is immediately behind the engine, and the radiator is of the nose type carried in front of the engine. The whole of the engine unit, tanks, etc., are covered with a stream-line aluminum cowling circular in cross section.

The undercarriage is similar in design to that used so successfully on the large four-engine Handley-Page machines, and consists of two entirely separate units, each unit having two wheels, one below the engine and the other near the fuselage, and all members are universally jointed so as to allow for any movement of either shock absorber. No portion of the undercarriage projects below the fuselage and thus any arrangement for dropping nails, etc., from the fuselage will not be interfered with. The tail skid is of the usual type, with the exception that it is kept almost entirely within the fuselage, thus considerably reducing head resistance.

A monoplane tail is fitted of ample size, and carries the usual elevators. The vertical surfaces consist of a monoplane fin and balanced rudder arranged on the center line of the fuselage. The elevators are unbalanced, but are carefully proportioned so as to reduce the load on the pilot's hand, and in addition, hand-adjusting gear is provided for the tail plane itself, whereby the pilot can alter the trim of the machine at any time during the flight.

Vickers Commercial and Amphibian

Since its first inception the Vimy-Commercial has been altered and improved in several respects. The large cabin with seating accommodation for 9-10 passengers, is built upon the famous Saunders "Consuta" principle with the layers of plywood sewn together, a form of construction which has proved very strong and durable. This construction also has the advantage that there is no internal cross bracing in the cabin, which is, therefore, particularly roomy and comfortable. There are eight wicker seats arranged along the sides of the cabin, and a ninth wooden seat is placed on the starboard side, opposite the entrance door.

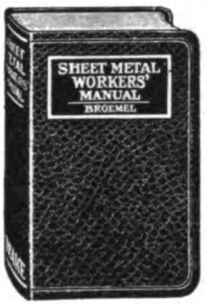
The pilot's cockpit is entered through two doors in the forward bulkhead of the cabin, and below this is a space for cargo, mail or luggage. A separate door in the port side enables the cargo to be loaded or unloaded without inconveniencing the passengers in the slightest. For long non-stop flights two pilots

(*Continued on page* 564)

DRAKE'S PRACTICAL MECHANICAL BOOKS

They Will Raise Your Pay—
ORDER ON 5-DAY TRIAL

The books listed below will perfect you in your chosen trade—pave the way to obtain the big positions—the fat pay envelopes. Written in non-technical language—easy to read—easy to understand. We will send any book postpaid—you benefit five days—if not entirely satisfied return the books and your money will be refunded in full. Order direct from this page.



Shop Practice Books

Sheet Metal Workers' Manual, ..Leatherette $2.00
Oxy-Acetylene Welding and Cutting ..Leatherette $1.75
Sound Welds .....Cloth $2.00
Slide Rule and Logarithmic Tables ..Leatherette $2.00
Handbook for Millwrights.....Cloth $2.00
Modern Blacksmithing .....Cloth $1.25
Machine Shop Practice.....Cloth $2.00
Mechanical Drawing and Machine Design .....Cloth $2.00
Pattern Making .....Leatherette $1.50

Carpentry and Building Books

Modern Carpentry, 2 vols.....Cloth $2.50
The Steel Square, 2 vols.....Cloth $2.50
Wooden Boat and Shipbuilding...Cloth $1.50
Modern Estimator and Contractors' Guide .....Cloth $1.50
Light and Heavy Timber Framing.Cloth $2.00
Builders' Architectural Drawing..Cloth $2.00
Concretes .....Cloth $1.50
Practical Bungalows and Cottages.Cloth $1.00
Hodgson's Low Cost American Homes... $1.00
Practical Course in Roof Framing.Cloth $1.50
Stair Building and Hand Railing..Cloth $1.25

Electrical Books

(Leatherette Bindings)

Practical Applied Electricity..... $2.50
Motion Picture Operation..... $1.75
Alternating Current $1.75
Electric Motor Control Systems..... $1.75
Wiring Diagrams and Descriptions..... $1.75
Electrical Tables and Data..... $1.75
Armature and Magnet Winding..... $1.75
Modern Electrical Construction..... $1.75
Modern Electric Illumination..... $1.75
Electricians' Operating and Testing Manual $1.75
Drake's Electrical Dictionary..... $1.75
Electric Motors, Direct, Alternating.... $1.75
Electrical Measurements and Meter Testing $1.75
Drake's Telephone Handbook..... $1.75
Modern American Telephony..... $2.00
Easy Electrical Experiments.....Cloth $1.25
Wireless Telegraph and Telephone Handbook .....Cloth $1.25
Telegraphy Self-Taught.....Cloth $1.25

Steam Engineering Books

Swingle's Handbook for Steam Engineers and Electricians.....Leatherette $3.50
Complete Examination Questions and Answers for Marine and Stationary Engineers .....Leatherette $2.00
Steam Boilers .....Leatherette $2.00
Swingle's Catechism of Steam, Gas and Electrical Engineering.....Leatherette $1.50

Painting Books

Scene Painting and Bulletin Art..Cloth $3.50
A Show at Sho' Cards.....Cloth $3.50
Sign Painting .....Cloth $3.50
Strong's Book of Designs....Leatherette $3.50
Signist's Alphabets .....Cloth $1.50
Modern Painter's Cyclopedia.....Cloth $1.50
Automobile Painting .....Cloth $1.25
Estimates, Costs and Profits, House Painting and Interior Decorating.Cloth $1.25
New Hardwood Finishing.....Cloth $1.25
The Amateur Artist .....Cloth $1.50
New Stencils and Their Use.....Cloth $1.25

Automobile Books

Automobile Ignition, by H. P. Manly .....Leatherette $2.00
Automobile Starting and Lighting, by H. P. Manly.....Leatherette $1.75
Brookes' Automobile Handbook .....Leatherette $2.00
The Ford Motor Car, Truck and Tractor, by H. P. Manly.....Leatherette $1.75
Starting and Lighting Troubles, Remedies and Repairs, by H. P. Manly .....Leatherette $3.00
Automobile Battery, Care and Repair, by H. P. Manly.....Leatherette $2.00
Automobile Catechism and Repair Manual .....Leatherette $1.50
Tires and Vulcanizing, by H. H. Tufford .....Cloth $2.00
Practical Gas and Oil Engine Handbook .....Leatherette $1.75
Automobile Upkeep and Repair, by H. P. Manly .....Cloth $1.50
Motorcycle Handbook, by H. P. Manly .....Cloth $1.50
Oxy-Acetylene Welding and Cutting, by H. P. Manly.....Leatherette $1.75

General Instruction and Reference Books

Practical Bricklaying, Self-Taught.Cloth $1.25
Practical Stonemasonry, Self-Taught .....Cloth $1.25
Practical, Up-to-Date Plumbing...Cloth $1.50
Hot Water Heating.....Cloth $1.50
Elementary Chemistry, Self-Taught.Cloth $1.25
Complete Courses in Civil Service..Cloth $1.50
Standard Cyclopedia of Recipes...Cloth $1.50
American Star Speaker.....Cloth $1.50

New Modern Language Books

By Prof. P. S. Allen, University of Chicago
French without a Teacher.....Cloth $1.25
Spanish without a Teacher.....Cloth $1.25
German without a Teacher.....Cloth $1.25
Everyday French (Easy Conversation)..$1.25
Everyday Spanish (Easy Conversation). $1.25

SEE ALSO OUR OTHER AD ON PAGE 8

ORDER DIRECT FROM THIS PAGE—ON OUR MONEY-BACK PLAN

The books listed above are only a few of the many in our catalogue, which you will receive promptly after filling out and mailing us the attached coupon. For quick action order direct from this page—cross name of each book wanted and send in with the price quoted. We prepay postage and send the books on our money-back plan.

FREDERICK J. DRAKE & CO.
PUBLISHERS
1014 Michigan Ave., Chicago
Drake Books Are For Sale at All Book Stores

Mail Coupon for Free Catalog
Your Guide to Home Study

FREDERICK J. DRAKE & CO.
1014 Michigan Avenue
Chicago, Ill.

GENTLEMEN:—Please send me free, postage paid, your illustrated catalogue which lists and describes over 100 Practical Mechanical Books for Home Study.

My name is.....

and my address.....

.....

Digitized by Google

This is not a Real Machine but a Wading River 4-Foot Scale Model NC-4

With a Wading River outfit, you, too, can build this perfect exhibition and experimental model. It is equipped with complete controls, dummy Liberty Engines, Paragon Propellers—every detail a perfect reproduction of the original. It is easy to build with Wading River parts.



BUILD AND FLY A MODEL NIEUPORT SCOUT BIPLANE

You can make it from our complete unassembled outfits. What this builder says stands good with all others who build this perfect model.

Feb. 9, 1919.

Have had fine success with my Nieuport Biplane. It has flown 181 feet. E. Waterhouse, 821 W. Mo. St., El Paso, Texas.

SET OF 11 SCALE DRAWINGS OF BEST KNOWN MACHINES FOR $1.50

This set includes the Nieuport monoplane, Bleriot, Curtiss Hydroplane, Antionette, Langley Tandem, German Taube, Deperdusin, Wright biplane, White Racer, White Flyer, and Champion Racer. Send 5c for our latest catalogue containing illustrations of models of Curtiss J.N.4-B, S.P.A.D. Scout, De Haviland 4, Caproni Biplane, Handley Page, Sopwith Triplane and others.

WADING RIVER MANUFACTURING CO.

672-D Broadway Brooklyn, N. Y.

ARE YOU

an aeronautical

Student
Draftsman
Designer
Constructor
Pilot
Mechanician

?

Then you need the new set of blueprints showing how the

DELERAY "MIDGET" SPORTPLANE

is built. These drawings, prepared by experts, clearly and accurately show every part of the aeroplane.

Span—17 ft. Weight—500 lbs.
Length—15 ft. Speed—39-65 m.p.h.

Complete set of 27 large blueprints sent immediately on receipt of $8.00.

DELERAY AIRCRAFT WORKS

Freeport, Long Island, N. Y.

Airplanes Engines Parts

UmakeM

Airplanes Curtiss Model J.N.-4 can be made complete ready to fly from UmakeM No. 17 (price $3.00), which includes blueprints, wood, metals, rubber and special tools necessary. Send for this set quick and Make Money Making UmakeM Flying Airplanes for sale. Enormous demand. Profits big. Completed Plane sells at $10 and can be made in 6 hours from UmakeM No. 17 Set. Ask about our 40 other UmakeM sets for making Airplanes, Toys, Novelties, Work Benches and practical Screw Cutting and Milling Lathes.

W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

Telegraph Pictures

BY ELECTRICITY



A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.

L. J. LEISHMAN CO Dept. L, Ogden, Utah

UmakeM Club

You send $5 for instructions, designs, blueprints then you Make UmakeM Money running UmakeM Community Shops or form your own UmakeM Club with the $5 outfit. You can make Bleriot, Curtiss, Speed and other Flying Planes; also real Work Benches, Bowling Stands, Stationary Racks, Baskets, Book Troughs, Arks, Circus, Wagons, War Tanks, Action Toys, Dogs, Birds, Squirrels, Elephants, Rabbits, Goats, Toads, Giraffes, Ostriches, Numbers, Letters, 19 Jointed Animals, Doll Furniture and Doll Houses. Principal dealers buy all their toys and novelties now for Christmas. Get your UmakeM shop started quick and coin UmakeM Money.

W. R. PRICE, Inc., Dept. 17 UmakeM Bldg., 127 5th Ave., N.Y.

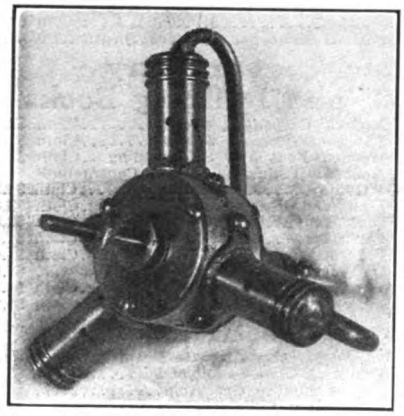
MODEL ENGINE CASTINGS

For engines described in previous numbers of "Everyday Engineering." Castings made in Bronze or "Duralite." Model water pumps also supplied.

J. E. CARRINGTON

40 So. Clinton St. East Orange, N. J.

Compressed Air Motors



THE new and improved method of propelling your model aeroplane. Manufactured of the finest materials. Workmanship guaranteed. Special propellers for the above motors. Send stamp for descriptive circular of these wonderful motors. We manufacture everything for the model aeroplane builder. Give us a trial and be convinced.

HEC AEROPLANE CO.

302 East 49th St. New York City

Mathematics Made Easy



The Arcoscope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only $1.00 postpaid. Order today before you forget.

Dept. U, L. J. LEISHMAN CO., Ogden, Utah

Mechanical Drafting

EXPERT SERVICE—REASONABLE
INQUIRIES INVITED
E. W. HEANEY & CO.
2105 Monterey Avenue New York City
Telephone Fordham 6249

WHAT IS NEW IN AVIATION

(*Continued from page* 563)

may be carried, and dual control is fitted as standard.

Should it be desired to use the machine as a cargo carrier, this can easily be done by removing the seats, when the cabin affords a roomy space for goods and merchandise. The capacity of the Vimy-Commercial when thus fitted is 1½ tons. It will therefore be seen that quite a considerable cargo can be transported by air at the—comparatively—high speed of 100 m.p.h. The machine has an endurance of five hours, and the petrol consumption is 35 gallons per hour.

There is little doubt that the "Viking amphibian machine exhibited by Messrs. Vickers, Ltd., will cause considerable interest, not only on account of its combination landing gear, which allows it to alight on and start from either land or water, but also because as a flying-boat, this machine represents a departure from standard practice, its hull design being considerably out of the ordinary. The flying-boat hull of the "Viking" has a pronounced Vee bottom both forward and aft of the step. Two retractable land wheels are mounted one on each side of the boat. These are operated from the pilot's cockpit, and can be raised and lowered during flight. If, therefore, the machine is used, as it would be, chiefly over sea but has to make land going journeys, in the course of its duties, it is able, should necessity arise, of alighting safely on an ordinary aerodrome.

A "conservatory" roof is fitted over the top of the boat, inside which the three passengers and two pilots are comfortably housed. If it is desired to use the boat for cargo carrying, three of the seats can be removed, when a space of 76 cu. ft. is available for commercial load. The engine, a 560 hp. Rolls-Royce "Eagle," Mark VIII, is mounted high in the gap between the planes and drives a small diameter four-bladed air-screw (pusher). The "Viking" has an overall length of 32 ft. and a span of 46 ft. Fully loaded, in flying trim, the weight is 4,545 lbs.

(*Part 2 in October issue*)

For photographing on textile fabrics the following bath may be used: Alcohol, 95%, 500 parts; gum mastic 2½ parts, gum benzoin 5 parts, cadmium chloride 15 parts. The material is immersed in the bath for one minute, the excess removed between two pieces of blotting paper, and it is allowed to dry. It is sensitized by immersion in a 5% solution of silver nitrate, drained off after spreading on a plate of glass and allowed to dry in the dark room. The regular printing process is followed, but the printing is carried further than with paper as the strength of the image is reduced in the fixing. It is toned in the following bath: Gold chloride 1 part, sodium borate 30 parts, water 1,000 parts. It is fixed in a 10% solution of hyposulphite.

Digitized by Google

LAMP BULBS AS FIRE EXTINGUISHERS

BURNT-OUT electric lamp bulbs can be turned into cheap and effective fire extinguishers by filling them with some such solution as twenty parts of calcium chloride and five parts of salt in seventy-five parts of water or with carbon tetrachloride which is often sold under various trade names for filling small hand extinguishers. The bulbs are filled by immersing them in the solution and breaking off the tips with a pair of pliers. The air having been largely exhausted from them, they will fill quickly and stay filled. To use the filled lamp bulb is thrown forcibly to the base of the flame so it will be broken and thus liberate the gas-forming liquid. Carbon tetrachloride is much more effective than calcium chloride, salt and water, but is more expensive.

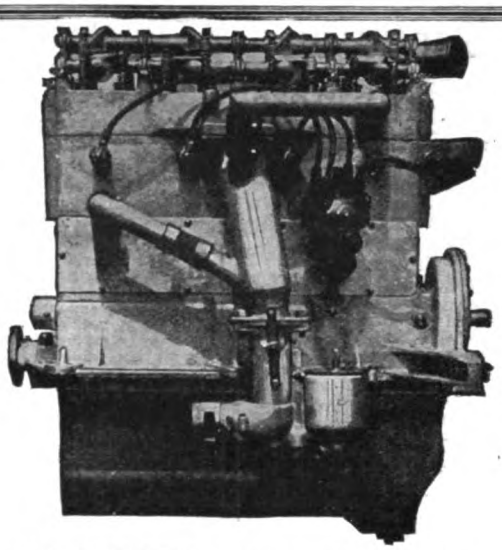
AIR-DRIED PEAT

AT a recent meeting in Toronto, a report was presented showing that the simple process of excavation, maceration and spreading peat, allowing the sun to do the drying and curing of the peat, produced the best results. The excavated peat contains about 88 per cent moisture, and none of this water need be removed mechanically. The peat is spread on the surface of the ground, usually on a part of the bog which has been cleared and drained. The drying and curing takes from two to four weeks to complete. Towards the end of this time the peat is turned over and a few days later is coned or stacked in hollow piles, and in a short time the peat is ready for marketing.

MEASURING CARBON CONTENT OF STEEL

THE Bureau of Standards, in Technologic Paper No. 141, entitled "An Electrolytic Resistance Method for Determining Carbon in Steel," described methods and apparatus for rapidly and accurately determining carbon in steel by absorbing in a solution of barium hydroxide the carbon dioxide resulting from direct combustion of the metal in oxygen and deducting the carbon content from the change in electrical resistance of the barium hydroxide solution.

Winnipeg, Canada, is in hopes that it will eventually become an ocean port by using the waters of the Red River. The mayor of that city has predicted that in twenty years' time seagoing ships will navigate the Red River and Winnipeg will become the Liverpool of Canada.



"ACE" MOTORS

Are Powerful, Light, Reliable and Economical

Weight 126 Pounds — Forty B. H. P.

These motors embody all the features of engineering that an extensive series of tests proved necessary, and are the product of ripe judgment of practical airmen. The ideal power plant for the man building his own plane.

Descriptive Literature on Request.

HORACE KEANE

Aero HK Planes Inc.

Sales Office
280 Madison Ave.
New York

Factory
North Beach
Long Island

Grind in Your Bearings

BEARING SURFACES FITTED TIMESAVER TRADE MARK WITHOUT SCRAPING

THE discovery of TIMESAVER Compound, the new bearing abrasive that will not charge the spindle or imbed in the soft metal, made practicable the fitting of bearing surfaces by grinding in.

Because of the vastly superior character of the finished product and the great savings in time and labor effected, TIMESAVER Compound has revolutionized shop practice on this important operation.

Send $1.50 for a trial can and convince yourself of these facts. Six can cartons $9.00, twelve can cartons $18.00.

M. T. K. SALES CORPORATION

296 Andrews Street, Rochester, N. Y.

Manufacturers: M. T. K. Products Co., Seattle, Wash.

FOR SALE

Rotary-Spark-Gap, with 4 to 6 volt, high speed, compound wound D. C. motor, rotary disc being made of bakelite, $8.00. One unwound transformer with laminations, .80. One-inch spark coil, practically new, $5.00. Ten Edwards buzzers; some high tone, at .50 each. One large buzzer at .35. 12-volt colored bulbs with sockets at .11 each.

JOSEPH F. MATIS
316 E. 89th St. New York City

DRAFTING

Inventions and Ideas Developed!

Mechanical, Electrical, Patent Office and Engineering Drawings of Every Description.

COMPETENT DRAFTSMEN AT YOUR SERVICE

A. G. HAGSTROM
116 Nassau St. New York City
Telephone Beekman 4580

Digitized by Google

Useful Books on Mechanical Subjects

Electro-Deposition of Metals

By George Langbein and William T. Brannt

The new eighth edition of this volume, which has been completely revised, considerably enlarged and entirely reset, is now ready. It is a complete and comprehensive treatise, written from a scientific as well as practical standpoint and especially intended for the practical workman, wherein he can find advice and information regarding the objects to be plated while in the bath as well as before and after electroplating. This volume is the foremost book on the subject in the English language and covers electro-plating and galvanoplastic operations, the deposition of metals by the contact and immersion processes, the coloring of metals, lacquering, and the methods of grinding and polishing as well as descriptions of the voltaic cells, dynamo-electric machines, thermopiles, and of the materials and processes used in every department of the art. Particular attention has been paid to all important innovations, and it has been endeavored to include all of the latest practical methods of plating, as well as the most recent machinery and apparatus. It is a ready book of reference and a practical guide to the workshop.

Octavo, 875 Pages, 185 Illustrations.

Price $7.50

Complete Practical Machinist

By Joshua Rose

One of the best-known books on machine shop work, now in its twentieth edition, and written for the practical workman in the language of the workshop. It gives full practical instructions on the use of all kinds of metal-working tools, both hand and machine, and tells how the work should be properly done. It covers lathe work, vise work, drills and drilling, taps and dies, hardening and tempering, the making and use of tools, tool grinding, marking out work, machine tools, etc. Throughout the entire classic the explanations are as clean-cut as the tools they describe, and the earnest mechanic or machinist seeking greater efficiency will be helped toward using both head and hands to better advantage. No machinist's library is complete without this volume.

547 Pages. 432 Illustrations

Price $3.00

Metal Worker's Handy-Book of Receipts and Processes

By William T. Brannt

This volume is a valuable work of reference and instruction for all engaged in the working of metals. It is a collection of formulas and practical manipulations for the working of all the metals and alloys including the decoration and beautifying of articles manufactured from them. The utmost pains have been taken to insure the accuracy and efficiency of the recipes so that with ordinary care as to quantities and manipulation the results may be implicitly relied upon.

It treats on alloys and amalgams; hardening, tempering, annealing; bronzing and coloring; casting and founding; cements; cleansing, grinding, pickling, polishing; decorating, enameling, engraving, etching; electro-plating, brasing, coppering, galvanizing, gilding, nickeling, silvering, tinning, etc.; fluxes and lutes, lacquers, paints and varnishes; solders and soldering; welding and welding compounds. To the new edition has been added several new chapters on die-casting, thermit and oxyacetylene welding, etc.

582 Pages. 82 Illustrations

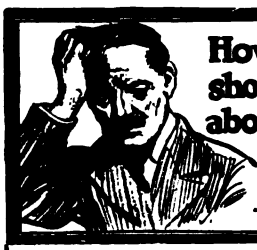
Price $3.00

Send for our new 48-page descriptive catalogue mailed free on request.

HENRY CAREY BAIRD & CO., Inc.

Publishers of Mechanical and Industrial Books

2 West 45th Street, New York, N. Y.



How much should I know about business law?

THIS question is being asked by an ever-increasing number of men and women who realize that a better understanding of business law means an addition to their income. One needs specialized knowledge today to be thoroughly successful—whether for one's self or for his employer. You are badly handicapped unless you KNOW JUST HOW TO HANDLE YOURSELF at every turn.

Are you in—or going into—business—entering a partnership—building a house—buying or selling property—employing agents—suing or being sued—in doubt on any legal point?

Ever-increasing opportunities are ahead of the man who keeps himself abreast of the times. During the period of industrial and social readjustment through which we are passing, every man and woman is facing constantly changing conditions. The courts have made new and very definite rulings concerning business relations between employer and employee, and between buyer and seller, and those who remain in ignorance of the fundamental laws on which these rulings are based are in constant danger of committing mistakes which may result in great loss.

Know the Law and Be Safe

While it would be impossible and impracticable for the average man or woman to consult a lawyer concerning the hundreds of questions which are constantly arising in one's daily affairs, the Virginia School of Business Law has compiled a course which makes it possible for every one to gain a complete and thorough knowledge of law as applied to the everyday problems of the individual.

This course, which is divided into ten treatises and which covers Corporations, Partnerships, Contracts, Sales, Agency, Real Estate, Wills, Bills, Notes and Checks, Bankruptcy, etc., has been prepared by the Hon. George Bosman, of the Virginia Bar, a specialist in business law, to meet the needs of the average man and woman. ** It is not cluttered with legal phraseology and does not waste time in lengthy discussions of theories, but in plain, concise language it fully covers all questions. ** A few moments a day, devoted to the study of this course or reference to it when you find it necessary, will put you in possession of facts which may save much litigation and thousands of dollars. ** The COUPONS ACCOMPANYING THE COURSE will save you many an attorney's fee.

10 Coupons for 10 Questions

With each subscription to this course there will be sent 10 LEGAL-ADVICE COUPONS, each one entitling the holder to a legal opinion on any subject and to the same sort of impartial advice which he might expect if he walked into an attorney's office and paid him his fee. These coupons are good for two (2) years and may be used by the subscriber as desired. The service he will receive in exchange for any one of these coupons may alone be worth the entire cost of the course.

A Service of Great Value

A short cut to the exact information you want. No useless instruction or verbiage. No wasted effort. A Practical, Accurate, Complete Guide to Everyday Business Affairs. Prompt advice and guidance in all troublous matters. Dependable counsel on any 10 Questions of Law which may cause you anxiety within the next two years. A direct guide to the correct settlement and handling of any mooted legal question. A sure means of forging ahead by being better informed than your competitor.

Pin $10 to this coupon below and mail it to us today. Your check will do. The complete set of 10 Lessons will come to you by return mail, along with 10 Legal-Advice Coupons, each one of which will entitle you to an authoritative opinion on a single subject. ** If, after five days' examination, you would rather have your money, ship the 10 Lessons and 10 Coupons back to us and we will make full refund—gladly and without question.

Just send in the coupon below (omitting the $10.00 payment if you like) and we will, without cost or obligation to you, send you a full, detailed description of the course and the service we offer.

Virginia School of Business Law

352 New Kirn Building, Portsmouth, Virginia

VIRGINIA SCHOOL OF BUSINESS LAW
352 New Kirn Building, Portsmouth, Virginia.

Enclosed find $10. Send me your complete course of 10 Lessons in Business Law along with 10 Coupons, each one of which will entitle me to an authoritative opinion on some legal point or question of my choosing; these coupons to be used within two years. Should I decide, after 5 days' examination, to return course and coupons you agree to at once refund my $10 payment.

Name

Address

Date Ev. E. Oct. 1920

MANUAL ARTS AND CRAFTS

(*Continued from page* 531)

fancy work may be stored on top of the tray more conveniently. "Local option" may determine that.

An additional till may be made sufficiently short, approximately 15½" long x 5¼" outside dimensions and fastened in the center with a round-head wood screw as a pivot in the center division. This would take the place of the lower tray and therefore be more desirable for some. Another method that may be employed is to fasten one corner of the till by the foregoing method. This would give a little more accessibility. If you take a board representing the till, you may very easily ascertain the amount required for clearance to swing the till clear in either position.

The handle M, Fig. 6, is easily made, requiring only a saw of almost any description, by keeping the lines nearly straight, it will be more in keeping with the general design. It may be modified by slightly curving these lines concave or convex with a spoke-shave or knife. A block or smoothing plane will also do this if held askew, i. e., that is, the cutter being about 45 degrees to the cut. This project is stained in a weathered oak, or old English oak color, then polished with one or two applications of beeswax cut in turpentine, will give a finish very near to the old Colonial furniture so much sought for.

SHORTAGE OF MOTOR FUEL SERIOUS

THE gasoline shortage in the Pacific Northwest is rapidly becoming acute. For the past month it has been with difficulty that the three large oil companies operating in that territory have been able to provide sufficient gasoline for the most necessary of occupations. The rationing system has been in effect for a month and in general has limited trucks to purchases of ten gallons and pleasure cars to tankfuls of three gallons. Only vehicles operated by fire and police departments and doctors have been able to secure unlimited supplies. The Standard Oil Co., Shell Co. and Union Oil Co. do not offer any hope for permanent relief from the shortage until in the middle of the summer at the very earliest, with possibilities that strict economy will be necessary until next fall. The reasons ascribed to the shortage are insufficiency of supply of the oil obtainable in California oil fields. Besides affecting hundreds by shortage of the gasoline supply, the lack of fuel oil is also embarrassing a great many manufacturers in that, since they are equipped to burn fuel oil, it is with difficulty that they are able to rapidly make changes that will provide for this latter situation may be the substitution of powdered coal or producer gas.

Digitized by Google

THE
Wireless World

The Official Organ of the Wireless Society of London

Commencing with April 3d, will be published fortnightly in order to adequately deal with the increasing amount of Wireless Experimental and Research Work.

Full of Practical hints and useful information for Wireless Amateurs.

Extensive reports of the Wireless Societies of Great Britain.

Annual Subscription 17s, Post Free

Single Copies 9d, Post Free

To be entirely up-to-date in your knowledge of Wireless you must be a subscriber to The Wireless World.

To the Publisher,
The Wireless World,
12-13 Henrietta St.,
London, WC2, England.

Please enter me as a subscriber to the Wireless World for the period ..... to .....

for which I enclose .....

Name .....

Address .....

Please write distinctly.

HOW FAST CAN A YACHT SAIL?

GENERALLY speaking, the speed of yachts is over-rated, says the *Scientific American,* and you may safely take from 20 to 30 per cent off when your friend tells you that his craft has done so and so. On the other hand, there are some well-authenticated records of high speed made by racing yachts under favorable conditions, which show the best of them to be wonderful examples of the science and craft of shipbuilding. The maximum speed of a yacht, supposing that her model and the cut of her sails are correct, is dependent upon certain adventitious conditions, such as the right kind of wind, the sea and (above all) the skipper. The ideal conditions for speed are when a yacht is reaching in a smooth sea with the wind over the quarter—that is, well abaft the beam—and with everything set that she can carry, without an excessive angle of heel.

A well-known authority, Major B. Heckstall Smith, author of "The Complete Yachtsman," in answer to the question, "How fast can a racing yacht sail?" states that at full speed a racing schooner about 105 feet on the waterline can do about 15.8 knots. This would be in a strong breeze, with the wind on the quarter. Assuming that this speed is about right, as he believes, he tells us that with exactly the same breeze a 90-footer can go 14.2 knots; a 75-footer, 13.4 knots; a 60-footer, 12 knots; a 50-footer, 10.9 knots; a 36-footer, 9 knots, and a 20-foot boat, 7 knots.

SOAP FROM LIGNITE TAR OILS

EXPERIMENTS, which have been said to have a satisfactory result, have been carried out in the laboratory of the Siemens Works in Berlin, with a view to converting lignite tar oils into fatty acids by the action of ozone. Similar experiments, carried out on a large scale by a process introduced by the city of Wiesbaden, have led to equally satisfactory results.

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6091B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name _____

Present Occupation _____

Street and No. _____

City _____ State _____

"The Radio Telegrapher"

Official Organ
UNITED RADIO TELEGRAPHERS' ASSOCIATION
Room 303
44 Broad Street, New York

Read about what's going on among the Commercial, Navy and Army operators.

ON SHIPBOARD
AT SHORE STATIONS
AT HOME AND ABROAD

Subscription $1.50 yearly, 15 cents a copy. $1.75 in Canada; $2.00 foreign.

IF YOU NEED SPECIAL INFORMATION WRITE OUR SERVICE DEPT., EVERYDAY ENGINEERING MAGAZINE

Your Prospective Customers

are listed in our Catalog of 99% guaranteed Mailing Lists. It also contains vital suggestions how to advertise and sell profitably by mail. Counts and prices given on 9000 different national Lists, covering all classes; for instance, Farmers, Noodle Mfrs., Hardware Dlrs., Zinc Mines, etc. *This valuable reference book free.* Write for it.

Send Them Sales Letters

You can produce sales or inquiries with personal letters. Many concerns all over U. S. are profitably using Sales Letters we write. Send for *free* instructive booklet, "*Value of Sales Letters.*"

Ross-Gould Mailing Lists St. Louis

Digitized by Google

It is One Thing to Desire—and Another to Determine

Almost everybody WANTS a good job—but not so many have the WILL TO DO what is necessary to get it.

Ask Yourself These Questions:—

Are you ambitious? Do you like machinery? Do you want an opportunity to qualify for a better job—with prospects of earning MORE MONEY? Would a position with shorter hours interest you? IF YOUR ANSWER IS YES—

We would advise you to see us at once.—

Don't be a misfit

THINK BIG—You can get what you want if you go after it the right way.

KNOWLEDGE—Is the BIG answer to your chance to earn BIG MONEY.

SUCCESS—Is the result of knowing how.

THINK THIS OVER—This is your opportunity.

WE TEACH YOU THE HOW—Of the biggest industry the World has ever known.

AUTOMOBILISM—has no limit as to how BIG an amount of money you can earn.

TAKE THIS OPPORTUNITY—to start yourself on a career of usefulness—make up your mind to BECOME AN AUTO EXPERT—and make yourself what you would like to be—A BIG SUCCESS—If you know how you cannot fail.

If your present occupation offers you no chance of promotion our advice to you is—come at once and LEARN THE AUTOMOBILE BUSINESS.

Yours for, a big success

BUFFALO AUTO SCHOOL
Buffalo, New York

P.S.—If you cannot call send us your name for full particulars.

Akron Quality Tires
REDUCE TIRE COST 65%

GOODYEAR Tube FREE

5000 Mile Guarantee

Akron Quality Tires are made to meet the increasing demand for reconstructed tires which are indispensable to the maintenance of the auto industry. Their great economy is your personal a vantage. To insure properly built and carefully selected goods always order Akron Quality Tires. Shipped direct from factory to you.

One tube given with each tire

30x3	$ 7.50	34x4	$11.85
30x3½	8.60	34x4½	13.55
32x3½ S.S. only	9.70	35x4½	13.90
31x4	10.90	36x4½	14.50
32x4	11.20	35x5	15.45
33x4	11.50	37x5	16.50

Reliner Free With Every Tire

State whether straight side or clincher desired. Send $2 deposit for each tire ordered, balance C. O. D. subject to examination. If you send full amount with order, deduct 5 per cent discount.

AKRON RUBBER CO.
Robey and Roosevelt
Dept. 483 CHICAGO, ILL.

SAVE MONEY!
A High Grade
INNER TUBE FREE
6000 MILES Guarantee



Economy Reconstructed Tires made by our new special process are guaranteed to give good service because the best materials are used in their construction. Our tires are guaranteed for 6,000 miles and we give a FIRST quality inner tube free with every tire ordered from us. Our tires are reinforced with extra plies of fabric making them strong so they resist punctures and blowouts.

RELINER IS FURNISHED WITH EACH CASING AT NO EXTRA COST.

THESE PRICES INCLUDE CASING, RELINER AND TUBE.

30x3	$7.15	33x4	$11.00	35x4½	$13.15
30x3½	8.25	34x4	11.25	36x4½	13.50
32x3½	9.00	32x4½	11.75	36x5	14.50
31x4	10.10	33x4½	12.25	37x5	14.50
32x4	10.45	34x4½	12.90		

State with your order whether a straight side or clincher, plain or non-skid tread. Send a deposit of $2 for each casing ordered. Balance C. O. D. subject to examination. 7% discount if full amount is sent with order. References furnished if desired.

UNITED ECONOMY TIRE CO.
205 West 48th Street New York City

AMATEUR LABORATORIES

How many times have you wished that you had a real Chemical Laboratory—one that you could call your own, in which you could perform the experiments that are found in various magazines, text books, etc., or with which you could study chemistry by actual practice?

We can gratify your wish whether you are just a beginner or one experienced in the line, for we sell Laboratories from $6.50 up to $109.25. Write for free circular and be convinced.

ZIEGLER EXPERIMENTAL LABORATORY
47 Judson St. Rochester, N. Y.

QST

A MAGAZINE DEVOTED TO AMATEUR WIRELESS

Official Organ: American Radio Relay League

New Developments, C.W. Transmission, Vacuum Tube Circuits, Regenerative Receivers, Underground and Loop Antennas, Radiotelephony, Relaying, Operating Department Work, all A.R.R.L. News; Humorous Stories by The Old Man. All these and many more are included in QST.

SPECIAL TRIAL OFFER

Regular price $2.00 per year, 20 cents per copy. Introductory rate: 7 months subscription for $1 and attached coupon.

PIN A DOLLAR BILL TO COUPON AND MAIL IT TODAY!

RETURN COUPON

American Radio Relay League,
Hartford, Conn.

Enclosed find $1; please enter my trial subscription to QST for 7 months.

Name_____

Address_____

EXPERIMENTAL · SCIENCE ·

· CHEMISTRY · · PHYSICS · · RADIO ·

All that its name implies

THE scientific magazine of experimental and practically applied science. Subscribe NOW. $1.50 yearly. 15c a copy at most newsstands. Literature on request.

Experimental Science Publishing Company,
710 14th St., Washington, D. C.

You Can Save $50.00



By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

$8.46 and up Parcels Post Paid

LIBERTY TOP & TIRE CO., Dept. E3, Cincinnati, O.

NEW BOOKS

ELECTRO-DEPOSITION OF METALS. By George Langbein. Translated with additions by William F. Brannt. 875 pages, 6¼ by 9¼ inches; 185 illustrations. Published by Henry Carey Baird & Co., Inc., 2 W. 45th St., New York City.

This is the eighth edition of the present work, which has been revised, enlarged and entirely reset. The book illustrates and describes processes and apparatus used in plating and finishing metals. It is written in simple language with special reference to the needs of the practical plater and metal finisher, and gives hundreds of tested formulas for solutions, many of which have heretofore been considered trade secrets. It discusses electro-plating, galvanizing, metal coloring, lacquering, and electrotyping, and covers the history and theory of electro-metallurgy. The translator has added considerable matter to the original work, particularly in the chapter on "Apparatus and Instruments" and in the section on "Useful Tables." The present volume describes new developments in machinery and apparatus for this work, such as the latest types of plating machines, ball bearing grinding and polishing lathes, sand-blast apparatus for cleaning, and lacquer spraying by compressed air. It also treats of the use of electrically heated japanning and lacquer baking ovens. In fact, a rather careful inspection of this work fails to disclose the lack of any information that an electro-plater or electrotyper should have in ascertaining the theory of his trade or carrying it out in a practical way. It may be fairly said that this work is a thorough and complete exposition of the modern theory and practice of electro-deposition of all metals.

BOOK ON BRASS MAKING

The Bridgeport Brass Company, Bridgeport, Conn., has issued a finely printed and profusely illustrated historical book extending to 80 pages, setting forth a brief history of the ancient art of brass making, and its early, and even recent, method of production, contrasted with that of the electric furnace process, a twentieth century achievement which has reached its culmination in the extensive works of the enterprising company. The record of the possibilities of the electric furnace from the bulk of the work, and the processes are minutely described. Of special interest is the section devoted to the Laboratory and Research department, an institution in itself, the scientific work of which makes it possible to control closely the properties

Digitized by Google

BOOK REVIEW

of the products passing through the plant. The publication of this work is a marked deviation from the traditions of the brass industry by making an open book of the practices and processes of brass making.

ORGANIC PHOTOGRAPHIC DEVELOPERS. By Samuel Wein. Two volumes in one, with indexes; 128 pages. Published by Forty-second Street Commercial Studio, New York, 1920.

The first and second chapters of this book treat of organic developers and dye sensitizers, giving specifications from patents and other sources of a large number of developers, French, German, etc. In several cases a description is given of how to prepare the developers and sensitizers.

The third chapter gives the chemical formulæ of organic developers in which bond diagrams are used and full chemical formulæ are given. Then there comes a list of the developers in three columns, the first column devoted to the trade names, the second to the chemical names and the third to the chemical formulæ.

The first volume has a table of contents and index; the second volume, divided into eight chapters, has no contents, but has its index. The following list of chapter headings gives the topics covered: Developing, Factorial Development, Bleaching and Intensification, Toning, The Diazotype Process, Recovery of Silver From the Hypo, Photographic Bronze and Plaster Plaques.

It is not necessary for us to review this part, as the titles clearly show the ground covered. It is not clear why so small a book should be divided into two volumes nor why the second volume has no contents table. The first volume has one. There are two indexes, one for each volume.

SHOP PRACTICE FOR HOME MECHANICS. By Raymond Francis Yates. 320 pages, 6 by 9 inches, 309 illustrations. Published by Norman W. Henley Publishing Co., 2 West 45th Street, New York City.

A thoroughly practical and helpful book prepared especially for those who have had little or no experience in shop work. The introduction is given over to an elementary explanation of the fundamentals of mechanical science. This is followed by several chapters on the use of small tools and mechanical measuring instruments. Elementary and more advanced lathe work is treated in detail and directions given for the construction of a number of useful show appliances. Drilling and reaming, heat treatment of tool steel, special lathe operations, pattern mak-

(*Continued on page 573*)



A pretty big load

—yes, but a mighty easy one for the Auto-Wheel. You may not want so many to ride, but you can be sure the Auto-Wheel will haul them safely. When the boys see the Auto-Wheel they'll want a ride.

Seasoned ash, steel tires and axles, and the best of workmanship make Auto-Wheel wagons the finest in the world. We use them to haul 1000-pound loads. Get an

Auto-Wheel Coaster
or an
Auto-Wheel Convertible Roadster

Organize an Auto-Wheel Club. "The Auto-Wheel Spokesman," a magazine for live boys, tells of our prize contests. Send names of 3 coaster dealers, telling which ones handle the wagon with the name "Auto-Wheel" on the sides. We'll put you on the mailing list for six months, FREE.

The Auto-Wheel Coaster Co., Inc.
Formerly the Buffalo Sled Co.
159 Schenck Street,
N. TONAWANDA, N. Y.
In Canada: Preston, Ont.
Export Office:
365 W. 23rd St., New York City.

Auto-Wheel



$110 A Month To Start As Railway Traffic Inspector

ONLY THREE MONTHS' spare time study will equip you for responsible position with a good salary from the start. Railway Traffic Inspectors advance rapidly—they work right with railway officials who are constantly seeking capable men. A pleasant position—you become broad minded—you travel and see country, expenses paid. S.B.T.I. instruction is very interesting—it's easily assimilated. We arrange for position; no age limit. Those who started studying a few months ago fill positions today and they're on the road to still further advancement, so write immediately for Booklet D 41 before you turn this page.

WE ARRANGE FOR A POSITION

Standard Business Training Institute, Buffalo N.Y.

Discover Your Talents

What Are You Best Fitted For?

Personal, Mental and Vocational analysis, by Dr. S. S. George, M.A., Ph.D., former U. S. Army expert. Will help you know your mind and what you are best fitted for. Complete course of tests and analysis, with 1,500 vocations classified, will be mailed to you on approval. Send $3.00 for the course postpaid. If it is not satisfactory return it in five days and we will refund your money. Address

The Vocational Guidance Institute
2258 Broadway, New York City

UmakeM Outfit No. 8 includes 10 good tools, designs, 3 ply wood, hardware, mechanical parts and everything to make a $30 Toy Circus set including Animal Wagon and Circus Wagon each drawn by two large jointed animals with Clowns Riders, 19 Wild and Domestic Animals, kicking and jumping Donkeys with riders and other Circus Things. This set is a rad hot Money Maker and several people can work with UmakeM No. 8 at the same time. Fine for families, toy clubs and schools. Send $10 for this set. Dealers buy Christmas toys now.

W.R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.

EASY to LEARN at HOME

ELECTRICITY
TAUGHT BY A PRACTICAL MAN

This Home Study Course, based on the years of practical experience of Yorke Burgess, who gives personal attention to each student, has placed hundreds of men and boys in better positions. Beginners get employment after taking the Burgess course a short while—over 85% of students now engaged in electrical work.

For BEGINNERS and EXPERIENCED MEN

What You Should Learn and The Way You Should Learn It

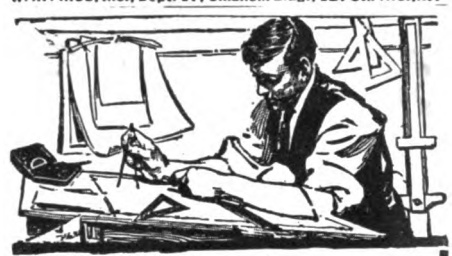
Why the Burgess method is best for you—Read what L. E. Watkins, E. E. M. E., of Brockton, Mass., one of the foremost Electrical Engineers in the U. S. and a pioneer in electric railway work, writes of the Burgess school: "It is indeed good that there has been established a school of Electricity on so practical lines Free From The Frills of the general run of correspondence schools."

YOU TAKE NO CHANCE—so confident are we of your success that YOUR PAYMENTS CEASE IF YOU ARE NOT SATISFIED—EASY TO LEARN—EASY TO PAY FOR. Apparatus, instruments, materials, etc., are included in the course. Mr. Burgess has just issued a new 48 page book, "ELECTRICITY," that every person interested in electricity or employed in any branch of electrical work should have. Contains valuable information and scores of letters from men and boys who are making a success by the Burgess method.

ELECTRICITY
TAUGHT BY A PRACTICAL MAN

SEND for this Remarkable Book N-9
IT COSTS YOU NOTHING
BURGESS ELECTRICAL SCHOOL
YORKE BURGESS, Supt.
751 E. 42nd St., Chicago, Illinois

UmakeM Lathe You make a High-grade Screw Cutting and Milling Lathe from UmakeM outfit No. 15 which includes all Castings and 12 detail blueprints. Complete outfit $35. Note following dimensions: Length over all, 2 ft. 11 ins.; Breadth, 12 ins.; Approximate weight, 105 lbs.; Dimensions of working surface of milling table, 4 ins. by 6 ins. This lathe has been designed to meet the wants of Model Makers who require a tool capable of very varied and accurate work. It is self-acting and Screw Cutting. With it all plain Milling work can be done, as well as making it easy to do a great many boring jobs otherwise very difficult. Address W. R. PRICE, Inc., Dept. 17, UmakeM Bldg., 127 5th Ave., N.Y.



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-356 Chicago

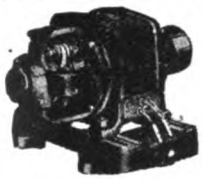


AMERICAN TECHNICAL SOCIETY
Dept. D-356
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass to me until fully paid.

Name.....
Address.....
Reference.....

Digitized by Google



NEW MOTORS

FACTORY GUARANTEED
ALL SIZES
PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v., 10 amp.	$19.50
15 v., 10 amp	$26.50
40 v. 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110v, 18amp.	$116.50
40v., 50amp.	$116.50
110v, 26amp.	$156.50
110v, 50amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., Complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$66.50
2 H. P.	$86.50
3 H. P.	$98.50
5 H. P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H. P.	$58.50
1 H. P.	$82.50
2 H. P.	$124.50
3 H. P.	$142.50
5 H. P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

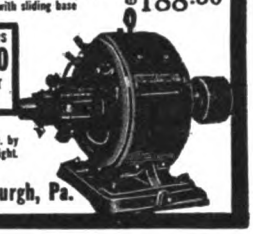
¼ H. P., 220 v. induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each Reg. Val. $34.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 10, West End, Pittsburgh, Pa.

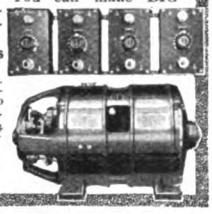
Big Profits in Battery Charging with the HB 32-Battery Charger

MAKE $150 TO $350 EVERY MONTH

Start your own battery business NOW. Make $150 to $350 Clear Profit every month with this HB Charger. Recharges 32 6-volt batteries, or equivalent, at one time. Costs 10c to 15c each. Owner pays 75c to $2.00. Figure the Profits. You can make BIG PROFITS and build a permanent business. Others are doing it—YOU can, too.

Small Cash Payment Brings You This Money-Maker

Balance on easy monthly terms. Profits easily pay for outfit. Absolute Money-Back Guarantee. No expensive repairs or replacements. Runs 24 hours a day. Big, steady, profitable income. Write TODAY for full information.



Hobart Brothers Company
Box EE94, Troy, Ohio
Successful Man'f'g Since 1893

NOW 35cts EACH

MODEL LIBRARY SERIES

1. The Study of Electricity for Beginners.
2. Dry Batteries, How to Make Them.
3. Electrical Circuits and Diagrams, Part 1.
4. Electric Bells, Annunciators and Alarms.
5. Modern Primary Batteries.
6. Experimenting with Induction Coils.
7. Electric Gas Igniting Apparatus.
8. Small Accumulators, How to Make and Use.
9. Model Steam Engine Design.
10. Practical Electrics.
11. Inventions, How to Protect and Sell Them.
12. Woodwork Joints, How to Make and Use.
13. The Fireman's Guide to the Care of Boilers.
14. The Slide Valve Simply Explained.
15. The Magneto Telephone.
16. The Corliss Engine and Its Management.
17. Making Wireless Outfits.
18. Wireless Telephone Construction.
19. The Wimshurst Machine, How to Make It.
20. Simple Experiments in Static Electricity.
21. Small Electrical Measuring Instruments.
22. Electrical Circuits and Diagrams, Part 2.
23. Induction Coils, How to Make Them.
24. Model Vaudeville Theatres.
25. Alternating Currents, Simply Explained.
26. How to Build a 20 foot Bi-plane Glider.
27. A B C of the Steam Engine.
28. Simple Soldering, Hard and Soft.
29. Telegraphy for Beginners.
30. Low Voltage Lighting with Storage Batteries.
33. House Wiring for Electric Light.
34. Magnets and Magnetism.
36. Small Windmills and How to Make Them.
37. Collin's Wireless Plans, Part 1.
38. Collin's Wireless Plans, Part 2.

SPON & CHAMBERLAIN
Publishers of Technical Books
122 E. Liberty Street : New York

THE RADIO REVIEW

A MONTHLY RECORD OF SCIENTIFIC PROGRESS IN RADIO TELEGRAPHY AND TELEPHONY

Monthly - Half-a-Crown

Single copies, post free 2s. 9d. Annual Subscription, post paid, 30/- post free.

THE RADIO REVIEW, a new monthly magazine, devoted entirely to the technical side of radio communication.

Edited by Professor G. W. O. HOWE, D.Sc., M.I.E.E., assisted by PHILIP R. COURSEY, B.Sc. A.M.I.E.E.

THE RADIO REVIEW is the Authoritative Journal of Wireless Research. Contributions from the pens of the World's leading Radio Scientists are a special exclusive feature.

. . . . . .

Editorial and Publishing Offices
12-13, HENRIETTA STREET
LONDON, W.C. 2

ALUMINUM CAN BE SOLDERED with SUPREME BRAND ALUMINUM SOLDER

FLOWS AT 500° FAHRENHEIT
REQUIRES NO FLUX

Used by General Electric Company, Worthington Pump Company, Hale & Kilburn Company, Bethlehem Shipbuilding Corp., National Lead Company, and hundreds of other manufacturers and repair shops.

Instructions for using with each bar.
Price $3.00 per Pound in Half Pound Bars.
Send Fifty Cents for 2-Ounce Sample Bar.

VANDAM SPECIALTY COMPANY
Grand Central Palace, Dept. EE, New York City

AGENTS AND DISTRIBUTORS WANTED

Sparko-Gap is a nationally advertised automobile and motor boat accessory—almost essential with present-day power gas—tested and proved by United States experts, the French Government, electrical engineers and users everywhere.

Can be installed in two minutes without tools or adjustments. Demonstrates its merit in the first five minutes of driving.

Universal market, big profits and chances to establish own business without any investment. Still a few territories open.

We want the right man and don't ask for any guarantee or stock order. Hustle and enthusiasm the only requirements. Write at once for territory still open.

SPARKO-GAP COMPANY
54 West 39th Street, New York City

TWO GOOD BOOKS

Designs for Small Dynamos and Motors

By Cecil P. Poole

186 pages containing designs for machines ranging from 1/6 h.p. to 2 kw. Fully illustrated, cloth.
Price $2 postpaid

Model Making

By Raymond Francis Yates
400 pages, 301 illustrations, cloth
Price $3 postpaid

A postcard puts you on our mailing list.

SWANSON BROS.
Technical Book Service
186 No. La Salle St., Chicago, Ill.

SCHNOTER'S SUSPENSORIES



YOU can enjoy perfect comfort and freedom. Schnoter's Suspensories and Jock Straps have gained their wide-spread popularity by quality, wear, fit and low price. If your druggist does not carry Schnoter's, Accept No Substitutes. Sent direct upon receipt of $1.00.

Send for booklet of other styles and prices.

J. C. SCHNOTER CO.
628 SIXTH AVE. Dept. (E) N. Y. CITY

THE OCTOBER NUMBER OF EVERYDAY ENGINEERING MAGAZINE WILL MAKE SPECIAL APPEAL TO MODEL MAKING ENTHUSIASTS

Digitized by Google

BURGESS ELECTRICAL HAND-BOOK

(called THE BURGESS BLUE BOOK, originally in blue-print form)

SHORT CUTS AND TIME SAVERS

Prepared in pocket size especially for practical men and those taking up the study of electricity. **Contains drawings and diagrams of electrical machinery—over 200 formulas for calculation and problems worked out showing how formulas are used.** From the personal note book of Yorke Burgess while on all different kinds of electrical work covering a period of nearly a quarter of a century.

Electrical laws, formulas, methods of calculation, etc. Simplified and made easy to understand and remember. Easy to apply in practical work. **Many valuable stunts not to be found in any other book.** Of value to any electrical man, whether Technical Graduate, Electrical Engineer, Student or Practical Man.

Electricians all over the world are sending for this book. **The most complete and valuable book of its kind published.** Nothing else like it. If you have never seen this book it is impossible for you to realize what you have missed.

Price $1.00

Send dollar bill, money order or check. You take no chance—money back ANY TIME if not satisfactory.

THE BURGESS COMPANY
Consulting Electrical Engineers
YORKE BURGESS, *President*
Engineering Division (Department 209) 753 E. 42nd Street
CHICAGO, ILLINOIS, U. S. A.

BUSINESS PRACTICE and ITS ACCOUNTING

New and up-to-date course of instruction BY CORRESPONDENCE. Complete with full legal forms and illustrations of all accounting principles. Highest professional endorsement. Indispensable for success in business today. Gives an understanding of economic conditions underlying business success.—Not excelled if equalled in thoroughness, but concise and to the point. 15 years' practical experience training apprentices and students for accounting and business. Graduates make good from beginning and advance rapidly afterwards. Write for circular, mentioning this periodical.

HENRY HEITMANN, Poughkeepsie, New York.



PATENTS

Before disclosing your invention to anyone, send for blank form, "Evidence of Conception," to be signed and witnessed. Form and information concerning patents FREE.

LANCASTER AND ALLWINE
225 Ouray Building, Washington, D.C.
Originators of the form "Evidence of Conception"

WILLIAM C. LINTON

Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost.

Offices
364 University St. Montreal, Canada
920 F St., N. W. Washington, D. C.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today

TALBERT & TALBERT 4850 TALBERT BLDG., Washington, D.C.

Competent Patent Service

By a Former Examining Official of the U. S. Patent Office

NORMAN T. WHITAKER
Lawyer and Engineer
580 Whitaker Bldg. Washington, D. C.
Branch Office, 67 Nassau St., New York City
INQUIRIES INVITED

Gas, Gasoline and Oil Engines

By Gardner D. Hiscox. Revised by Victor W. Pagé. Just issued new revised and enlarged edition. Every user of a gas engine needs this book. Simple, instructive and right up-to-date. The only complete work on the subject. Tells all about internal combustion engineering, treating exhaustively on the design, construction and practical application of all forms of gas, gasoline, kerosene and crude petroleum-oil engines. Illustrated by over 400 engravings, many specially made from engineering drawings, all in correct proportion. Nearly 700 octavo pages and 500 engravings.

Price, net, $3.00

Modern Gas Tractor, Its Construction, Utility, Operation and Repair.

By Victor W. Pagé. Treats exhaustively on the design and construction of farm tractors and tractor power-plants, and gives complete instructions on their care, operation and repair. All types and sizes of gasoline, kerosene and oil tractors are described, and every phase of traction engineering practice fully covered. Invaluable to all desiring reliable information on gas motor propelled traction engines and their use. Second edition revised by much additional matter. 5¼ x 7½. Cloth, 504 pages, 228 illustrations, 3 folding plates.

Price, $2.50

Published and for Sale by

The Norman W. Henley Publishing Co.
2 West 45th Street New York, U. S. A.



"Good Bye, Boys!"

"Today I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. But after a few months I began to realize that I was nothing but a human machine and that I couldn't expect to advance that way.

"So I wrote to Scranton and arranged for a spare time study course that would give me special training for our work. Why, do you know, it gave me a whole new interest in our business? In a few months I was given more responsibility and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come—I'm to be manager of our Western branch at $5,000 a year! It just shows what spare time training will do."

If *you* want to make more money, show your employer you're trying to be *worth* more money. If you want a bigger job, show him you're willing to *prepare* for it.

There's a simple, easy way to do it. For 28 years the International Correspondence Schools have been training men and women right in their own homes whenever they had a little time to spare. More than two million have stepped up in just this way. More than 100,000 are studying now. Ten thousand are starting every month.

Can you afford to let another priceless hour pass without finding out what the I. C. S. can do for you? Here is all we ask—without cost, without obligation, mark and mail this coupon.

— — — — — TEAR OUT HERE — — — — —

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6092-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____ 7-26-10
Present Occupation_____
Street and No._____
City_____ State_____

The Universal Triangle

One simple, inexpensive, tool that replaces all triangles and protractors.

Presents at once, 90, 60, 45, and 30 degree angles to either side of the vertical without inverting or re-setting.

Thumb-nut secures adjustment at any angle and facilitates handling.

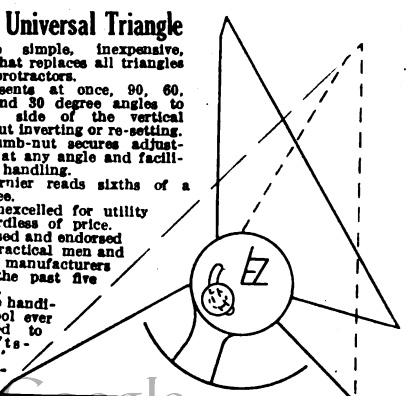
Vernier reads sixths of a degree.

Unexcelled for utility regardless of price.

Used and endorsed by practical men and big manufacturers for the past five years.

"The handiest tool ever offered to draftsmen."

Transparent.

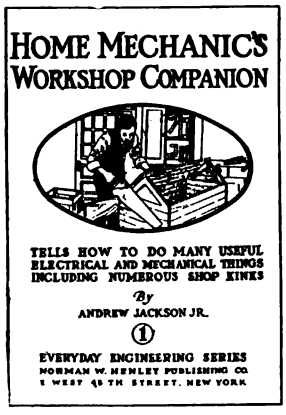


$2 Postpaid. EDWIN Z. LESH Dayton, Ohio

Digitized by Google

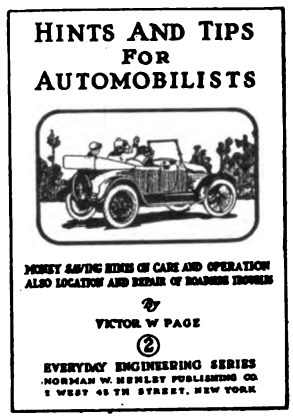
A SPECIAL OFFER TO OUR READERS

ANY ONE OF THESE BOOKS WILL BE SENT FREE FOR EACH NEW OR RENEWAL SUBSCRIPTION WHEN SENT DIRECT TO US AND NOT THROUGH AN AGENT



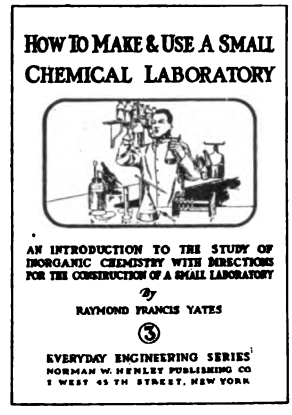
For the Handy Man in the Home or Shop

There has always been a demand for a hand book of mechanical instruction that would help the average everyday man to do the many small jobs of repair work that are found around the home and shop.



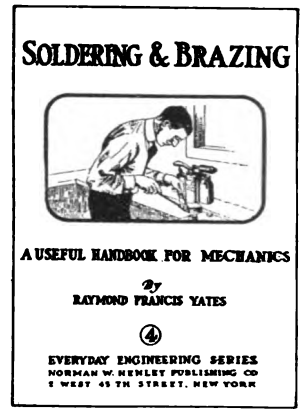
For the Automobile Owner or Driver

The book is ideal for the busy man or woman who wants to know about car operation and upkeep because of the economies possible when an automobile is intelligently operated. It contains many money saving hints.



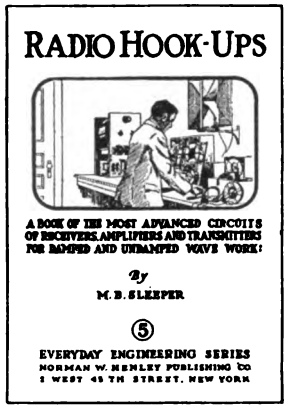
For the Student Chemist and Experimenter

This book gives all the necessary information for a well-grounded understanding of chemistry. It will not only be a help, but an inspiration to study further into this fascinating realm of science.



For the Mechanic and Model Maker

This treatise gives all the necessary "kinks" that will enable one to accomplish successful soldering. If a mechanic has not succeeded in his soldering, this book may tell him just what he needs to produce good work.



For the Radio Experimenter and Amateur

In this book the best circuits for different instruments and various purposes have been carefully selected and grouped together. The result is a comprehensive summary of radio circuit diagrams for every purpose.

A special feature of this book is the explanations which accompany each circuit, giving construction or operating details.

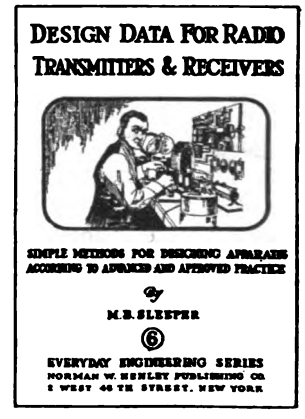
ALL of these Books are written in Simple Non-technical Language and contain Information of Real Value on Subjects of Timely Interest.

TRY TO SEND US FOUR NEW SUBSCRIBERS—WITH YOUR OWN—SO WE CAN SEND YOU THE SET OF SIX BOOKS

Fill Out the Special Blank Below
Check Off the Title Desired and Mail with Your Remittance

Special Circular Describing These Books Sent on Request

The Experience and Knowledge of Experts Condensed and Simplified for the Handy Man —the Mechanic and the Radio Experimenter.



For the Radio Engineer and Student

In Design Data, radio experimenters are given such information, readily accessible, as to make it possible for them to have modern and highly efficient equipment and to get the best possible results from the instruments they make or buy.

EVERYDAY ENGINEERING MAGAZINE

2 WEST 45TH STREET NEW YORK CITY

You may enter my subscription to EVERYDAY ENGINEERING MAGAZINE for ..... years at $2.00 per year (Canada, $2.25; foreign, $2.50). Please let this start with the ..... issue. I enclose $....., and
(Date of issue)
according to your special offer send me copy of book checked off.

Name .....

Street .....

City .....

State .....

TEAR OFF AND MAIL THIS NOW

EVERYDAY ENGINEERING SERIES OF HANDBOOKS Check off title desired here		
1	HOME MECHANIC'S WORKSHOP COMPANION	
2	HINTS AND TIPS FOR AUTOMOBILISTS	
3	HOW TO MAKE AND USE A SMALL CHEMICAL LABORATORY	
4	SOLDERING AND BRAZING	
5	RADIO HOOK-UPS	
6	DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS	

Digitized by Google

BOOK REVIEW

(*Continued from page* 569)

ing, grinding, and grinding operations, home foundry work, etc., make up the rest of the volume. The book omits nothing that will be of use to those who use tools or to those who wish to learn the use of tools. The great number of clear engravings add much to the text matter and to the value of the volume as a visual instructor. This book tells how to do mechanical work in a way that everyone can understand and every mechanical experimenter, model maker, machinist apprentice or handy man will find much information of value by a careful perusal of its interesting text and illustrations.

INVENTIONS, THEIR PURCHASE AND SALE. By William E. Baff, Patent Attorney. 230 pages 5 by 8. Published by D. Van Nostrand Company, 25 Park Place, New York City.

This book is essentially a manual on the marketing of inventions and it views the subject from various angles. It is a book of business policy and is intended to enlighten inventors and others about plans by which inventions may be profitably exploited. It should be particularly valuable for busy people in every line desirous of understanding the nature of patent property in inventions. It will appeal to the capitalist or manufacturer as well as to the inventor. It gives information on how to gauge the value of an invention and how to exploit the patents to best advantage. As the author is a well-known specialist in patent law, the material is of a helpful, practical nature that appeals particularly to mechanical men.

USING ENGINE AS A BRAKE

THE motor-car driver should not forget that his car has three brakes. If he puts the gears in second speed and cuts off the spark, steep grades will have no terror for him. He should shut off the engine and slide into second as he rolls across the ridge, but should not drive in second. The spark can be shut off if the throttle will not close. Then with a six-cylinder car, six compression brakes are gained and the engine is cooling in the meantime. If necessary, a gentle touch of the service or emergency brake now and then generally will hold nicely. At times an abrupt or long drop will call for low instead of second in compression. On all but the steepest grades this will hold the car with but very little use of the brakes, and will keep the brakes in reserve for real emergencies.

Put hard soap on lag screws, wood screws or any screw for wood. It will surprise you how much easier they will go in.

A $25 PHONOGRAPH FOR $10.98

Hear the Great Artists in your Home

Greatest Phonograph Bargain Ever Offered. *Send $1 Only*

Buy Direct from Manufacturer and Save Money



Plays all Makes of Records Any Size or Cut

Send $1 and Coupon

Special features are: clear, sweet-toned sound box, silent, powerful spring motor, automatic regulator, starter and stopper. Cabinet finished in Colonial mahogany. The metal parts highly nickeled. Will last a life time and is fully guaranteed in every respect. Phonograph will be shipped upon receipt of $1.00; you pay the balance, $9.98, after you get the phonograph.

Plays Victor, Columbia, Edison and Emerson Records

Send $1.00 today

Columbia Sales Company

53 Academy St., Dept. 691, Newark, N. J.

CUT OUT AND MAIL AT ONCE

COLUMBIA SALES COMPANY

53 Academy St., Dept. 691, Newark, N. J.

Gentlemen: Enclosed find $1. Ship at once one guaranteed phonograph. If satisfactory, I agree to pay the balance, $9.98, after I receive the machine. If not satisfactory I will return the same, and you will refund my money.

Name.....

Address.....

PRINCE ALBERT *the national joy smoke*

Our exclusive patented process cuts out bite and parch.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering. "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 912 Bogue Bldg., Indianapolis

Army Dress Shoe

"For Work or Dress Wear"

Here's the identical shoe Uncle Sam O. K.'d for dress wear in the army. Handsome, comfortable, wears like iron.



Don't confuse this genuine dress shoe with inferior shoes that sell for less. Real economy means not saving a few pennies on the original cost, but in getting your money's worth.

Only $7.90

On Arrival. Postage Free

RELIABLE MAIL ORDER CO.,

Dept. 93, 25 Huntington Ave., Boston, 17, Mass.

Send..... pairs, postage free. I'll pay the postman on arrival. Money back if I want it.

Name..... Size.....

Address .....

AMBITIOUS MEN

Send for Our Free Catalog of Home Study. Books on All Mechanical and Electrical Subjects

NORMAN W. HENLEY PUB. CO.

2 W. 45th Street New York City



The Best Diamond Bargains in 75 Years

Never in nearly ¾ of a century business existence have we offered such amazing bargains as against prevailing prices. This diamond banking house rated at over $1,000,000.00 lends money on high grade jewelry. Unpaid loans must be sold.

Why Pay Full Prices

Customers letters prove tremendous savings. Everything sent on approval. Try to match for 60 per cent more. Write for Latest Bargain List. Send your name and address for latest bargain list. No obligations. Write today—*now.*

Jos. De Roy & Sons, 9566 De Roy Building

Only Opposite Post Office Pittsburgh, Pa.

References by permission: Bank of Pittsburgh, N. A., Marine National Bank, Union Trust Company, Pittsburgh, Pa.



Let Us Send You this Suit

Made to your measure, payable after received

Perfect fit, fine goods and tailoring, $20 saving, *all guaranteed or no pay.* Samples Free. Every man wanting to dress well and save money should write at once for our beautiful free book of cloth samples and correct fashions, explaining everything. Write letter or postal, just say "Send me your samples" and get everything by return mail free. Important to every man. Write today sure.

PARK TAILORING COMPANY

Dept 274 Chicago, ILL

Earn $35 to $100 a Week

BECOME A PROFESSIONAL PHOTOGRAPHER





Big opportunities NOW. Qualify for this fascinating profession. Three months' course covers all branches:

MOTION PICTURE—COMMERCIAL—PORTRAITURE

Cameras and Materials furnished free

Practical instruction; modern equipment. Day or evening classes; easy terms. The School of Recognized Superiority. Call or write for complete catalog No. 20.

N. Y. INSTITUTE OF PHOTOGRAPHY

141 W. 36th St., N. Y. 505 State St., Bklyn.

Basketry and Craft Materials

Free catalogue, Reeds, raffia, wooden bases, chair cane, dyes, books, tools for work in leather, beads, stencilling, wood block printing, china, glass painting, painted wood, weaving, carving, jewelry, copper, pottery.

LOUIS STOUGHTON DRAKE

21 Everett Station Allston, Boston 34, Mass

Digitized by Google

THE H. E. BOUCHER MFG. CO.

150 Lafayette Street
NEW YORK CITY

GENERAL MODEL MAKERS
Marine Models a Specialty

BUILD and FLY YOUR OWN MODEL AIRPLANE



PROPELLERS

Dia.	Weight Propeller	Pitch	Price
6"	1½ oz.	8"	$0.40 each
7½" Racing	2½ oz.	11"	.45 each
7½" Heavy Load	4 oz.	11"	.50 each
8" Racing	2 to 2½ oz.	18"	.55 each
9" Racing	3½ oz.	16"	.60 each
9½" Heavy Load	6 to 8 oz.	12"	.65 each
10" Racing	3½ oz.	22"	.70 each

Prices include postage.

We can supply propellers either right or left constructed on scientific basis by specially constructed machinery. Guaranteed to work. A trial will convince. Send five cents for catalogue of finished airplanes and parts.

MODEL MAKERS SUPPLY COMPANY
Everyday Engineering Magazine
Box HDH 2 West 45th Street
New York City



WHEELS

No. 22. Aluminum with imitation rubber tires, weight one-third ounce, diameter 1¾". Price—$0.50 pair.

No. 23. Aluminum with real rubber tires, weight one ounce, diameter 2". Price—$0.75 per pair.

THE AMERICAN MODEL SALES AND MFG. CO.

601 Broadway New York City

PATTERNS
MODELS
CASTINGS

SHIP FITTINGS
RAW MATERIALS
BOILERS

MAIL ORDERS ONLY

PROMPT SERVICE

TELEPHONE SPRING 3337

WILLIAM VOGEL

INVENTIONS DEVELOPED
MODELS, EXPERIMENTS
Absolute Secrecy Guaranteed
CONSULTATION
Phone Barclay 9134 96 Warren Street
New York City

CELLULOID

SHEETING, PRINTING, MOULDING, TURNING, DIE CUTTING
EXPERIMENTAL WORK, ETC.
NAPIER BROWNING CO.
105 W. 40th ST. NEW YORK CITY

FREEING A SEIZED ENGINE

OCCASIONALLY the repairer receives a call to start a seized engine that has resisted the best efforts of the owner of the car. At such times the repairer must exercise the utmost ingenuity, for the owner has generally tried all the easy and well-known methods before the repairer arrives.

In such cases the first thing to do is to make sure that it is the engine and not some other part of the transmission or rear axle that is at fault. The rear wheels should be jacked up and the emergency brake released and the gear shift lever placed in neutral The wheels should turn freely and there should be no binding in the rear axle system.

The spark plugs should be removed or the compression taps turned to relieve the compression. Then if the crank cannot be turned over by hand or by means of the starter, or by the two working together, the car may be towed with the gears in high and the clutch disengaged. As soon as the car has attained some momentum the clutch may be allowed to engage gently, care to be taken not to allow a sudden motion, which might strip the gears in the rear axle or even break a shaft.

If this does not free the engine, kerosene can be poured into the cylinders and allowed to remain for a couple of hours. This will have a tendency to dissolve any old oil which may have gummed the pistons to the cylinder walls. Then the car may be towed again and an attempt made to turn over the engine by engaging the high gear. The engine can be turned over more easily in high than in low gear because it does not have to revolve so rapidly.

After one has succeeded in turning over the engine the drain cock in the bottom of the crankcase should be opened and the mixture of kerosene and old oil drained out. Then the new oil should be added, the radiator should be filled with hot water in order to expand the cylinders and the spark plugs replaced. After starting the engine it should be run slowly under its own power for some little time, in order that the new oil may work to all parts of the engine and to allow the engine to work out some of its stiffness.

Sometimes water leaks into the cylinders and rusts the pistons fast to the cylinder walls. There is also a possibility of moisture condensing within the cylinders if the car is allowed to remain standing in a damp place without being used.

If the engine is fitted with a removable head, as is now used on many cars, it is often but the work of half an hour to remove the cylinder head and ascertain if the pistons are stuck in the

Digitized by Google

cylinders. The movement, of course, will be very slight, but if the pistons are not rusted to the cylinder walls some slight movement should be obtainable.

If only one piston is tight, it may be possible to remove the lower half of the crankcase and take off the cap of the connecting rod of the tight piston. If there is sufficient room in the crankcase, the connecting rod can be tied to one side and the engine used to drive the car home on three cylinders. Or the tight piston may be driven out of the cylinder with a block of wood. The wire leading to the spark plug of the seized cylinder should be grounded when attempting to run the engine on three cylinders.

It is sometimes possible to rap each piston separately with a block of wood at the same time that the strain is applied to the starting crank, thus releasing the pistons from the cylinders and allowing a film of lubricating oil to penetrate between the parts.

On some cars the rim of the flywheel is exposed so that it may be gripped with a heavy wrench and the wrench used to assist in turning over the crankshaft. If one man lies on the bonnet over the engine and pulls up on the starting crank, at the same time that the car is being towed, the simultaneous strain at both ends of the crankshaft will often be enough to start the movement of the pistons in the cylinders.

When the car is in the garage and compressed air is available, this may be forced into the cylinders through an air valve made from a discarded tire, a valve and a broken spark plug. If an air pressure of 100 pounds a square inch is exerted over an area on the top of the piston of 15 square inches, this should be sufficient to start it. Of course, the poppet valves will have to be closed while the air is being admitted into the cylinder.—*Automobile Journal*.

DESCENT AT 450 MILES PER HOUR

LIEUT. WEISS of the French Army was attempting to establish a height record recently, but unexpectedly found his supply of oxygen virtually exhausted. The Paris correspondent of the *Morning Post* states that at the moment he was at 8,000 meters and his only chance of safety was to nose dive. For a certain number of seconds he achieved a speed of 450 miles per hour, and actually traversed 4,300 yards of descent in thirty seconds. The machine was injured as a result of the strain, and certain portions of the wings were torn off, while some supports also were broken before he was able to flatten out the machine for landing.

LEARN DRAFTING

At Home—In Spare Time
as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.

Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.







Draftsmen Get $35 to $100 a Week

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

Draftsmen are needed in greater numbers, and receive better salaries than ever before.

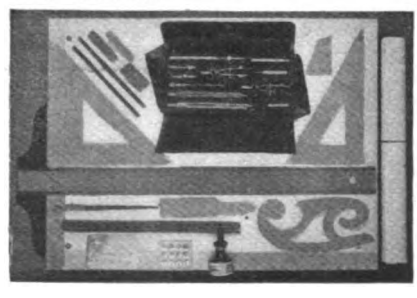


How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1158, 14th & T Sts., N. W., Washington, D.C.

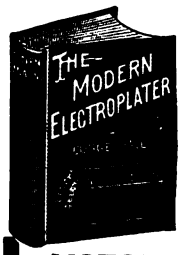
COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1158, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below: (Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting	Ship Drafting
Automobile Drafting	Statistical Drafting
Electrical Drafting	Radio Drafting
Aeroplane Drafting	Automotive Drafting
Special Machinery Drafting	Hydrographic Drafting
Sheet Metal Drafting	Machine Design
Structural Drafting	Tool Design
Highway Drafting	Shop Mathematics
Patent Drafting	Builders' Course
Topographical Drafting	

Name .....
Age ..... Address .....
City ..... State .....

Digitized by Google



HENLEY'S
New Practical Books



MOTOR BOATS AND BOAT-MOTORS

By Victor W. Pagé, and A. Clark Leich. (6 x 9.) 524 pages. 372 illustrations. Cloth. Price $4.00.

Indispensable for owners, users, repairmen or operators of motor boats and marine engines.

SHOP PRACTICE FOR HOME MECHANICS

By Raymond Francis Yates. (6 x 9.) 324 pages, 309 illus. Cloth. Price $3.00.

Deals with small tools and machines such as those employed about the home shop.

STARTING, LIGHTING AND IGNITION SYSTEMS

By Victor W Pagé. 815 pages. 492 specially made engravings. 1920 Edition, Revised and Enlarged. Price $3.00.

A practical treatise on latest automobile starting, lighting and ignition system practice. Over 200 wiring diagrams are shown in both technical and nontechnical forms. Complete data is given for locating troubles in all systems, the various steps being considered in a logical way for those without expert electrical knowledge. All ignition systems receive full consideration, starting with the simplest battery and coil forms found on early cars to the modern short-contact timer and magneto methods used with the latest eight and twelve-cylinder motors.

ABRASIVES AND ABRASIVE WHEELS

By Fred B. Jacobs. 340 pages, 200 illustrations. Price $3.00.

A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantage in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering.

HENLEY'S TWENTIETH CENTURY BOOK OF RECIPES, FORMULAS AND PROCESSES

Edited by Gardner D. Hiscox. 1920 edition. Cloth binding. Price $4.00.

The most valuable technochemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts and tells thousands of ways of making money and is just the book everyone should have at this command.

LIQUID AIR AND THE LIQUEFACTION OF GASES

By T. O'Conor Sloane. 400 pages fully illustrated. (1920.) Price $3.00.

The third revised edition of this book has just been issued. Much new material is added to it; and the all-important uses of liquid air and gas processes in modern industry, in the production especially of nitrogen compounds, are described. The book gives the history of the theory, discovery, and manufacture of Liquid Air, and contains an illustrated description of all the experiments that have excited the wonder of audiences all over the country. It shows how liquid air, like water, is carried hundreds of miles and is handled in open buckets.

MODERN ELECTROPLATING

By Kenneth M. Coggeshall. 350 pages, 142 illustrations. Price $3.00.

Anyone interested in practical plating and metal finishing will find this book a valuable guide and complete manual of the art.

EXPERIMENTAL WIRELESS STATIONS

By P. E. Edelman, E. E. (5 x 7) 390 pages, 167 illus. Cloth. Price $2.50.

Answers every question—clears up mysteries of things radio, you have often wondered about.

THE MODEL T FORD CAR, ITS CONSTRUCTION, OPERATION AND REPAIR, INCLUDING THE FORDSON FARM TRACTOR, F. A. LIGHTING AND STARTING SYSTEM, FORD MOTOR TRUCK

By Victor W. Pagé. 410 pages, 153 illustrations, 2 large folding plates Price $2.00.

This is the most complete and practical instruction book ever published on the Ford car and Fordson tractor. To the 1920 Revised Edition matter has been added on the Ford Truck and Tractor Conversion Sets and Genuine Fordson Tractor. All parts are described. All repair processes illustrated and fully explained. Written so all can understand—no theory, no guesswork. New Edition.

MODEL MAKING

By Raymond Francis Yates. 400 pages, 301 illustrations. Price $3.00.

A new book for the mechanic and model maker. This is the first book of its kind to be published in this country and all those interested in model engineering should have a copy. The first eight chapters are devoted to such subjects as Silver Soldering, Heat Treatment of Steel, Lathe Work, Pattern Making, Grinding, etc. The remaining twenty-four chapters describe the construction of various models such as rapid fire naval guns, speed boats, model steam engines, turbines, etc.

ELECTRICIAN'S HANDY BOOK

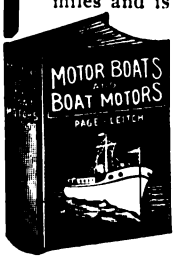
By Prof. T. O'Conor Sloane. 840 pages, 600 engravings, handsomely bound in cloth. 1920 edition. Price $4.00.

This work has just been revised and much enlarged. It is intended for the practical electrician who has to make things go. The entire field of electricity is covered within its pages. It is a work of the most modern practice, written in a clear, comprehensive manner, and covers the subject thoroughly, beginning at the A B C of the subject, and gradually takes you to the more advanced branches of the science. It teaches you just what you should know about electricity. A practical work for the practical man.

WESTINGHOUSE E. T. AIR-BRAKE INSTRUCTION POCKET-BOOK CATECHISM

By Wm. W. Wood, Air-Brake Instructor. Cloth. 1920 edition. Price $2.50.

A practical work containing examination questions and answers on the E. T. Equipment. Covering what the E. T. Brake is. How it should be operated. What to do when defective. Not a question can be asked of the engineman up for promotion on either the No. 5 or the No. 6 E. T. equipment that is not asked and answered in the book. If you want to thoroughly understand the E. T. equipment get a copy of this book. It covers every detail. Makes air-brake troubles and examinations easy. Fully illustrated with colored plates, showing various pressures.



These Are the Books You Should Procure

All Up-to-date and Reliable

Any of these books sent prepaid on receipt of price. FREE—1920 Catalogue of Practical Books—Send for a Copy

The Norman W. Henley Publishing Co.

2 WEST 45th ST., NEW YORK



Digitized by Google

Let me work for you

I WORK for Kings and Queens. I work for the President of the United States.

I work for the Architects who build your sky scrapers.

I work for the Surveyors and Engineers who make your big bridges and subways possible.

I have a Mathematical keyboard with the characters and symbols used in higher and lower Mathematics, and for Engineering, Mechanics, etc.

I AM INVALUABLE TO THE STUDENT OF MATHEMATICS, ENGINEERING, CHEMISTRY, AND MEDICINE, AS I CARRY THE CHARACTERS AND SYMBOLS IN EVERY PROFESSION--EVERY SCIENCE.

I "speak" every language, from Eskimo Indian to Kata Kana Japanese.

I use "speak" advisedly, because *I literally make your writing talk*--as these samples of my work show.

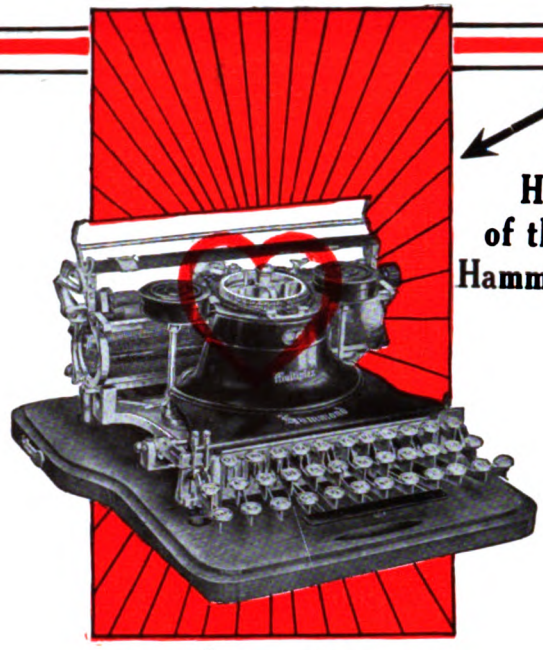
The above paragraphs were written on *one* Multiplex and give a very limited example of the work that can be done on this unique "writing machine"—the only "writing machine" in existence. Just examine the Multiplex and you'll find that it is as great an improvement over the ordinary typewriter as the fountain pen is over the old-fashioned quill.



Also an Aluminum PORTABLE Model

For traveling — for Home. Weighs about 11 lbs. Full capacity. Ask for *special* folder.

The Hammond Typewriter Co.
585A E. 69th Street New York City



The Heart of the Hammond

I am the

MULTIPLEX HAMMOND

Standard "Writing Machine"

Over 365 Different Type-Sets

Including All Languages to Select From

Any one of which may be substituted in a few seconds: "Just Turn the Knob"

I have shown you a few proofs of my versatility in the various types in the column opposite.

I think you will agree with me, when you see me, that no other typewriter *can* do what I do.

No other typewriter can *make your writing "TALK."*

No other typewriter can *INSTANTLY change from one style of type, or from one language to another.*

Multiplex Hammond Reasons

1. Variety of writing beyond the ordinary.
2. All sorts of type and languages on ONE Multiplex.
3. Automatically uniform type impressions without a cultivated touch.
4. Permanently perfect alignment.
5. Any width of paper, and writes cards flat without bending.
6. Large type, small type, medium type—all on ONE Multiplex.
7. Aluminum Portable, travellers' and home model.

There are more than sixteen (16) things I can do that cannot be done on any other writing machine; and it will pay you to

Mail the Coupon for FREE BOOKLET "How President Wilson Frightened the Lords at Midnight"

We will also send you our pamphlet, "People Who Count." Thousands of prominent men and women in all walks of life, and in all four corners of the globe, prefer and personally use the Multiplex. Note this partial list:

President Wilson
Queen Alexandra of England
King and Crown Prince of Sweden
Caliph of Morocco
King and Queen of Norway
Cardinal Merry del Val
Sir James Matthew Barrie
Walt Mason
Wallace Irwin
William Dean Howells
Bertha M. Clay
John Kendrick Bangs
Leigh Mitchell Hodges
Prof. L. A. Loiseaux
Etc., Etc.

MAIL FOR FREE BOOKLETS

HAMMOND TYPEWRITER COMPANY,
585A East 69th St., New York City.

Please send, entirely free and without obligation, the literature mentioned in your advertisement in Everyday Engineering.

Name .....

Address .....

Occupation .....

Digitized by Google

Time and a Half For Straight Time

You can get an extra half dollar or more for every dollar you earn now. No overtime work is necessary. Just your regular time and a set of **Modern Machine Shop Practice** will turn the trick. Read how to get these famous books by 27 shop experts that will help you make three or four dollars with the same effort it takes you to get two dollars now.

MACHINE SHOP PRACTICE

6 big volumes bound in genuine American Morocco. 2300 pages and more than 2500 photographs, plans, drawings, etc.

A Few of the Things Explained

Shop Work, Shop Kinks, Gear Cutting, Lathes and Screw Machines, Planers, Millers, Jigs, Shop Management, Metallurgy, Welding, Die Making, Laying Out Dies, Tool Making, High Speed Steel, Thread Cutting, Milling Cutters, Punch Work, Tool Design, Foundry Work, Molding, Malleable Practice, Forging, Heat Treatment of Steel, Annealing, Hardening, Pattern Making, Mechanical Drawing, Machine Drawing, Design of Machines, Auto. Shop Work.

What They Will Do for You

These books explain and tell you everything connected with Shop Work; more than a thousand different subjects. Not a thing is missed—not the smallest detail. They cover everything, from the simplest machine operation to the most difficult tool and die making propositions you will ever be up against. They will make a **shop expert** out of you in your spare time and it will only cost you 7 cents a day to buy the books after a weeks' free use.

Ask Our EXPERTS

With every set of these books we give absolutely free, one years' consulting membership in the American Technical Society. It usually sells for $12.00. This entitles you to write in at any time within a year and ask our experts' advice about anything connected with shop work that you don't understand.

Use One Week FREE!

Don't send any money. Just the coupon is all you need. We will ship the books express collect and you can use them a whole week in your own home or shop just as if they were your own. Try to find some tough proposition they won't explain. Show them to the other men in your shop—give them every test you can think of and send them back at our expense if you don't want to keep them. If you do want the books to help you earn more, like thousands of other men have done, send us only $2.80 You can send the balance of our special $24.80 price the same way —$2.00 each month. Begin now to get ahead—do it the speedy way, too. This coupon is your ticket on the speedy route. MAIL IT TODAY.

AMERICAN TECHNICAL SOCIETY, Dept. M-35-B CHICAGO, ILL. U.S.A.



SEND THE COUPON NOW

AMERICAN TECHNICAL SOCIETY Dept. M-35-B CHICAGO, ILL. U. S. A.

Please send me the six-volume set of "Modern Shop Practice" for seven days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within seven days and balance at $2.00 a month until $24.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine, and fully paid for. If I want to get along without the books, I will return them at your expense after seven days.

Name.....

Address.....

Reference.....

.....

Digitized by Google

THE CAREY PRINTING CO. Inc. NEW YORK

EVERYDAY ENGINEERING MAGAZINE

AUGUST 1920
Vol. 9 No. 5

Twenty Cents
a Copy



INDUSTRIAL NIAGARA (See Page 396)

Digitized by Google

Prices of McGraw-Hill Home Study Courses Must Go Up

Now is the Time to Get Ready for Bigger Pay

Industrial America is teeming and throbbing with the greatest activity in its history. Every day hundreds of men in small positions are raised to bigger responsibilities and bigger pay. A search is being made everywhere for men who have the necessary training to assume these new responsibilities.

A McGraw-Hill Home Study Course Will Prepare You Quickly

The McGraw-Hill Home Study Courses are founded on actual work as it is done in the great fields of engineering which they cover. No space is wasted with higher mathematics and theory. Only facts, written so that you can understand them. About one hundred thousand men are now using them as a daily guide. They are equally valuable to the expert and the beginner.

Not One Cent in Advance

Small Monthly Payments If You Are Satisfied

No matter what your age is, where you are located, or how limited your means, you can succeed through one of the McGraw-Hill Home Study Courses. Everyone contains a complete education on the subject covered. No matter how much you might pay for books or courses you cannot acquire knowledge that will advance you more rapidly and surely than a McGraw-Hill Home Study Course.



Power Plant Library

Power plant practice complete, including mathematics, boilers, engines, electricity, turbines and refrigeration. Now the most used engineers' library in existence. Has enabled thousands of men to pass the most rigid examinations. 2,500 pages, 1,500 illustrations. Eight handsome volumes, bound in the tough T pattern of cloth, as durable as leather. Price $16, payable $2.00 per month.

Factory Management

A set of books written by leading authorities, to help men fit themselves to take complete charge of the shop or factory. Covers industrial organization, administration, purchasing, manufacturing costs and accounts, engineering of shops, factories and power plants. 6 volumes 2,300 pages, fully illustrated. Bound in semi-flexible karatol. Price $20, payable $2 in ten days and $3 per month.

Croft Library of Practical Electricity

Without question of more practical value than anything of the kind ever attempted in the world of electricity. Enables you to know electricity as experts know it. Mathematics, practical electricity, electrical machinery, central stations, wiring for light and power, wiring of finished buildings, illumination. 8 flexible volumes, pocket size, 3,000 pages. Price $20, payable $2 in 10 days and $3 per month.

Iron and Steel Library

The high positions in the great iron and steel world are now attainable through this library, which is written by authorities actually engaged in this work. Metallurgy, foundry work, blast furnaces construction, operation and products, refractories. A complete iron and steel library. Seven volumes, over 3,000 pages. Fully illustrated. Price complete $24, payable $3 per month.

Machine Shop Library

Machine shop practice complete. Written by eight practical men, well known in the machine shop world. Now the standard in America. No other set of books on the subject ever equalled it in popularity. Mathematics, drawing and design, composition and heat treatment of steel gears, tool work, grinding, jigs and fixtures, screw machines, dies, etc. 9 volumes, 3,000 pages. Price $20, payable $2 in 10 days and $3 per month.

Metal Mining Library

Herein is brought together in nine flexibly-bound volumes the very meat of metal mining practice in America. Examinations, principles of mining, timbering, thousands of working details, ore dressing, surveying, accounting, costs. All the information you need to reach the high positions in the mining world. The most intricate problems solved by plain words and illustrations. Price $24, payable $3 per month.

Coal Mining Library

Coal mining and colliery practice complete, including outside and inside work—both mechanics and engineering. Of assistance to every man in the business, from the lowest paid man to the operator. It is now looked upon as a necessity, and as containing the secrets of success in coal mining. 8 volumes. 3,000 pages. 1,700 illustrations. Price $20, payable $2 in 10 days and $3 per month.

Radcliffe's Electricity

A three-volume compact set of books on the practical side of electricity. In question-and-answer form, for quick reference. This course is somewhat condensed, and will be found of special value to those interested in electricity as used in power plants. 700 pages of facts, illustrated and carefully indexed. Price $6, payable $1 per month.



Any Library Shipped on Ten Days' Trial—At Our Expense. Merely Return the Coupon

Look at the illustrations of the libraries at the left and right of this page. Then refer to the coupon, check the library you want, fill out the blank spaces carefully and return to us. After receiving the books, go over them carefully. Keep them ten full days. See how much knowledge you can gain from them within ten days. If then you decide you cannot afford to be without them, send us the small monthly payments called for. Paper has advanced 300% and is still going up. This is your chance to procure a McGraw-Hill study course at the old price.

Pay only $1 to $3 per month if you are satisfied

Free Examination Coupon

McGRAW-HILL BOOK CO., Inc., 239 W. 39th St., N. Y.

Gentlemen: Send for ten days' free inspection the Library I have checked below:

- [ ] **Croft's Electricity**, $20—payable $3 per month.
- [ ] **Machine Shop Library**, $20—payable $3 per month.
- [ ] **Iron and Steel Library**, $24—payable $3 per month.
- [ ] **Mining Library**, $24—payable $3 per month.
- [ ] **Coal Mining Library**, $20—payable $3 per month.
- [ ] **Power Plant Library**, $16—payable $2 per month.
- [ ] **Factory Management**, $20—payable $3 per month.
- [ ] **Radcliffe's Electricity**, $6—payable $1 per month.

If satisfactory I will send first payment in ten days and the same amount each month until paid. If not wanted I will return the books at your expense.

Signature .....

Residence address .....

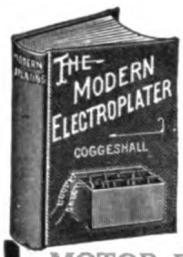
City and State .....

Your employer .....

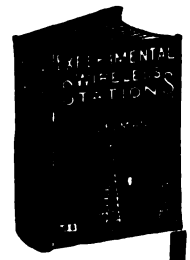
His address .....

Your occupation .....ED 9-20

Digitized by Google



HENLEY'S
New Practical Books



MOTOR BOATS AND BOAT MOTORS

By Victor W. Pagé, and A. Clark Leich. (6 x 9.) 524 pages. 372 illustrations. Cloth. Price $4.00.

Indispensable for owners, users, repairmen or operators of motor boats and marine engines.

SHOP PRACTICE FOR HOME MECHANICS

By Raymond Francis Yates. (6 x 9.) 324 pages, 309 illus. Cloth. Price $3.00.

Deals with small tools and machines such as those employed about the home shop.

STARTING, LIGHTING AND IGNITION SYSTEMS

By Victor W Pagé. 815 pages. 492 specially made engravings. 1920 Edition, Revised and Enlarged. Price $3.00.

A practical treatise on latest automobile starting, lighting and ignition system practice. Over 200 wiring diagrams are shown in both technical and nontechnical forms. Complete data is given for locating troubles in all systems, the various steps being considered in a logical way for those without expert electrical knowledge. All ignition systems receive full consideration, starting with the simplest battery and coil forms found on early cars to the modern short-contact timer and magneto methods used with the latest eight and twelve-cylinder motors.

ABRASIVES AND ABRASIVE WHEELS

By Fred B. Jacobs. 340 pages, 200 illustrations. Price $3.00.

A new book for everyone interested in abrasives or grinding. A careful reading of the book will not only make mechanics better able to use abrasives intelligently, but it will also tell the shop superintendent of many short cuts and efficiency-increasing kinks. The economic advantage in using large grinding wheels are fully explained, together with many other things that will tend to give the superintendent or workman a keen insight into abrasive engineering.

HENLEY'S TWENTIETH CENTURY BOOK OF RECIPES, FORMULAS AND PROCESSES

Edited by Gardner D. Hiscox. 1920 edition. Cloth binding. Price $4.00.

The most valuable technochemical formulæ book published, including over 10,000 selected scientific, chemical, technological and practical recipes and processes. This book of 800 pages is the most complete book of recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, helps, practical ideas and secret processes are revealed within its pages. It covers every branch of the useful arts and tells thousands of ways of making money and is just the book everyone should have at his command.

LIQUID AIR AND THE LIQUEFACTION OF GASES

By T. O'Conor Sloane. 400 pages fully illustrated. (1920.) Price $3.00.

The third revised edition of this book has just been issued. Much new material is added to it; and the all-important uses of liquid air and gas processes in modern industry, in the production especially of nitrogen compounds, are described. The book gives the history of the theory, discovery, and manufacture of Liquid Air, and contains an illustrated description of all the experiments that have excited the wonder of audiences all over the country. It shows how liquid air, like water, is carried hundreds of miles and is handled in open buckets.

MODERN ELECTROPLATING

By Kenneth M. Coggeshall. 350 pages, 142 illustrations. Price $3.00.

Anyone interested in practical plating and metal finishing will find this book a valuable guide and complete manual of the art.

EXPERIMENTAL WIRELESS STATIONS

By P. E. Edelman, E. E. (5 x 7) 390 pages, 167 illus. Cloth. Price $2.50.

Answers every question—clears up mysteries of things radio, you have often wondered about.

THE MODEL T FORD CAR, ITS CONSTRUCTION, OPERATION AND REPAIR, INCLUDING THE FORDSON FARM TRACTOR, F. A. LIGHTING AND STARTING SYSTEM, FORD MOTOR TRUCK

By Victor W. Pagé. 410 pages, 153 illustrations, 2 large folding plates. Price $2.00.

This is the most complete and practical instruction book ever published on the Ford car and Fordson tractor. To the 1920 Revised Edition matter has been added on the Ford Truck and Tractor Conversion Sets and Genuine Fordson Tractor. All parts are described. All repair processes illustrated and fully explained. Written so all can understand—no theory, no guesswork. New Edition.

MODEL MAKING

By Raymond Francis Yates. 400 pages, 301 illustrations. Price $3.00.

A new book for the mechanic and model maker. This is the first book of its kind to be published in this country and all those interested in model engineering should have a copy. The first eight chapters are devoted to such subjects as Silver Soldering, Heat Treatment of Steel, Lathe Work, Pattern Making, Grinding, etc. The remaining twenty-four chapters describe the construction of various models such as rapid fire naval guns, speed boats, model steam engines, turbines, etc.

ELECTRICIAN'S HANDY BOOK

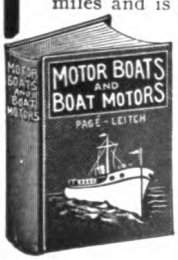
By Prof. T. O'Conor Sloane. 840 pages, 600 engravings, handsomely bound in cloth. 1920 edition. Price $4.00.

This work has just been revised and much enlarged. It is intended for the practical electrician who has to make things go. The entire field of electricity is covered within its pages. It is a work of the most modern practice, written in a clear, comprehensive manner, and covers the subject thoroughly, beginning at the A B C of the subject, and gradually takes you to the more advanced branches of the science. It teaches you just what you should know about electricity. A practical work for the practical man.

WESTINGHOUSE E. T. AIR-BRAKE INSTRUCTION POCKET-BOOK CATECHISM

By Wm. W. Wood, Air-Brake Instructor. Cloth. 1920 edition. Price $2.50.

A practical work containing examination questions and answers on the E. T. Equipment. Covering what the E. T. Brake is. How it should be operated. What to do when defective. Not a question can be asked of the engineman up for promotion on either the No. 5 or the No. 6 E. T. equipment that is not asked and answered in the book. If you want to thoroughly understand the E. T. equipment get a copy of this book. It covers every detail. Makes air-brake troubles and examinations easy. Fully illustrated with colored plates, showing various pressures.



These Are the Books You Should Procure

All Up-to-date and Reliable

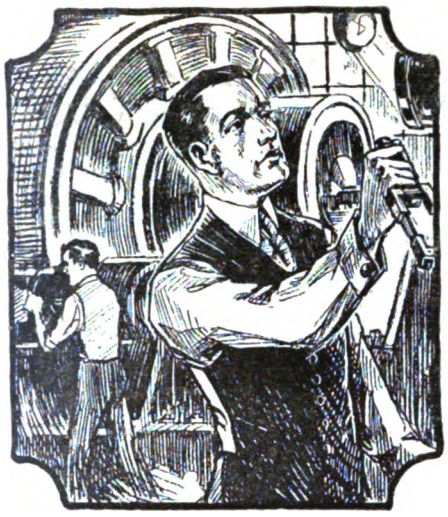
Any of these books sent prepaid on receipt of price. FREE—1920 Catalogue of Practical Books—Send for a Copy



The Norman W. Henley Publishing Co.

2 WEST 45th ST., NEW YORK

Digitized by Google



Dr. Charles P. Steinmetz, Chief Consulting Engineer of the General Electric Company, has said that, "The world needs men who know something of electricity, of the operations and control of electrical power. It needs men more every year, its very existence depends on the electrician."—*Electrical Experimenter, June, 1919.*



What a Knowledge of Electricity Would Mean to YOU

A real job with a man's size salary—that's what it would mean. It's easy to get it if you know electricity. Electricity is the biggest force in the world today. It's one of the best paying fields a man can get into. Just see what the great Steinmetz says about electricity—"the very existence of the world depends on the electrician." That's the kind of business to be in for real money making. Get into it as quick as you can—train yourself at home—in your spare time.

8 Great, Big VOLUMES

3800 Pages—2600 Pictures Clearly Covering

Elements of Electricity; Electrical Measurements; Electric Wiring and Lighting; Underwriter's Electrical Requirements; Theory, Calculation, Designs and Construction of Direct Current Generators and Motors; Types of Generators and Motors; Management of Electrical Machinery; Electric Lighting; Alternating Current Machinery; Power Transmission; Electric Railways; Power Stations; Switchboards and Switching; Storage Batteries; Applied Electro-Chemistry; Electric Elevators; Electric Welding and Heating; Wireless Telegraphy and Telephony; Land and Submarine Telegraphy.

The Cyclopedia of

Applied Electricity

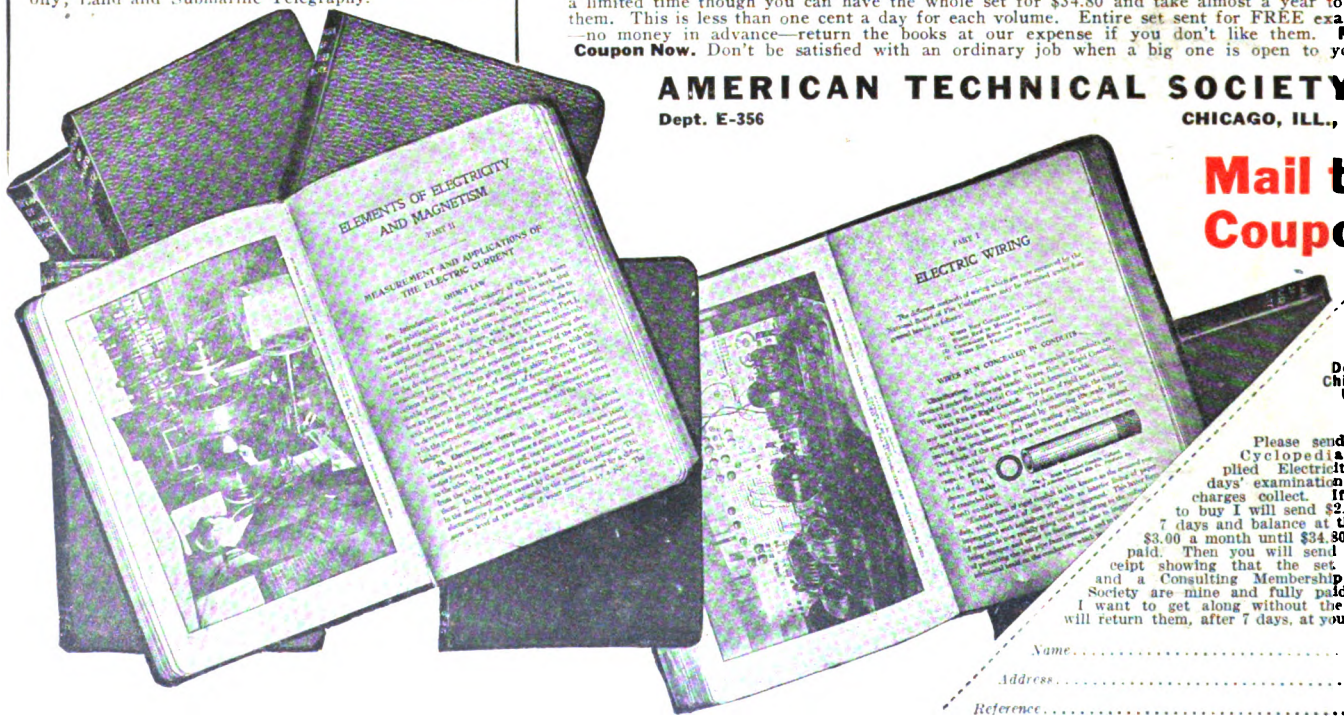
The world's greatest electrical books will fit you to hold the biggest kind of a job. They were written by the engineers and experts that helped to make electricity what it is today. These men know what you need. They give you 50 years of electrical experience at your finger tips. Plain, everyday language and thousands of pictures make everything as simple as A B C. Glance over the partial list of what the books contain and see our offer that gives them to you a whole week free. Mail the coupon today.

Reduced Price—Year to Pay

The regular price of this great library is $7.50 a volume—$60.00 for the set of 8 volumes. For a limited time though you can have the whole set for $34.80 and take almost a year to pay for them. This is less than one cent a day for each volume. Entire set sent for FREE examination—no money in advance—return the books at our expense if you don't like them. **Mail the Coupon Now.** Don't be satisfied with an ordinary job when a big one is open to you.

AMERICAN TECHNICAL SOCIETY

Dept. E-356 **CHICAGO, ILL., U. S. A.**



Mail this Coupon

American Technical Society
Dept. E-356
Chicago, Ill.,
U. S. A.

Please send me the Cyclopedia of Applied Electricity for 7 days' examination, shipping charges collect. If I desire to buy I will send $2.80 within 7 days and balance at the rate of $3.00 a month until $34.80 has been paid. Then you will send me a receipt showing that the set of books and a Consulting Membership in your Society are mine and fully paid for. If I want to get along without the books, I will return them, after 7 days, at your expense.

Name.....

Address.....

Reference.....

THE CAREY PRINTING CO. INC. NEW YORK

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

UNIVERSITY OF CHICAGO
097 328 156

Digitized by Google